Can Summer Enrollment Lead to More Equitable Outcomes?
Early Summer College Enrollment and Four-Year Degree Attainment at a Young Research Institution

By

TAMMY L. JOHNSON
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Approved:

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Heather Rose, Chair

_____
Cassandra M. D. Hart

_____
Paco Martorell

Committee in Charge

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Abstract

Using institutional data from University of California, Merced (UC Merced), this dissertation explores the relationship between enrolling in academic units in the summer term immediately after the first year of college (first-summer) and four-year degree completion at a Hispanic- and Minority-Serving Institution, through the lenses of Academic Momentum research and the theory of student engagement in the Educational Interface. A number of variables are considered, including student demographic and academic characteristics, as well as student first-year academic success, which is defined using cumulative first-year GPA and unit accumulation. Specific populations of interest include First-generation, Pell-eligible, URM, and STEM students.

Students who are First-generation or URM were found to be less likely to enroll in first-summer, while STEM students were more likely to enroll, as were students who experienced greater academic success in terms of GPA and unit accumulation in their first year of college.

Overall, first-summer was associated with a statistically significant increased likelihood of four-year degree completion, especially for STEM students, but the association changed when controlling for varying levels of first-year academic success. The strongest associations between first-summer and four-year degree attainment were found with students in the lowest or highest first-year Academic Success Groups.

The association of first-summer and four-year degree completion for students who earned at least a 2.0 first-year GPA but did not complete 30 academic units in the first year was positive but not statistically significant. However, further exploration of this group found first-summer to be positive and significant for STEM students and students who entered as an Undeclared major.

DEDICATION AND ACKNOWLEDGEMENTS

I dedicate this dissertation to my grandmother who taught me to value education, my mother, who believes in me always, and my son, who still cannot believe I paid money to do all this work.

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Glossary of Terms

Equitable Access: For the purposes of this study, students who fall into one or more of the following: First-generation, Pell-eligible, or Underrepresented Minority.

First-generation: Students who identify as the first in their family to go to college.

First-summer: The summer after the first year (freshman) of college and before the sophomore year.

First-year: The first year of college, also referred to as the freshman year, or a first-year student.

First-Year College Success Groups or College Success Groups: For the purposes of this study, the four groupings of students as determined by the first-year grade point average (GPA) and number of units completed.

Hispanic: The race identifier, Hispanic, is used in this study because it is the word used by IPEDS, the University of California, as well as the terminology used to identify Hispanic-Serving Institutions.

IPEDS: The Integrated Postsecondary Education Data System is used by the US Department of Education's National Center for Education Statistics to gather information from institutions of higher education that award federal student financial aid.

Pell-eligible: Eligibility for Federal Pell Grant is linked to the federal poverty level. Pell-eligibility can be used to identify students with high financial need.

SAP: Satisfactory Academic Progress is a measure of academic progress defined by the institution of higher education and accepted by the Department of Education. It is a combination of cumulative GPA and unit completion used to define the minimum standard a student must meet to maintain financial aid eligibility.

STEM: Science, technology, engineering, and math, often used to identify disciplines of study or careers in science, technology, engineering and/or math.

Underrepresented Minority: The University of California uses IPEDS reporting standards and includes Black/African American, Native American/Alaska Native, and Hispanic to identify underrepresented minority status.

Chapter 1

INTRODUCTION

Background and Purpose Statement

Since 1980, income inequality has expanded dramatically between those who hold college degrees and those who do not. In 2008, the wage differential between a high school graduate and a college graduate was 40% (Autor et al., 2020; Goldin & Katz, 2008). Increasing one's human capital by earning a college degree has become a reliable pathway to improving an individual's socioeconomic status. This phenomenon is reflected in the growing numbers of first-generation students attending college, especially those from lower socioeconomic levels. From 1980 to 2002, the number of high school students from lower socioeconomic families who expressed interest in attending college rose from 22% to 66% (Bowen et al., 2009). Students are motivated to choose college in order to acquire better employment opportunity and increased earning potential (Pascarella & Terenzini, 2005).

While the number of individuals enrolling in college in the United States is increasing, the number of students graduating from college within six years of enrolling has experienced only modest gains since 2006, when 54.1% of students entering that year obtained a degree within six years. That number increased to 60.1% for the fall 2014 first-year cohort; however, degree completion rates vary considerably between institution types. Students at private nonprofit four-year institutions complete degrees within six years at a rate of 76.7%, followed by public four-year institutions at 67.4% and private for-profit institutions at 45.5%. These statistics diverge further when factoring in student demographic characteristics (*Completing College*, 2020).

Institutions of higher education want to improve student persistence and higher education researchers are keen to understand what factors contribute most to persistence and degree completion. The persistence and degree completion literature demonstrates the complexity of student persistence

and the numerous factors impacting a student's ability to remain enrolled and complete their degree (Berger & Milem, 1999; Cabrera et al., 1993; DesJardins et al., 2003; Hossler et al., 2013; Kahu & Nelson, 2018; Metzner & Bean, 1987; Rendón, 1994; Sandefur et al., 2006; Tinto, 1993; Tinto, 2012). Institutions must determine what opportunities and resources should be available in their local context to help students persist (Bensimon, 2007; Bolkan et al., 2021; Cuellar, 2014; Dawson et al., 2020; Harris & Bensimon, 2007; Hu & Ma, 2010).

What can institutions of higher education do to help students increase their probability of timely degree completion? Academic Momentum research examines the relationship between early college enrollment patterns, circumstances, and students' progress to degree completion, and demonstrates a positive relationship between earning summer academic units and degree attainment (Adelman, 2006; Attewell et al., 2012; Attewell & Jang, 2013; Brownback & Sadoff, 2020; Franke & Bicknell, 2019; Liu, 2016; Liu, 2020). These findings were particularly impactful for African American students, for whom Adelman (2006) found that enrolling in more than four summer-term credits was positively correlated with increased degree attainment rates. For African American students who did not enroll in summer, 21.2% went on to attain a degree, compared to 42.5% of students earning 1-4 units and 78.2% of students earning four or more units. Further research into the relationship between summer study and degree completion has identified a positive relationship between first-summer enrollment (in academic units in summer after the first-year of college), and degree completion (Attewell et al., 2012). Many longitudinal studies focus on obtaining a degree in six to eight years and include community college transfer, as well as students who start college at a four-year institution, but could there be a relationship between first-summer and four-year degree completion? Could four-year institutions use first-summer strategically to improve four-year degree completion rates, especially for populations that have been historically underrepresented in higher education?

The University of California reports a system-wide four-year graduation rate of 71.3% and a six-year graduation rate of 88.5% (*Undergraduate Graduation Rates*, 2020), which is higher than national averages of 45.3% and 63.4%, respectively (*Digest of Education Statistics,* 2020). Those percentages are lower for Pell-recipient, first-generation and underrepresented minority students. The UC system has goals to increase the four-year graduation rate to 76% by 2030 (*Undergraduate Graduation Rates*, 2020). At the November 2017 meeting of the Regents of the University of California, the Total Cost of Attendance Working Group presented its final report on the University's Education Financing Model (*Total Cost of Attendance Working Group Final Report*, 2017). It presented eight recommendations, one of which was to promote summer enrollment as a way to reduce time to degree.

University of California, Merced (UC Merced), the youngest university in the UC system, accepted its inaugural class of undergraduate students in the fall of 2005. Since opening, the highest four-year graduation rate of a first-year cohort was 49% for the class of 2017 (*Center of Institutional Effectiveness*, n.d.). Though 49% of the first-year class of 2017 graduated in four years, the disaggregated data shows disparities between different student demographic groups and disciplines of study. First-generation (first-gen) and Pell recipient (Pell-eligible) students complete their degrees at percentages consistent with the campus average of 49%; however, there are disparities associated with School majors (e.g., majors in science, technology, engineering, and math (STEM) vs. non-STEM majors), and underrepresented minority (URM) status. URM students include those who identify as African American/Black, Native American, and Hispanic. URM status is associated with a disparity in the percentage of students completing their degree in four years, with 46% of URM students completing in four years and 52% of non-URM students completing in the same timeframe. Major, identified by a major belonging to one of the three Schools (Engineering, Natural Sciences, and Social Sciences, Humanities & Arts) represents the greatest divergence in rate of four-year degree attainment. The

School of Engineering four-year degree completion rate is 31%, followed by 47% from the School of Natural Sciences, while 66% graduated from the School of Social Sciences, Humanities and Arts.

Research Questions

With this study, I sought a deeper understanding of the characteristics of students enrolling in the first summer (the summer after the first year of college) as well as the relationship between first-summer participation and four-year degree attainment for students at UC Merced. I hypothesized enrolling in academic units during the first summer would have a positive relationship with four-year degree attainment. I was especially interested to understand the impact for students who were: 1) first-gen, Pell-eligible or from URM populations, who I refer to as the Equitable Access (EA) group; 2) students who experience lower levels of academic success in their first year; and 3) students in STEM majors. It is important to note that 42% of UC Merced students are included in all three Equitable Access groups in that they are first-gen, Pell-eligible and URM students. Finally, degree completion and student persistence literature report additional factors that can contribute to an individual's likelihood of attaining a degree. I controlled for characteristics including disaggregated race, gender, high school GPA, distance from home, and in-state vs. out-of-state status. Specifically, the research questions I addressed are:

1. What are the demographic characteristics of students who enroll in summer term after their first year of college at University of California, Merced? How do they compare to their peers who do not enroll? How are the demographic characteristics associated with first-summer enrollment?
2. How does first year academic success relate to first-summer enrollment? Do students enroll to catch up or to get ahead? Does it differ for Equitable Access group or STEM students?

3. To what extent is enrolling in academic units in the first summer related to four-year degree completion rates for students at UC Merced? Is the relationship different for Pell-eligible, First-gen, URM, STEM students, and by First-Year Academic Success Group?

This work is important because UC Merced and the University of California system seek to increase the equity of degree-attainment and four-year graduation rates, especially for students in the Equitable Access groups and students in STEM majors. My goal with this study is to contribute to the understanding of the potential for early summer enrollment to be used strategically to address opportunity and access gaps that may lead to increased four-year degree completion rates.

Chapter 2

GUIDING THEORETICAL FRAMEWORKS

I undertook this work as a quantitative study at a Hispanic-Serving Institution that enrolls a majority of URM students and so I explored this data guided by a QuantCrit theoretical framework (Gillborn et al., 2018). I explored first-summer enrollment through the framework of student persistence as an Educational Interface (Kahu & Nelson, 2018), understanding student success is dependent on the intent, actions and interactions of students and institutions, and the sociocultural context in which they exist.

QuantCrit as a Guiding Frame

The five constructs of QuantCrit research are: "1) the centrality of racism, 2) numbers are not neutral, 3) categories are neither 'natural' nor given: for 'race' read 'racism', 4) voice and insight: data cannot 'speak for itself', and 5) using numbers for social justice" (Gillborn et al., 2018). As I considered the centrality of racism as it applies to my study, I was immediately aware that the construct of URM is a social construct used to identify persons who are outside of the White dominant power structure in the United States, a power structure I inhabit and benefit from. It was important for me to "interrogate the collection, analysis, and representation of statistical material for likely bias in favor of the racial status quo" (Gillborn et al., 2018, p. 170). The second construct of QuantCrit is that numbers are not neutral, and statistics tell the story the researcher is invested in telling. I undertook this study focusing on success and with the understanding summer participation is one of access as opposed to a choice. Many students who want to enroll in summer term are kept out because of barriers that are beyond their control to overcome, such as access to grant financial aid or to online courses. Access to online courses enables them to meet their degree requirements and also personal or familial responsibilities at home.

The third construct is that categories are not neutral, and racism is perhaps a more accurate word than race. The University of California's application for undergraduate admission includes race

identifiers required by the U.S. Department of Education which first asks if the individual is Hispanic or Latino (yes or no). Second, individuals are asked in the same fashion if they are African American or Black, American Indian or Alaska Native, Asian, Pacific Islander or Native Hawaiian, or White. Students who identify themselves as Hispanic or Latino in the first question are also asked to identify with the second group of identifiers, though Hispanic or Latino are not included. I know from my experience as a practitioner working with Teacher Preparation Program Credential Candidates at UC Merced that this can be confusing for students who identify as Hispanic or Latino, but do not identify as African American or Black, American Indian, or Alaska Native, Asian, Pacific Islander or Native Hawaiian, or White. Students who are from other countries who are in the United States with a visa are identified by the University as International regardless of race or ethnic origin. Finally, applicants are asked to identify which group(s) best represents their background and may check multiple responses. This list includes 70 sub-categories of ethnic and geographic identifiers grouped under the six reported race identifiers. (*Student Ethnicity Collection and Reporting at UC*, 2017).

The fourth construct of QuantCrit is that data does not speak. Rather, researchers, with all their personal biases, tell their story of the data. My bias is as a practitioner in the summer academic space, and the department in which I am employed may benefit from identifying a relationship between early summer participation and four-year degree completion. I am also a White woman of European descent, and I recognize and respect that there will be people who object to my use of a critical race frame. I internally questioned if my experience is adequate to serve and uphold the equity, justice, and anti-deficit standards of the QuantCrit frame, though I humbly tried.

The final construct of QuantCrit is one of social justice, equity and how researchers can use data to critique deficit assumptions. My approach to this study aimed to peel back the layers of early summer participation to first understand who has historically attended summer term, and then to explore the academic habitus of summer participants before considering the relationship of early summer

enrollment to four-year graduation. I sought to shed light on who has access, who may be kept out, and who may be helped by a more intentional and student-serving institutional strategy for summer term.

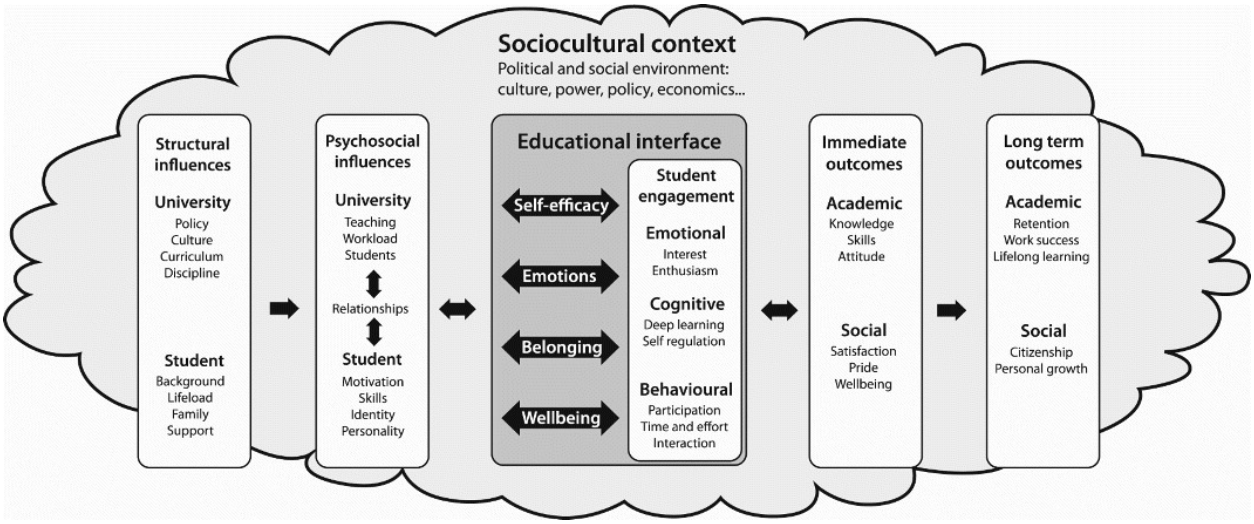
Student Engagement in the Educational Interface

The Educational Interface (Kahu & Nelson, 2018) exists within the sociocultural context of the relationship between a student and the institution they attend (Figure 1). The four constructs that comprise the Educational Interface are:

> academic self-efficacy, the student's perception of their capabilities for the task at hand; emotions, resulting from the student's appraisal of their situation; belonging, the connection students feel to the institution, discipline, and people; and finally, well-being, stemming in part from lifeload and stress (p. 64).

Figure 3

Kahu & Nelson's (2018) Refined Conceptual Framework of Student Engagement Incorporating the Educational Interface



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This work expands Kahu's (2013) prior engagement framework which positioned engagement as "a variable state that is influenced by a wide array of student and institutional factors, as well as by the

socio-political context within which the students, teachers and institutions are situated" (Kahu & Nelson, 2018, p. 61).

My study explored the relationship of first-year academic success to first-summer enrollment through the lens of engagement and persistence in the Educational Interface. It is inaccurate to assume summer enrollment is simply a student's choice or decision to enroll. A student's ability and interest to participate in first-summer term depends on their unique situation and their experience during their first year of college. Everything a student has known, learned, and experienced in K-12 and at home quickly expands to include the influences of new friends, peers, faculty, staff, and the institution's policy, culture, and curriculum. A student's feelings of self-efficacy, the relationships they develop, their connection to their institution, and their ability to take on summer course workload—in addition to other responsibilities they may have—must align for a student to consider taking courses in the first summer. Interest is only the beginning. What the student needs must be offered or met by the institution in order to facilitate summer engagement.

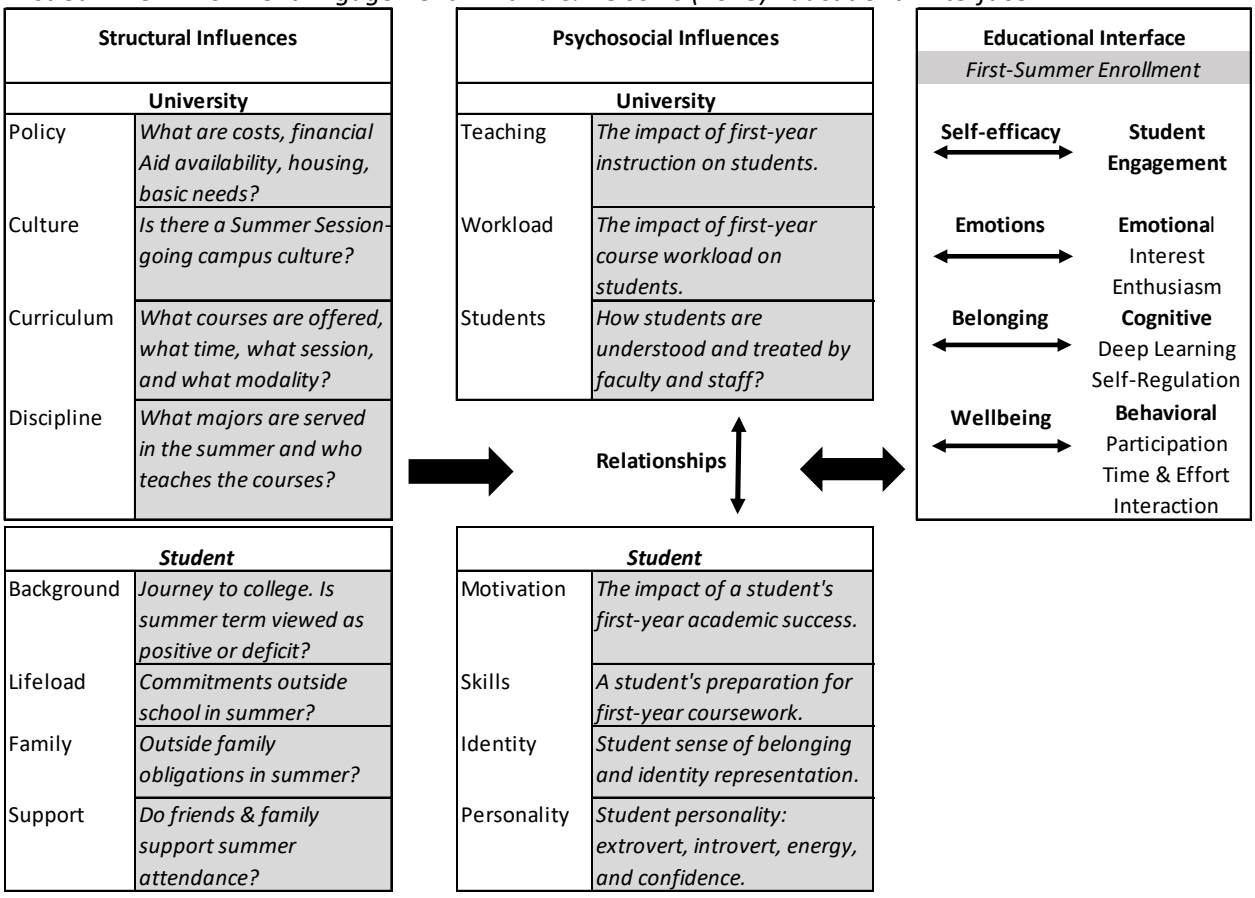
My experience as a practitioner in this space led me to believe that student needs can include such things as specific courses, efficient and effective course scheduling, access to online courses, access to advising, academic support and tutoring, activities, employment, housing and basic needs, and financial aid (Figure 2). I focused on the on the Structural and Psychosocial Influences in the Educational Interface because this study considered if first-summer enrollment (engagement) was associated with Immediate Outcomes (persistence) and Long-term Outcomes (graduation), as displayed in Figure 1.

I envision summer term through the lens of the Educational Interface as a dynamic partnership between the student and the institution, especially at an institution that serves a large number of historically underrepresented students who have great financial need, and/or are first-generation students and may have less college-going social capital (knowledge gained through attending and graduating from college) at home. The decision to pursue enrollment in summer term early in their

academic career is a demonstration of engagement, interest, belonging, and even well-being that equity-minded institutions should be prepared to support and serve.

Figure 4

First-Summer Enrollment Engagement in Kahu & Nelson's (2018) Educational Interface



Note. The shaded areas demonstrate the situations of UC Merced students and institution in the Educational Interface, as they relate to first-summer enrollment.

Chapter 3

LITERATURE REVIEW

Through this review of literature, I discuss three areas of higher education research related to my questions. The first section is dedicated to the current state of college attendance including what students go through to get to college, the changes in demographics of who attends college, and options for paying for education. While the student journey to college may seem removed from this study, it is important to include in the context of UC Merced as a Hispanic- and Minority-Serving institution serving predominately first-generation students from populations that are historically underrepresented and underserved in higher education. Their journey to college is different from that of their peers who are not First-gen and grow up with the benefit of familial college-going social capital, and institutions of higher education can improve service for historically underrepresented students through understanding and valuing the cultural capital they bring. I then introduce literature related to student persistence and success in higher education and the contributions of Hispanic- and Minority-Serving institutions. Finally, I address the issue of academic momentum, summer enrollment, and the relationship that has been demonstrated between enrolling in summer academic units early in a student's academic career—which I refer to as "first-summer"—and eventual degree completion.

Ultimately, this study explores if the first-summer construct of Attewell's Academic Momentum findings, which predicts degree attainment in eight years can be associated with increased likelihood of degree attainment in four years when the other two constructs (enrolling directly after high school graduation and enrolling full time) are met by the majority of first-year students at University of California, Merced.

The Journey to College

Deciding to go to college is not as simple as saying one will go. Many scholars have looked at the importance of pre-college conditions that contribute to the likelihood of an individual student enrolling in college. Oakes (2003) identifies seven conditions needed to bring equity and diversity to college access including: 1) safe and adequate school facilities, 2) college-going school culture, 3) rigorous academic curriculum, 4) qualified teachers, 5) intensive academic and social supports, 6) opportunities to develop a multi-cultural college-going identity, and 7) family-neighborhood-school connections. College choice literature consistently discusses the importance of family, personal community, or a significant other's support in an individual's pursuit of college (Kurlaender et al., 2019; Oseguera, 2013; Perna & Kurban, 2013). An individual's aspirations to attend college and their belief that they can are important contributors to college attendance (Kurlaender et al., 2019). Unfortunately, first-generation students often lack personal or familial college-going knowledge, (Kurlaender et al., 2019; Perna & Kurban, 2013), or social capital (Sandefur et al., 2006). If a high school does not have a strong college-going school culture, students may not have adequate and timely information about the courses required for college admission, GPA requirements or how to apply for financial aid to help them pay for college (Alemán et al., 2017; Oseguera, 2013). The availability of financial resources as well as knowledge and information about financial aid impact how an individual is able to navigate their pathway to college (Perna & Kurban, 2013).

For many students, the pathway to college is a complex process full of barriers and difficult decisions. Acevedo-Gil, (2017) building on Perna's (2006) college choice model, explains the complexity of college choice and attainment for Hispanic students in her discussion of college *conocemiento*. She explains an individual's path to college is not a straight line, where decision after decision is made. Instead, it is more of a serpentine, or winding path where obstacles may disrupt the individual's progress and cause them to reconsider previous decisions they made on their college attainment

journey. This is particularly important for institutions committed to serving historically underrepresented students, and Minority-Serving Institutions like UC Merced. It is important for institutions to both intentionally provide information for students so they may make decisions for themselves, and also to understand that their decision-making process may be different from a student coming from a family with generational college-going knowledge.

College Attendance and Completion in the United States

In the United States in 2017, 66.7% of high school graduates enrolled in college after high school (*Percentage of High School Graduates That Go to College*, 2021), but only 62% of students who began college in 2012 had completed a degree six years later, in 2018 (*The NCES Fast Facts Tool Provides Quick Answers to Many Education Questions (National Center for Education Statistics)*, n.d.). The four-year degree attainment rate was lower; only 55.3% of students who started college in 2012 had earned a bachelor's degree in four years (*Percentage of High School Graduates That Go to College*, 2021), though the National Center for Education Statistics (NCES) reported this number lower yet at 43.7% (*Digest of Education Statistics,* 2020). These statistics are even more concerning when they are broken down by student race, institution type and socioeconomic status. Hispanic and African American students, even those who graduate in the top 50% of their high school class and are considered prepared for college, disproportionately attend open-access four- and two-year colleges instead of more selective institutions with higher degree completion outcomes (Carnevale & Strohl, 2013). Considering the 2013 college entry cohort, 37.5% of Hispanic and 25.7% of African American students earned a degree in four years, compared to 53.5% of Asian and 45.3% of White students. The numbers are lower for public institutions and lowest at for-profit institutions.

The highest four-year graduation rates were found in selective nonprofit institutions, where 56.4% of students graduated in four years, including percentages higher across every racial demographic (*Digest of Education Statistics,* 2020). Selectivity is associated with a number of positive outcomes for

students. Highly selective institutions with more resources can afford to offer more high-cost degree programs, such as those in technology and health sciences, provide more academic and wellness support services to help students succeed, and can afford desirable amenities such as athletics facilities, theaters and museums (Bowen, 1981). They can even lead, on average, to more lucrative post-graduation employment or educational opportunities (Eide et al., 2016). According to Carnevale & Strohl (2013), the most selective institutions spend $27,900 on average per student for instruction each year, or 465% more than open access two- and four-year colleges, which spend on average $6,000 per student. More recent higher education spending trends find similar disparities in per-student spending. The National Center for Educational Statistics reports in the 2018/2019 academic year the average total spending per student was highest at private non-profit four-year institutions ($63,830) followed by public four-year institutions ($47,890). Private for-profit institutions spent far less on average than private non-profit colleges, spending on average $17,190 per student (*The NCES Fast Facts Tool Provides Quick Answers to Many Education Questions (National Center for Education Statistics)*, n.d.).

Public institutions of higher education are under pressure from policy makers and taxpayers to decrease costs and increase degree attainment rates, especially four-year degree attainment rates. At the same time, public institutions are increasingly dependent on tuition revenue, as opposed to government support to operate (Hossler et al., 2013). Public institutions, which serve the vast majority of underrepresented minority and low socioeconomic status students, have fewer resources per student and serve more students than the most selective public and private institutions.

It is important not to lose sight of who has access to institutions and who does not. Instructional expenditure per student is important because of its association with improved degree completion rates. Titus (2004) found that selectivity is positively associated with persistence. He continued to research the impact of institutions on persistence by studying the financial resources available at institutions, finding that institutions with more resources and that are less reliant on tuition have a positive effect on

student persistence (Titus, 2006). In the same study, he found students from low SES backgrounds are disproportionately represented at institutions with fewer financial resources and that are more reliant on tuition to fund instruction and operations.

How Students Pay for College

The methods federal and state governments use to support students' college attendance have shifted in response to the increase in college attendance and the costs associated with more people going to college, including more people from lower socioeconomic backgrounds. Since the 1980s, financial aid has evolved from mostly need-based grants to loans, and personal debt in the form of student loans has become one of the main pathways available to students and families to pay for college (Burdman, 2005). The Reauthorization of the Higher Education Act in 1992 shifted federal and state financial aid policies from providing grant funding for college to providing access to government subsidized loans (Pascarella & Terenzini, 2005), which has disproportionately impacted students from lower socioeconomic backgrounds. Policy makers view loans as an opportunity to create more access for more students to obtain a college education, while students, especially those most in need of financial assistance, often do not view loans as financial aid. Instead, they may differentiate between grants, which are viewed as financial aid, and loans which are seen as something other than financial aid (Burdman, 2005).

The main sources of federal grant aid are the Federal Pell Grant, the Federal Supplemental Educational Opportunity Grant, and the Federal Work Study programs. Additionally, students in California may apply for the Cal Grant program (*Cal Grant Programs*, n.d.; *Grants | Federal Student Aid*, n.d.). In 2017, the Federally funded Pell Grant Program returned to a year-round award model beginning with summer 2018, after ceasing the year-round program in 2011, beginning with summer 2012 (Liu, 2020; *What to Know About Financial Aid for Summer Classes*, n.d.). Though the Federal Pell Grant Program has returned to include opportunity for summer grant aid, the California Cal Grant program

does not provide additional funding for attending terms outside of the regular school year (fall and spring semester or fall, winter, and spring quarters) (*Program Fact Sheets and Other Information*, n.d.). The University of California provides the Blue and Gold Opportunity Plan for families with incomes under $80,000, the Middle Class Scholarship program, for families with household assets under $191,000, and the California DREAM Loan program for AB 540 students who attend a University of California campus (*Types of Aid | UC Admissions*, n.d.), during the regular academic year. However, the UC system does not have the ability to provide the same programs during the summer term.

Student Persistence and Degree Completion

I approach the question of first-year academic success through persistence and degree completion literature by first looking at the evolution of college persistence research beginning with Tinto's student integration work, followed by Bean's student departure theory and into more modern ideas around persistence. Their work, though widely critiqued, provided a foundation for researchers such as Tierney and Rendón, to expand responsibility for student persistence and success to include the actions and climates of institutions and the role of institutional representatives to validate the experiences of their students as greater numbers of diverse students, including ethnic and racial groups, first-generation, and students from low socioeconomic backgrounds enrolled in college. This includes research into the impact of financial aid on the ability of students to persist and the preparation of the institution to serve the students they receive.

Early Student Persistence Research

Understanding why some students persist and attain a bachelor's degree and why others do not is the basis for a broad body of research spanning recent decades. Tinto studied student departure from college, or failure of the individual to integrate and persist. His earlier research focused on the actions and circumstances of the student in relation to their decision to leave college, likening a student's decision to drop out of college to the decision of an individual to take their life. The inability of the

individual to integrate into college or society was the common factor linking these two personal decisions and actions (Tinto, 1975). Tinto later evolved his view of student integration to include the actions and influence of the institution and institutional representatives and their impact on the ability of an individual student to integrate and persist (Tinto, 1993; Tinto, 2012).

Education researchers were not satisfied with Tinto's framing of student departure as it placed blame for a student's departure from college on the individual and their circumstances and failed to consider institutional responsibility. Bean (1980) proposed a causal model of student departure. He proposed that student background variables such as performance and socioeconomic status as identified by Tinto interacted with organizational determinants, such as institution quality, opportunity, housing, and choice of major. His study considered how the student's background interacted with the organizational determinants, leading to either satisfaction and the student's commitment to the institution, or departure. Bean's analysis identified that the departure model was different for males and females, and that some individuals left for positive reasons, such as the opportunity to transfer to another institution. Bean's identification of the strength of a student's commitment to the institution contributing to the student's decision to remain there opened the door for the expansion of student persistence research. This research focused on the importance of the actions of the institution and the need to recognize the expanding diversity of students attending college. The needs of these diverse students, would be included in Bean's work with Metzner (Metzner & Bean, 1987) to expand the student departure frame in relation to part-time and commuter students, who they referred to as non-traditional students.

Institutional Responsibility for Student Persistence

The shift described above introduced the idea that institutions also had a responsibility and role in a student's ability to persist in their studies. Scholars considered that student integration and student departure might converge to better explain student persistence (Cabrera et al., 1993). These findings

shed light on the complexity of student persistence by demonstrating the interconnectivity of individual, environmental and institutional factors and how, together, they impact an individual student's ability to persist.

Tierney's (2000) cultural model put the onus for student success on institutions by challenging them to improve student success and also evolve to serve rapidly diversifying student bodies. Tierney encouraged collaborative relations of power, as opposed to a fixed power structure that is controlled entirely by the dominant group(s) and stressed the importance of establishing connection and cooperation between the home, the community, and the school. The cultural model includes the importance of identity and of affirming identity in teaching and learning; it is important for institutions and educators to understand the role identity plays in how a topic is approached and perceived. Finally, with regard to academic success, Tierney encouraged challenge over remediation and stressed the importance of academic support. In this way, the cultural model rejects the fixed power structure of the education system that sorts and labels those with less power into categories such as at-risk, or non-native speaker, and encourages educational institutions to challenge students while providing academic support to help them meet the challenge.

Validation theory (Rendón, 1994) represents an important evolution in the approach of researchers to understand student persistence and how historically underrepresented students become successful college students. Rendón first made note of the changing demographics of students attending college and that previous student persistence research was centered around White males with college-educated parents from above-average socioeconomic backgrounds. Her early work demonstrated five key findings. When a student is validated, they feel supported and able to learn. The earlier validation occurs, the greater the impact will be on their college experience. Rendón stressed that institutions need to take an active role in validating students by training faculty and staff and by supporting the development of validating teaching and learning models. Rendón later adjusted her use of the term

"non-traditional" to refer to students who had been historically underrepresented or underserved by higher education. According to Rendón,

> If anything can be said for sure about higher education students today, it is that they are diverse in multiple ways—gender, race/ethnicity, generational status, class, residential and immigrant status, academic preparation, religion/spirituality, age, language needs, ability and disability, learning style preference and worldview. (Rendón, 2006, p. 1)

Positive college academic and social experiences are associated with increased persistence and have been found to be especially important for URM students (Baker & Robnett, 2012; Carter, 2006; Xu & Webber, 2018). What leads to an individual's ability to persist can be different for different populations, and it is important for institutions to understand what special interventions, such as advising, academic help, first-year experiences and social integration programs, have been successful with populations similar to their own student body (Bai & Pan, 2010; Bolkan et al., 2021). As institutions seek to develop positive campus climates where students feel a sense of belonging, it is important they are mindful that identity is fluid and identities intersect. The intersectionality of identity can create disruption for an individual, even in a space where they "belong" based on one identity, but do not feel welcome because of another personal identity (Tachine et al., 2017; Vaccaro & Newman, 2017; Yosso et al., 2009).

Persistence and First-Year Academic Success

First-year academic success is consistently found to be associated with persistence and degree completion when it is studied in relation to the number of units completed and GPA (Adelman, 1999, 2006; Attewell & Monaghan, 2016; McCormick, 1999; Pascarella & Terenzini, 2005; Szafran, 2001; Witteveen & Attewell, 2017). Most four-year college degrees are designed to be completed in approximately 120 semester units, which on average is 15 units per semester and 30 units per year for four years.

McCormick (1999) identified several important associations among first-year academic success, persistence, and degree attainment. Students with first-year GPAs lower than 2.0 were less likely to complete 30 units in the first year, resulting in the need to take additional units in subsequent terms in order to graduate in four years. The equity implications of this finding are made more disturbing by the association of socioeconomic status (SES) to first-year unit completion: 31% of low SES students completed 30 or more units compared to 41% of middle SES and 48% of high SES students. First-year credit accumulation was found to be correlated with credit accumulation throughout the college years, creating an educational disparity for low SES students. McCormick (1999) found enrollment in at least one summer term to be associated with an 82% degree attainment rate, as opposed to 67% for students who did not participate in summer term. Similarly, Attewell and Monaghan (2016) found completing 15 units per term to be associated with increased probability of degree completion. Each time Adelman studied degree completion, he found an association between credit accumulation, first-year GPA, and degree completion (Adelman, 1999, 2006), with fewer completed units being associated with a 33% decrease in the probability of degree completion, and completing the first year with a GPA in the top two quintiles increased the probability of degree attainment by 22%. Interestingly, Szafran (2001) found students who took more units (minimum, 12, maximum, 19, average, 14.56, SD 1.55) had higher GPAs (average GPA 2.01). A relationship was found between course difficulty, unit load and success, leading to the conclusion that students can be successful and make degree progress when they are neither under-challenged nor over-loaded with difficult courses, which aligns with Tierney's cultural model of student persistence (Tierney, 2000).

Given the importance of the first-year academic experience on persistence, what circumstances increase the probability of academic success? Researchers point to the importance of both academic and social engagement, and the preparedness of the institution to serve diversified student bodies (Bensimon, 2005; Braxton, 2014, 2020; Brint et al., 2008; Conrad, 2015; Flynn, 2014; Garza & Fullerton,

2018; Hu & Ma, 2010; Kahu, 2013; Kahu & Nelson, 2018; Kinzie & Kuh, 2017; Kuh et al., 2017; Kuh et al., 2006; McNair et al., 2016; Ngo & Lee, 2007; Nguyen et al., 2018; Offenstein et al., 2010; Rendón et al., 2000; Swail, 2003; Wood & Williams, 2013). It is understood that higher education, especially predominately White institutions of higher education, need to improve their ability to serve Black, Hispanic, and Native American students (Bensimon, 2005; Rendón, 2006; Rendón et al., 2000; Swail, 2003; Urias et al., 2016; Wood & Williams, 2013), as well as specific groups within the larger group identified as Asian, such as South East Asians (Ngo & Lee, 2007; Nguyen et al., 2018). The education debt is greatest for men of color, many of whom do not matriculate to college directly after high school and have different needs from their younger peers in order to be successful (Urias et al., 2016; Wood & Williams, 2013).

College persistence literature encourages institutions to adopt high impact practices, such as first-year seminars, writing seminars, global learning, learning communities, internships, culminating senior experiences, and service-learning to facilitate student engagement and success (Finley & McNair, 2013; Kinzie & Kuh, 2017; Kuh et al., 2017; Kuh, 2012; Kuh et al., 2006). However, high impact practices are not always associated with timely degree completion (Johnson & Stage, 2018), and not all students have the ability to participate in many of these activities because of financial or cultural constraints. Though the importance of academic and social engagement are widely accepted as important contributors to persistence, Hu and Ma (2010) found the relationship between engagement and persistence to be non-linear. They found engagement to be both social and academic and students who were highly engaged in only one aspect were less likely to persist than students who were moderately engaged both socially and academically. Flynn (2014) found third-year engagement to be more closely associated with degree completion than first-year engagement, except for Black and Hispanic students, for whom early engagement was associated with increased likelihood of persistence. Engagement can also be different depending on the discipline of study (Brint et al., 2008). They found student

engagement in STEM majors was associated with interest in skill acquisition and employment goals after graduation, while engagement for students in the humanities and social sciences was focused on interactions with faculty and peers and the exchange of ideas.

In addition to theories of engagement, researchers have noted the relationship between academic achievement and persistence (Adelman, 2006; Bettencourt et al., 2020; DesJardins et al., 2003) and found that academic success in high school, especially in mathematics could help predict college persistence, especially for students in STEM majors. Likewise, students who arrive at college with greater levels of social capital, in terms of family income and education level, are more likely to persist (Sandefur et al., 2006). Other researchers have identified specific variables that can be associated with persistence such as distance from home to their college (Garza & Fullerton, 2018), and major (Bettencourt et al., 2020). While I note these findings, they may not take into consideration the experiences, challenges, and barriers faced by many historically underrepresented students.

The Impact of Financial Aid on Persistence

Many education researchers have explored the role of an institution to provide and award financial aid and how financial aid impacts the ability of many students to persist (Bannister & Krammer II, 2014; Brownback & Sadoff, 2020; Consolazio, 2021; Dawson et al., 2020; Denning, 2019; Goldrick-Rab et al., 2016; Hu & St. John, 2001; Liu, 2020; Schudde & Scott-Clayton, 2016; St. John et al., 1996, 2000). Some researchers questioned Tinto's disregard of college cost as a viable concern for students and used motivation theory to explain how individuals are challenged to focus on improving their condition unless their basic needs are met (St. John et al., 2000). In this way, students from low socioeconomic backgrounds can find it challenging to focus on and be successful in college when they are concerned about paying for their education and having enough money to meet their basic needs. While Tinto initially suggested cost to be an excuse for lack of commitment to college, others looked at the importance an individual's financial situation had on every aspect of an individual's college choice

process. Students must consider cost when deciding if they can apply to a four-year college, attend community college, or go to college at all. Cost will drive where they will decide to apply, and often financial aid award offers are used to determine which college to select (St. John et al., 1996).

Recent literature has gone beyond persistence and has identified correlations between financial aid and degree completion. Denning (2019) looked at the impact of financial aid on college completion for students who turn 24 prior to January 1 of their senior year of college. Students in this situation are considered adults and their aid eligibility no longer includes their parental income. Denning found that the additional aid they received because they became independent for their senior year in terms of aid eligibility helped some students graduate earlier than they would have without the aid, and earlier than did similar peers who turned 24 after January 1 of their senior year. Similarly, Goldrick-Rab et al., (2016) looked at the outcomes of a grant aid implementation program in Wisconsin and found that an additional $3,500 grant aid increased four-year degree attainment by nine percent.

Other researchers examined the relationship of loss of Pell grant aid and persistence (Schudde & Scott-Clayton, 2016). A Pell grant is first awarded as need-based aid. If students with an expected family contribution (EFC) of $5,846 or below (Consolazio, 2021), or if the combined parental income is $49,999 or less (*How Aid Is Calculated | Federal Student Aid*, n.d.), they qualify for federal Pell grant. However, once the student is enrolled, they must meet federal Satisfactory Academic Progress (SAP is a Federal Financial Aid policy) to continue to be eligible to receive Pell grant aid. Failure to meet SAP leads to loss of the Pell grant, which often creates an insurmountable enrollment barrier for students from the most economically disadvantaged backgrounds (Schudde & Scott-Clayton, 2016). How institutions of higher education utilize the federal, state, and other sources of aid available to them is a powerful contributor to student persistence, especially for the most vulnerable students they serve (Dawson et al., 2020). I address the relationship of Financial Aid to summer enrollment in the literature review related to my third research question.

Persistence and Hispanic and Minority-Serving Institutions

The role of Hispanic- and Minority-Serving institutions is important in the context of UC Merced, where 63% of students identify URM. UC Merced opened for undergraduate enrollment in fall of 2005 and Hispanic students have held the largest share of incoming student enrollment since fall 2009 when Hispanic student enrollment reached 31%. That percent steadily increased, reaching 54% in fall 2021 (*Undergraduate Retention and Graduation | Center of Institutional Effectiveness*, n.d.).

Hispanic-Serving Institutions often serve more than Hispanic students and can have multiple minority-serving designations. Nearly all have become Hispanic-Serving because they are located in a geographical location with a large Hispanic population (Contreras & Contreras, 2015), which makes them different from Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs) which were originated to serve Black and Native American students respectively. The situation of UC Merced is somewhat different. It is located in a rural, predominately agricultural community in Central California, and the student body is equally representative of Southern California, Northern California and the Bay Area, and Central California.

Hispanic- and Minority-Serving institutions that receive Title III and V (Higher Education Act) funds from the Department of Education serve a disproportionate number of low SES and Pell-eligible students. They have less funding than institutions that do not receive Title III and V funds, especially in terms of endowment funds (Scott, 2007). And yet, Hispanic-Serving institutions often perform above expectations, helping Latina/o/x students develop academic self-concept and social agency, even with their limited funding situations (Cuellar, 2014, 2015). Latina/o/x students with less college-going social capital often choose to enroll in a Hispanic-Serving institution, even when they are admitted to a more selective, non-HSI institution. Latina students are more likely to enroll in a Hispanic-Serving Institution regardless of background or preparedness (Cuellar, 2015). While the success of Hispanic students at HSIs

is a positive outcome, it is concerning in terms of equitable access for Hispanic students to more selective institutions with higher persistence and degree completion outcomes.

Hispanic- and Minority-Serving institutions are successful when faculty and staff share the commitment to student success (Conrad, 2015). The importance of practitioner knowledge to student success is invaluable and contributes to positive campus climate and validation of student experiences (Bensimon, 2007). It is recognized that in order to be a student ready campus, faculty and staff must be ready to help students navigate the hidden curriculum of how to be a successful student (Harris & Bensimon, 2007).

Antideficit Research and Student Persistence

I close the persistence section by relating the literature about persistence research to the QuantCrit frame. Persistence and degree attainment are almost always approached as problems that need to be fixed. Institutions and legislators want to improve four-year graduation rates, researchers want to help them identify ways to improve timely graduation, but rarely does research focus on what has worked as opposed to what has not worked. Harper (2007) studied men of color who had been successful in STEM and developed an anti-deficit achievement framework for studying students of color using nine researchable areas of achievement: family factors, K-12 school forces, out-of-school college preparatory experiences, classroom interactions, out-of-class engagement, experiential and external opportunities, industry careers, and graduate school enrollment and research careers. Similarly, Urias et al. (2016) rejected the deficit-based research approach and focused their study on 15 men of color who successfully transferred from a community college to four-year institutions. Tuck (2009) cautioned researchers against damage-centered research and encouraged researchers to join her "in re-visioning research in our communities not only to recognize the need to document the effects of oppression on our communities but also to consider the long-term repercussions of thinking of ourselves as broken" (p. 409). The research of these individuals and others who have done similar work shaped my intent and

goals for contributing to the understanding of success and persistence. While there are lessons to be learned from failure in research, there is possibly more to be learned from researching success in education. As such, I wanted to understand how students have utilized first-summer and have been successful.

Academic Momentum

Most degree programs are structured as a four-year degree, though some colleges and universities, like UC Merced, provide pathways for students to complete some degrees in three years. How students navigate the four or even three-year pathways varies between different institutions and the students who attend them. Students can increase their odds of graduating in four years by taking least 15 units per term that count toward their degree (Attewell & Monaghan, 2016; McCormick, 1999). However, institutions should also do their part to support students by providing degree requirement maps for all programs, flexible and adequate scheduling of courses, transfer pathways including transfer of general education requirements (Complete College America, 2011). Self-service degree progress reports, sometimes referred to as degree audits or degree paths, can also help students monitor their progress to degree completion (*MyDegreePath | Office of the Registrar*, n.d.). However, adequate and even intrusive advising is an important role of the institution to help ensure and improve timely progress to degree completion (Bolkan et al., 2021).

Attewell et. al.'s (2012) study of Academic Momentum tested specific aspects of Adelman's Toolbox (1999, 2006). While Adelman's studies focused on reporting degree completion data and trends and did not seek to address why students may or may not have completed a degree, multiple studies identified students enrolling directly after high school, enrolling full-time, and earning academic credits in the summer after their first year to increase the likelihood that the student will persist to a degree (Attewell et al., 2012; Attewell & Jang, 2013; Liu, 2016, 2020; Offenstein et al., 2010; Witteveen & Attewell, 2017). Attewell et al.'s study (2012) addressed selection bias that was not discussed in

Adelman's (1999, 2006) work which focused on descriptive statistics and correlations. In order to address selection bias—that is the differences between student types and groups within their study such as students who begin college part time or at a community college compared to students who begin full time at four-year institutions—they employed three different matching analyses including, optimal matching, weighting on the predicted odds, and propensity score matching to control for 27 covariates and self-selection. Though the three methods resulted in different levels of magnitude, all three found a positive association between first-summer enrollment and degree attainment. They found gender, socioeconomic status, and high school preparation to have the greatest potential for heterogeneity and developed models to specifically compare like populations (Attewell et al., 2012).

How does this apply to UC Merced? Over 99% of first-year students at UC Merced begin college in the fall after they graduate from high school (*Undergraduate Retention and Graduation | Center of Institutional Effectiveness*, n.d.), which conforms with the first construct of Academic Momentum. Though entering college in the fall after high school graduation is an important aspect of both Attewell and Adelman's studies, some argue a gap-year can be beneficial if the individual is able to engage in developmental activities, such as travel (Martin et al., 2013). However, students from higher socioeconomic levels who can afford to engage in developmental gap-year activities currently persist to degree attainment at higher rates than their peers from lower socioeconomic backgrounds.

The second construct of Academic Momentum is enrolling full time, which is defined as 12 or more units for an undergraduate. At UC Merced fewer than 1% of undergraduate students enroll less than full time (*Undergraduate Retention and Graduation | Center of Institutional Effectiveness*, n.d.). The UC Merced General Catalog defines normal progress to degree completion for an undergraduate as passing, on average, 15 units per semester in order to complete 120 units in four years (*Progress to Degree and Academic Standing - University of California Merced - Acalog ACMS™*, n.d.).

The third construct of Academic Momentum is enrolling in academic credits in the summer after the first year of college. In the context of four-year research universities, most first-year students enroll directly after high school and it is rare for students to be enrolled less than full time; however, enrolling in summer term is typically voluntary, and not part of the regular academic year. It is important to address selectivity when considering summer enrollment because summer is an optional term; institutions often view it as supplemental and not specifically linked to institutional mission, goals or assessed outcomes (Attewell & Jang, 2013). Less financial aid is available in terms of variety of sources and amounts, the tuition and fee structures are usually different, and the funding structure for summer term is different from the regular academic year. In the case of the University of California, summer term is self-supporting, and the tuition revenue generated by the courses pays for the cost of instruction and provides the only institutional source of grant aid for that summer term. For these reasons, I framed summer enrollment in terms of access opposed to a choice, with the understanding that some students who would like to enroll in summer term may be kept out because of their financial situation or responsibilities outside of school during the summer.

Summer Enrollment

Students are motivated to enroll in summer term for a variety of reasons. Adelman (2006) identified a positive relationship between earning four or more credits in the summer and degree attainment, especially for Black students, as one of many items in a student's toolbox that increases the probability of degree completion. His study does include students who attain degrees in as many as eight years, however. Chandler and Weller (1995) found students had both academic and social reasons for taking summer courses, with academic reasons (such as timely graduation, completing major requirements, or taking a course requisite) being most important. Some students cited non-academic reasons for attending summer classes, including keeping an off-campus job in the college town, using their leased place to live, or staying close to college friends. This study was conducted at a midwestern

regional university, and it is important to note the demographic characteristics do not include SES or race. This study also recognized that some students were pushed to enroll in summer term to gain access to courses in high demand during the regular academic year. Some studies have looked at summer through Bourdieu's (1987) theory of social reproduction (Ro et al., 2021; Tichavakunda, 2019) to look at who participates in summer academics and experiences. Ro et al. found students who had parents with graduate or professional degrees understood the value of advanced degrees, were more likely to have connections in professional networks, and were more likely to take part in research opportunities or an internship. Conversely, they found students from low SES backgrounds were less likely to participate in these high impact practices because it would be unpaid work, and they could not afford to work for free. Tichavakunda's study of engineering students resulted in similar findings to Ro, et al.. Summer internships and research lead to skills accumulation and often post-graduation employment, and yet students who could benefit from these activities the most—historically underrepresented students—also faced the most barriers to participating in them. Headlam et al. (2018) cited a number of barriers to summer enrollment in their sample institution. In addition to students' commitments outside of school during the summer, they found the extra financial aid forms for summer session to be overly complex and unnecessary, which suggested a lack of institutional commitment to making summer accessible for students.

Other researchers have identified a relationship between summer enrollment and degree completion. Students who struggle academically who enroll in academic units in the summer improve their likelihood of persisting to the following year, thereby increasing their probability of obtaining a degree (Liu, 2016). Offenstein et al., (2010) found the correlation between summer enrollment and degree completion to be statistically significant for all groups including traditional age, older, full- and part-time, Asian, Black, Latino and White students. In an earlier study of degree progress and credit accumulation, McCormick (1999) also found an association between summer enrollment and degree

completion, and that students in who enrolled in a summer term were 15% more likely to complete a degree. Importantly, students who enroll in academic units in summer demonstrate their commitment to degree completion and increase the probability that they will persist to the following fall term (Franke & Bicknell, 2019).

As has been demonstrated, early participation in summer academic coursework (first-summer) can increase the probability of degree completion, especially for students whose institutions of higher education are invested in improving degree completion rates, including for URM, students from lower socioeconomic levels and students who begin college and need to complete courses that are prerequisites for college level coursework (Attewell & Jang, 2013).

However, some studies have conversely demonstrated that excessive use of summer enrollment can be negatively associated with four-year degree completion. Wada (2019) studied a campus implementation of a four-year degree completion campaign at University of California, Davis and found the more summer terms a student enrolled in, the less likely they were to complete their degree in four years, though it is possible there were other reasons for lengthier time to degree for these students, such as changing major, course withdrawal or non-passing grades.

Financial Aid Challenges Related to Summer Enrollment

Earlier in this literature review, I addressed the importance of financial aid and especially grant-based aid to persistence for students from low SES backgrounds who are often disproportionately first-generation and URM. Participating in summer academics presents the same financial challenges as the regular academic year, but there are fewer grant-based financial aid funds available during the summer (Bannister & Krammer II, 2014; Liu, 2020). Researchers who have studied institution-based summer financial aid experiments have found a relationship between grant aid and summer participation (Bannister & Krammer II, 2014; Brownback & Sadoff, 2020; Headlam et al., 2018; Liu, 2016). In one study an institution assessed the importance of grant aid to summer enrollment by tracking their usual

summer enrollment, but in addition they targeted one group of students with an outreach campaign and a second group who received the outreach campaign and additional grant aid. Students in the control group, with no additional outreach or grant aid enrolled at a rate of 23.2%. Students in the information campaign enrolled at a rate of 28.7%. Students who received information and grant aid enrolled at a rate of 37.9%. Brownback and Sadoff (2020) conducted an experiment at a community college, randomly assigning grant aid to students who expressed less interest in summer enrollment. Grant aid, even for students who did not indicate they were interested in summer enrollment, was associated with a 31% increase in rate of graduation and a 58% increased rate of transfer to a four-year institution within one year of the program implementation. Liu's (2016) study of year-round Pell at a community college demonstrated a similar relationship between grant aid and summer enrollment, finding for each additional $1,000 of year-round Pell funding students received, summer enrollment increased by 28 percentage points.

The University of California system wants to understand how students feel about Summer Session. In spring 2020, the University of California included questions about summer enrollment on the Undergraduate Experiences Survey (UCUES) (*Summer Enrollment*, 2021). Students were asked about their satisfaction with their UC summer session experience and 47% of 15,612 students across the UC system indicated they were not satisfied with the affordability of Summer Session. At UC Merced, 44% of 423 students were not satisfied with the affordability of summer session. When asked about the impact of cost on their decision to take summer classes at a non-UC institution, 65% of all UC students indicated lower cost was a reason, while 77% of UC Merced students indicated their decision was made because of lower cost. It is important to note that the UCUES survey data demonstrated that 56% of students did not feel they needed to take summer courses and 34% of students in the data set never took summer courses.

Options for summer financial aid at UC Merced include access to the Federal Pell Grant program, if the student has any award eligibility remaining for the year, and the percentage of summer fees set aside by the institution to award as grant aid. UC Merced returns 40% of the per-unit fees to the allocation of grant aid available for distribution in that summer term. This is referred to as Return to Aid (RTA) and is the first commitment of summer session revenue in any given year. In summer 2021, 2,312 students were enrolled at UC Merced in summer session, generating a total of 18,844 student credit hours, or 628 full time equivalencies (FTE). Financial aid in the amount of $10,067,188 was distributed to 3035 undergraduate and graduate students (universities award aid for their students who participate in summer academic enrollment at other institutions within the system and students participating in university-coordinated learning experiences such as Study Abroad). Of the aid distributed, 69% was grant aid, 22% was fellowships, scholarships, and other sources of non-loan aid, and 9% was loans[1]. It is worth noting that 11% of the loans that were offered to students were accepted compared to 97.2% of grant aid and other sources of non-loan aid, demonstrating these students' unwillingness to accept loans.

[1] Data provided by UC Merced's Office of Financial Aid and Center of Institutional Effectiveness to the Department of Summer Session

Chapter 4

RESEARCH DESIGN

This study is quantitative in design and utilized institutional data from UC Merced. Through it, I sought greater understanding of the characteristics of students who have enrolled in first-summer, and the relationship between first-summer enrollment and four-year degree attainment. I was particularly interested in students from groups with lower institutional four-year degree attainment outcomes including URM students, students in STEM majors, and students who were less academically successful in their first year of college. My goal with this study was to understand if first-summer may be leveraged to improve four-year degree attainment at my institution, and if there are specific groups in need of additional institutional action or support to access first-summer enrollment. Specifically, I explored the characteristics of students who enroll in first-summer, how first-year college academic success relates to first-summer enrollment, and how first-summer enrollment was related to four-year degree attainment at UC Merced.

Research Question 1 addressed the demographics and characteristics of students enrolled in first-summer for the years included in this study. The variables I included are informed by the persistence and degree completion literature, and the University of California system-wide degree completion data. I sought to understand how the variables correlate to first-summer enrollment participation at UC Merced. Through this question I explored which students have enrolled in first-summer, which students did not, and if there were any groups that were not represented in first-summer enrollment.

With Research Question 2, I sought to understand the relationship between first-year academic success and first-summer enrollment. I wanted to understand if first-summer enrollment at UC Merced could be associated with catching up or getting ahead. The Academic Momentum and degree

completion literature that addresses summer enrollment focuses on the association between summer enrollment and degree attainment as an outcome but does not address student motivation to enroll in summer term. The Educational Interface framework identifies the importance of self-efficacy to engagement and persistence, which led me to question if students who were less successful in their first year felt prepared for summer enrollment even though they may have benefited from enrolling in summer term if they were to persist to complete their degree.

Research Question 3 explored the first-summer construct of Attewell's Academic Momentum degree completion frame but examined the relationship between first-summer and four-year degree attainment. I modeled the probability of graduating in eight semesters as a function of enrolling in academic units the first summer at UC Merced. I also controlled for a variety of other student characteristics such as the Equitable Access Group variables (first-generation, Pell-eligible, and URM), the First-Year Academic Success Groups, STEM major, gender, California Resident, commuting distance, and high school GPA.

Data and Sample

This study utilized de-identified student data from UC Merced for first-year (freshmen) students entering in fall for the years 2009 through 2017, acquired from the Center of Institutional Effectiveness (CIE) with the support of the Vice Provost and Dean for Undergraduate Education (VPDUE), and permission of the University Registrar. This data provided nine cohorts of first-year students for the dataset. The number of observations in the study is 13,745. The study is limited to students who entered in fall terms, including those who matriculated with advanced placement units, dual enrollment college-level units, or other college-level units they obtained during high school. I did not count previously earned college level units toward their first-year unit accumulation. I did not include spring admit first-year students because I could not be assured of accurate first-year units earned to compare them with

fall semester entrants. I also excluded transfer students because they completed their first college year and first-summer prior to matriculating at UC Merced.

UC Merced's four-year graduation rates are the lowest in the system, and it serves the highest percentage of Equitable Access group students relative to the student body of each of the campuses in the UC system (*Fall Enrollment at a Glance*, 2022). At UC Merced, 54% of students are enrolled in a STEM major (identified as Physical Sciences, Other Health Sciences, Life Sciences, Engineering, and Computer Science), while at the system level only 43% of students are enrolled in a STEM major. This is important because UC Merced provides a greater percentage of its students with the ability to choose a STEM major and the majority of UC Merced students come from populations that are underrepresented in higher education. Table 1 compares the Equitable Access groups, gender, STEM major and California Resident status for undergraduate students in the University of California System to UC Merced.

Table 2

Undergraduate Student Characteristics of the University of California System and UC Merced

	UC System	UC Merced
First-Generation	37%	74%
Pell-Eligible	33%	59%
Underrepresented Minority	30%	67%
Female	54%	48%
Male	44%	50%
Other (gender)	2%	2%
STEM Major	43%	54%
California Resident	83%	> 99%

Note. Statistics obtained from the University of California Office of the President website for fall 2022, UC fall student enrollment at a glance.

Measures

The institutional data for my study contained detailed information about enrollment. For first-year enrollment, defined as the first year (freshman) of college enrollment at UC Merced, I counted the total number of academic units completed. First-year GPA is the cumulative grade points earned in the

fall and spring semesters of the first year. Students who matriculate in fall but did not enroll the following spring were excluded.

For enrollment in first-summer, I used a binary variable to indicate the student enrolled in and completed academic units at UC Merced in the summer after the first year of college entry.

For race, I utilized the race identifiers used by the University of California for the Integrated Postsecondary Education Data System (IPEDS) reporting purposes including African American, Native American, Asian, Hispanic, International, Pacific Islander, Two or More Races, and White. For Underrepresented Minority (URM), I included students who are African American, Native American, or Hispanic. For gender, I used the gender identifiers male, female, and other/non-binary.

For geography, I included two variables. The first is California Resident, which groups students by students who pay in-state tuition (Resident) versus out-of-state tuition (Non-Resident)[2]. The second variable I included for geography is Local, which is a construct I used to identify students with a home address in commuting distance to UC Merced. For this purpose, Local includes Merced, Madera, Mariposa, and Stanislaus counties and the cities of Fresno and Clovis due to their size and proximity to UC Merced[3].

I grouped students by the association of their declared major with the three Schools at UC Merced: Engineering, Natural Sciences, and Social Sciences, Humanities & Arts. For this classification, I used the major they listed when applying to UC Merced. The variable STEM includes students from the schools of Engineering and Natural Sciences. For the academic variables, I included cumulative high school and first-year college GPA and first-year college units. High school GPA is the GPA as calculated for the University of California admissions process.

[2] Though resident status is a commonly used demographic variable, fewer than 1% of UC Merced students are Non-Resident. It is excluded from regression models due to its small size.
[3] Students in the Local variable can commute to Merced in an hour or less. Other geographic variables, such as the San Joaquin Valley, would extend further than commuting distance to Merced.

Data Analysis

Question 1. What are the demographic characteristics of students who enroll in summer term after their first year of college at University of California, Merced? How do they compare to their peers who do not enroll? How are the demographic characteristics associated with first-summer enrollment?

The purpose of my first question was to gain a deeper understanding of the students who have had access and selected to enroll in summer academic units at UC Merced. To address this question, I compared first-summer enrollment rates by student characteristics and variables demonstrated to be predictive of student success by the research literature. The first set of characteristics I considered are those associated with UC Merced's strategic goal to develop "the next generation of diverse scholars, leaders and agents of change" (*GOAL 2: Develop Future Scholars and Leaders | Strategic Plan*, n.d.). I used the term Equitable Access (EA) group to describe students who are first-generation, Pell-eligible, or URM. Specifically, I computed summer enrollment rates separately for students by Equitable Access group. Although I was primarily interested in understanding summer participation based on the student characteristics UC Merced focuses on in order to improve equity in education outcomes, I also wanted to understand more comprehensively who summer students were. The literature demonstrates the importance of prior academic success, race, gender, and major.

The last set of student characteristics I considered may relate to students' decision to enroll in the summer term. For example, students who live within commuting distance of UC Merced may find it more convenient to enroll in summer compared to those who live farther away. Therefore, I compared enrollment rates based on this feature ("Local"). Similarly, non-resident students may be incentivized to enroll in summer by the summer fee model, which is based on California resident, or in-state tuition, and for that reason I compared enrollment rates based on this characteristic as well. Understanding summer participation across these variables was important to identify gaps in participation or if there were barriers to summer enrollment related to specific student characteristics.

I begin with a series of tables to display the descriptive statistics of the student demographic characteristics for the study variables using STATA as the system of analysis. The comparison of first-summer enrollment was repeated for all variables to demonstrate how summer enrollment was proportionately reflective of the matriculated student body. The academic variables are displayed to include the descriptive statistics (mean and standard deviation) of high school GPA, first year college GPA, compared by first-summer participation.

In order to understand whether enrollment rates are statistically different, I used t-tests to compare the students who enrolled in first-summer and those who did not. The first series of t-tests compared the Equitable Access students to their non-EA counterparts for both first-summer enrollment and first-summer non-enrollment. I did so to understand the degree to which summer enrollment participation has been equitable and representative of all students. I used the outcomes of the t-tests to inform which variables I considered as I conducted further analysis through questions two and three. To further explore the relationship between the variables and first-summer enrollment access, I provide tables demonstrating the correlations between first-summer enrollment, race, gender, geography, and school in the Appendix.

Question 2. How does first year academic success relate to first-summer enrollment? Do students enroll to catch up or to get ahead? Does it differ for Equitable Access group or STEM students?

Through my second research question I sought to understand how students' academic success in their first year of college may have related to their decision to enroll in Summer Session. I wanted to understand whether UC Merced students who experienced less academic success enrolled to catch up, whether students who experienced more academic success enrolled to get ahead, or whether these students enrolled for some other reason that cannot be explained entirely with quantitative data. To understand these patterns, I compared summer enrollment rates for four different groups of student academic success defined by first-year GPA and the number of units completed. The literature

demonstrates most colleges and universities encourage students to complete at least 30 semester units in the first year of college to be on track to complete their undergraduate degree in four years. Similarly, a 2.0 or greater GPA is identified by most institutions as a passing undergraduate GPA. I classified students into the following four Academic Success groups:

Group 1: students who completed fewer than 30 units with less than a 2.0 GPA.

Group 2: students who completed fewer than 30 units with a 2.0 GPA or greater.

Group 3: students who completed 30 units or more with less than a 2.0 GPA.

Group 4: students who completed 30 units or more with a 2.0 GPA or greater.

Students in Group 1 are students who experienced less success across both the GPA and units completed dimensions. Students in Groups 2 and 3 experienced success in one dimension, but not the other. Students in Group 4 experienced success in terms of units completed and GPA, and for the purposes of this study, their summer enrollment could not be directly associated with the need to catch up.

To understand if first-summer enrollment was proportionately representative of students across these groups, I identified the numbers and percent of Equitable Access Group students in the four Academic Success groups for the full dataset, irrespective of first-summer enrollment. I then considered how the Equitable Access groups were represented in the Academic Success groups broken down by first-summer enrollment or non-enrollment. After providing this context, I computed first-summer enrollment rates of each of these academic success groups. Importantly, I compared these different enrollment rates separately for the Equitable Access groups.

Based on the literature informing this question, I hypothesized students with lower first-year academic success and students from the Equitable Access groups, especially students with great financial need will have had lower participation rates during the first summer.

Question 3. To what extent is enrolling in academic units in the first summer related to four-year degree

completion rates for students at UC Merced? Is the relationship different for Pell-eligible, First-gen, URM, STEM students, and by Academic Success Group?

My third research question tested the first-summer construct of the Academic Momentum frame at UC Merced. I specifically tested whether first-summer enrollment was associated with four-year degree attainment, defined as graduating in four years. I hypothesized that first-summer enrollment would increase the probability of graduating in four years, while also considering the Equitable Access and Academic Success variables, Race, Gender and Geography variables, and STEM, represented by students graduating from the Schools of Natural Science and Engineering.

While my second research question was intended to provide insight into how first-year academic success may have influenced students' decision to enroll in summer term, this third research question helped me understand the extent to which first-summer enrollment was related to the probability of graduating in eight semesters for students, especially those in the Equity Access groups, STEM majors, and those who experienced lower levels of academic success in the first year. Does prior student enrollment and degree attainment data at UC Merced demonstrate support for the idea that summer term can be leveraged to contribute to improved equitable four-year graduation attainment rates? I addressed this question in two steps.

First, I compared the four-year graduation percentages for students by first summer enrollment and by the four Academic Success Groups[4]. I did this separately for students based on their Equitable Access classification as well as other breakdowns. I did this to demonstrate the gaps in four-year degree attainment and the magnitude of those gaps by the Equitable Access, STEM, and Academic Success variables. There is a high percentage of overlap (42%) among students who are first-gen, Pell-eligible, or URM, and I included a variable (Any EA) for students who were associated with any of the three

[4] Cohort year 2017 achieved the highest four-year graduation percentage to that point in time at UC Merced. Their first-summer was in 2018 well before the pandemic, and I do not treat their cohort differently from prior cohorts.

Equitable Access variables. I drew specific attention to two Academic Success situations. Group 1 students experienced less academic success in that they completed fewer than 30 units, their GPA was less than 2.0, and they may not have maintained SAP and remained eligible for federal or state financial aid. Group 2 students' GPA was at least 2.0 but they did not complete 30 units, while Group 3 completed 30 units, but their GPA was below 2.0. With this analysis, I sought to understand how first-summer enrollment related to both first-year academic success and graduating in four years for my populations of interest, students with less first-year academic success and who were Equitable Access. I conducted further analysis by STEM major status because of the important role UC Merced plays in the UC System providing access for EA students who wish to enroll in STEM majors.

As a practitioner, I wanted to understand how summer term can best serve students and potentially contribute to improved four-year degree attainment rates. However, the cost of summer enrollment at the University of California is an insurmountable barrier for many students, including students with high financial need as well as middle-income students. There are fewer sources of grant aid available for summer term, and eligible students are offered loans in addition to grant aid to cover their cost of attendance. However, students are less likely to borrow (Burdman, 2005), especially early in their academic careers to enroll in summer, when they do not yet feel the pressure of degree completion. (Liu, 2016)

There are additional factors that impact both graduation rates and the ability of a student to enroll in first-summer. The literature demonstrates a difference in summer enrollment across race, gender, distance from home, non-resident student status, discipline of study as well as the first-year college success variables. It was important to understand how the relationship between first-summer and four-year graduation was associated with these characteristics. It was also important to understand this relationship for Equitable Access students considering the Academic Success Groups and how students in STEM majors differ from their peers in the social sciences and humanities. To understand

how additional factors impact the relationship between first-summer enrollment and four-year graduation, I estimated the following regression model for all students in the sample:

$$\text{Grad4}_i = \beta_0 + \beta_1 \text{Summer}_i + \beta_2\text{First-gen}_i + \beta_3\text{Pell-eligible}_i + \beta_4\text{URM}_i + \beta_5\text{STEM}_i + \sum_{j=6}^{13} \beta_j \text{Race}_{ij} + \beta_{14}\text{Female}_i + \beta_{15}\text{Local}_i + \sum_{j=16}^{18} \beta_j \text{AcadSucGrp}_{ij} + e_i \quad (1)$$

I estimated a series of regressions leading to the full model presented in Equation 1. The dependent variable, Grad4_i, takes on the value of 1 if a student *i* graduated four years. The first model I estimated includes only Summer_i (capturing first-summer enrollment) as an independent variable. In this model, the coefficient represents the mean differences in graduation rates between students who attended first-summer relative to those who did not. Model 2 adds the three EA variables: First-gen_i, capturing first-generation status, Pell-eligible_i, capturing Pell grant use, and URM_i capturing whether students are members of URM groups. Model 3 adds STEM_i, the variable indicating whether students declared intentions for STEM majors at application, and Model 4 adds the Race_{ij}, Female_i, and Local_i variables, and I included eight dichotomous race variables, which capture differences relative to the omitted category of white students. Model 5 adds a series of indicators for whether students are in Academic Success Groups 1-3 (AcadSucGrp_i), with the Group 4 (most successful) category omitted. With the outcomes of these analyses, I demonstrated how differences in first-summer enrollment and graduation rates were related to a student's Equitable Access classification and STEM status, while controlling for other variables that were also related to graduation rates. To further understand the relationship between first summer and graduation rates, I also estimated the full model of four-year degree completion separately for Groups 1, 2, and 4. I excluded Group 3 from this analysis due to its small sample size (*n*. 65).

Chapter 5

FINDINGS AND DISCUSSION

In the following sections, I discuss first-summer enrollment along the demographic variables included in this study, how first-year academic success, especially of EA and STEM students relates to the four college success groups, and finally, the relationship between first-summer enrollment and four-year degree completion. I am most concerned with students who are first-generation, Pell-eligible, URM, and students who struggled academically in their first year of college. I am also interested in students in STEM majors, due to the strictly-structured course requirements of many STEM degrees that can contribute to lengthier degree completion averages.

I use student demographic characteristics to provide context for understanding first-summer participation by comparing the composition of students who did enroll in first-summer to that of the group of students who did not enroll. I focus my discussion on the characteristics in which the difference in summer participation was statistically significant. I then turn my focus to first-year college success, defined by GPA and cumulative units completed in the first year of college, how the EA and STEM students are distributed across the four Academic Success Groups, and finally, the percentages of EA and STEM students across these three academic success groups who did or did not enroll in first summer. I am most interested in students in Academic Success Group 1 because these students need to improve their GPA and accumulate more units, and in Academic Success Group 2 because these students need to accumulate more units in order to be on track to graduate in four years. I am also interested in STEM students because of their lengthier time-to-degree rates at UC Merced. Finally, I discuss the relationship between four year graduation, the first-year academic success and the EA and STEM groups. I contextualize these results in the overall four-year degree completion rates for the students in my study.

Student Demographic Characteristics by First-Summer Enrollment

My first research question identifies and describes the students who have enrolled in first summer and how they compare to their peers who do not enroll. Ultimately, I sought to understand if any groups of students are underrepresented in access to first-summer enrollment. Prior research demonstrates the demographics of students attending college has been evolving since the 1980's and that students from more diverse backgrounds, especially students from lower socioeconomic levels, are enrolling in college (Bowen et al., 2009). This trend is realized at UC Merced which serves a larger proportion of URM students than the UC system-wide average and in some cases, serves a larger share of underrepresented groups than the average state population for that group (*U.S. Census Bureau QuickFacts*, n.d.) For instance, 48.8% of UC Merced students identify as Hispanic, while individuals of Hispanic origin comprise 40.2% of the State population. The trend is similar for Asian students who make up 22.9% of the UC Merced population and 15.9% of the State population. Conversely, White students represent 12.5% of the UC Merced student population compared to 35.2% of the State population. Throughout this section, I compare the characteristics of students who attended first-summer to the characteristics of students who did not. For each characteristic, I conducted a t-test to determine if the composition of the summer school group is the same as the composition of the non-summer school group.

Equitable Access Variables

Considering the Equitable Access variables in Table 2, the differences in first-generation and URM status for first-summer participants and non-participants were statistically significant. URM students' percentage share of first-summer enrollment was 45.1%%, while the URM percentage share of students who did not enroll in first-summer was 56%, suggesting that URM students were under-represented within the group of first-summer enrollees. This difference was statistically significant at the less than one percent level ($t(13{,}743) = 8.68$, $p < 0.0000$). Following a similar trend, first-generation

students' percent share of first-summer enrollment was 63.7%, while their percent share of students who did not enroll in first-summer was 68%. This was statistically significant at the less than one percent level ($t(13,743) = 3.59$, $p < 0.0003$). This outcome indicates first-generation students were also underrepresented within the group of first-summer enrollees. The difference in Pell-eligible student participation was not found to be statistically significant, though the Pell-eligible share of participation in first-summer was slightly higher than the percent share of total enrollment and of students who did not enroll in first summer and students who were not Pell-eligible were slightly less likely to enroll. It is interesting that students with the greatest financial need did not demonstrate an enrollment disadvantage compared to their non-Pell-eligible peers. However, considering the combined Any EA variable, representing students who fell into any of the three EA variables, compared to the not-EA

Table 2

UC Merced Student Characteristics - Equitable Access by First Summer Enrollment

	Total	Total	Not Enrolled		Enrolled			
	n	%	*n*	%	*n*	%	*t*	*P*
First-Generation	9,266	67.4%	8,121	68.0%	1,145	63.7%	3.59	0.00
Pell-Eligible	8,594	62.5%	7,443	62.3%	1,151	64.1%	-1.43	0.15
URM	7,506	54.6%	6,695	56.0%	811	45.1%	8.68	0.00
Any EA	11,513	83.8%	10,053	84.1%	1,460	81.2%	3.10	0.00
Total Students	13,745		11,948		1,797			

Note. Equitable Access is a term I use in this study to include students who are first-generation, Pell-eligible and/or Underrepresented Minority (URM).

(control) group, students in the Any EA group are less likely to enroll in first summer than their not-EA peers. This outcome was statistically significant at the less than one percent level.

The trend for Pell-eligible vs. non-Pell-eligible students is worth noting as it opens an avenue for research into the relationship between Expected Family Contribution (EFC) or family income and summer enrollment. Expected Family Contribution is a calculation used by the Federal Government to determine a student's eligibility for financial aid and what share of the full cost of attendance the parents or family are supposed to contribute to a student's college expenses (*What Is My Expected*

Family Contribution (EFC)? | Federal Student Aid, n.d.). Students who are Pell-eligible have the lowest levels of EFC and therefore receive the largest awards of Federal and State grant aid. However, the range of family income for students who are not Pell-eligible is large and grouping all students who are not Pell-eligible into a single group does not provide a complete interpretation of financial access to summer enrollment for these students.

Race

Though URM students as a group were demonstrated to be underrepresented in first-summer enrollment, enrollment representation across the individual race groups with which students identify was more complex, as demonstrated in Table 3. Asian students' percent share of first-summer enrollment was 35.3%, compared to 21.1% of their non-enrolling peers, and their overall percentage (22.9%). The difference in Asian students' representation in first-summer enrollment compared to the non-enrollment group was statistically significant at the less than one percent level ($t(13{,}743) = -13.47$, $p < 0.00$), indicating Asian students' enrollment share in first-summer was significantly higher than their peers. The opposite enrollment pattern was found for Hispanic students, which were the largest race

Table 3

UC Merced Student Demographic Characteristics - Race by First-Summer Enrollment

	Total	Total	Not Enrolled		Enrolled			
	n	%	*n*	%	*n*	%	*t*	*P*
African American/Black	745	5.4%	662	5.5%	83	4.6%	1.61	0.11
Native American	30	0.2%	24	0.2%	6	0.3%	-1.13	0.26
Asian	3,156	22.9%	2,521	21.1%	635	35.3%	-13.47	0.00
Hispanic	6,731	48.8%	6,009	50.3%	722	40.2%	8.02	0.00
International	683	5.0%	641	5.4%	42	2.3%	5.51	0.00
Pacific Islander	475	3.4%	411	3.4%	64	3.6%	-0.26	0.79
2 or More Races	94	0.7%	79	0.7%	15	0.8%	-0.83	0.41
Other/Decline to State	146	1.1%	117	1.0%	29	1.6%	-2.45	0.01
White	1,685	12.2%	1,484	12.4%	201	11.2%	1.49	0.14
Total Students	13,745		11,948		1,797			

Note. International includes students who hold a student, exchange, visitor, or diplomatic visa.

group by percentage (48.8%) in the study. Only 40.2% of students enrolled in first-summer identified as Hispanic, compared to 50.3% of their non-enrolling peers. This ten percentage point difference was statistically significant at the less than one percent level (t(13,743) = 8.02, p < 0.00), indicating Hispanic students were less likely to enroll in first-summer. The lower participation rate amongst Hispanic students in this study should be explored in future studies through qualitative means to gain a deeper understanding into the experience of these students.

Two other race groups that were small in number, but for which the first summer share of enrollment was statistically different were international students (*n.* 683), who were underrepresented among first-summer enrollees while students who identified their race as "other" or "declined to state" (*n.* 146), were overrepresented among first-summer enrollees. Finally, African American students (*n.* 745) made up a smaller share of first-summer enrollment relative to their representation among the non-enrolling students, but the difference was just outside of the cut-off for significance at (t(13,743) = 1.61, p 0.11).

Gender and Geography

First-summer participation did not differ statistically based on the gender variables, though the percentage share of female and Other/Decline to state students who enrolled in first summer were slightly larger than the percentage share of their peers of the same groups who did not, while the male percentage share was slightly lower.

Conversely, there were differences in first-summer enrollment based on geography variables (Table 4). The first-summer group had higher shares of both California residents and local students. The first-summer enrollment group was comprised of 98% residents, while non-enrollees contained only 95.6% residents. This difference was statistically significant at the less than one percent level (t(13,743) = -4.75, p < 0.00). While this is not necessarily surprising, the low non-resident participation rate is particularly interesting because non-resident students pay additional out of state tuition during the

regular academic year but do not pay a higher rate to enroll in Summer Session, and it is noteworthy that discounted tuition did not yield increased enrollment for non-resident students, at least not in first-summer.

Table 4

UC Merced Student Demographic Characteristics - Gender & Geography by First-Summer Enrollment

	Total	Total	Not Enrolled		Enrolled			
	n	%	*n*	%	*n*	%	*t*	*P*
Male	6,509	47.4%	5,669	47.4%	840	46.7%	0.56	0.58
Female	7,170	52.2%	6,224	52.1%	946	52.6%	-0.44	0.66
Other/Decline	66	0.5%	55	0.5%	11	0.6%	-0.87	0.39
Resident*	13,186	95.9%	11,425	95.6%	1,761	98.0%	-4.75	0.00
Not-Resident	559	4.1%	523	4.4%	36	2.0%	4.75	0.00
Local**	2,542	18.5%	1,973	16.5%	569	31.7%	-15.56	0.00
Not Local	11,203	81.5%	9,975	83.5%	1,228	68.3%	15.56	0.00
Total Students	13,745		11,948		1,797			

Note. ** Local represents a home address within one hour commuting distance to UC Merced.
* Resident includes students with legal permanent residence in California as defined by UC.

Students in the Local group (i.e., those from Merced, Stanislaus, Madera, or Mariposa Counties as well as those from cities of Fresno and Clovis), were over-represented in first-summer enrollment as opposed to their non-local peers, who were underrepresented. Local students comprised 31.7% of first-summer enrollees, while they only accounted for 18.5% of students in this study. The Local student participation in first-summer was statistically significant at the less than one percent level ($t(13{,}743) = -15.56$, $p < 0.00$). This demonstrates that proximity of the permanent address to campus was associated with a student's participation in first-summer and that convenience may be important. It is important to note that students take courses in the summer at other institutions. However, institutional research at UC Merced found that students who enrolled in summer courses at UC Merced had higher degree completion rates than their peers who took college courses elsewhere (Chatman, 2016), as such, I focus this study on students enrolled in first-summer at UC Merced.

As a practitioner at this institution, I know summer coursework was offered in-person until the summer of 2020 when the global pandemic shifted much of higher education to remote learning methods. Students in this study who are from families that expected them to come home in the summer did not have access to UC Merced courses and could not enroll and also meet their family obligations unless their home address was within commuting distance, and they had access to transportation. Likewise, students with limited financial resources may have found the cost of living away from home in the summer a barrier to summer enrollment. It is also possible the institution did not offer courses the students needed during the summer term.

School and STEM Association

Students' school of admission, as an indicator of student major and STEM association, demonstrated interesting trends of first-summer enrollment (Table 5). Students from the School of Natural Sciences (SNS), who were STEM majors, represented 44.6% of the share of first-summer enrollment compared to 30.8% share of students who did not enroll. This difference was statistically significant at the less than one percent level ($t(13{,}743) = -11.65$, $p < 0.00$). Students from the School of Social Sciences, Humanities & Arts (SSHA) percent share of first summer enrollment was 18.1%, lower than the share of students who did not enroll, which was 27.7%; this difference was statistically

Table 5

UC Merced Student Demographic Characteristics - School by First Summer Enrollment

	Total	Total	Not Enrolled		Enrolled			
	n	%	*n*	%	*n*	%	*t*	*P*
Undeclared	2,472	18.0%	2,218	18.6%	254	14.1%	4.56	0.00
Engineering*	3,154	22.9%	2,738	22.9%	416	23.1%	-0.22	0.83
Natural Sciences*	4,483	32.6%	3,682	30.8%	801	44.6%	-11.65	0.00
SSHA	3,636	26.5%	3,310	27.7%	326	18.1%	8.59	0.00
Total Students	13,745		11,948		1,797			

Note. UC Merced is made up of three schools. School is used to identify a STEM or non-STEM major. SSHA is the acronym for the School of Social Sciences, Humanities & Arts.
* For this study STEM students are from the schools of Engineering and Natural Sciences.

significant at the less than one percent level. Similarly, Undeclared students' share of first summer enrollment was 14.1%, compared to 18.6% share of students who did not enroll. This difference was statistically significant at the less than one percent level. The only School without a statistically significant difference in representation in the summer enrollment and non-summer enrollment groups was the School of Engineering (SOE), also representing STEM majors. This is noteworthy considering the School of Engineering has the lowest four-year degree completion rates at UC Merced.

As a practitioner with knowledge of the local context, it is important for me to note a share of early summer participation on the part of students from SNS may have been related to a student demand barrier related to laboratory classroom availability for general chemistry. This pushed unmet demand to the summer term until that barrier was resolved in summer 2015, which I address through regression estimates and discussion later in this study.

Academics

The final group of student characteristics I considered was academic in nature and included high school GPA, first year college cumulative units, and first year college cumulative GPA. As a practitioner in the summer academic space, I am regularly confronted with the perception that students enroll in summer term only if they have failed or are behind. This was clearly not the case, as Table 6 demonstrates.

Table 6

UC Merced Student Demographic Characteristics - Academic by First Summer Enrollment

	Total	Total	Not Enrolled		Enrolled			
	M	SD	M	SD	M	SD	*t*	*P*
High School GPA	3.51	0.31	3.5	0.31	3.54	0.33	-3.84	0.00
First-Year College GPA	2.71	0.64	2.7	0.65	2.82	0.57	-7.79	0.00
First-Year College Units	24.68	7.13	24.63	7.1	24.96	7.31	-1.82	0.07
Total Students	13,745		11,948		1,797			

Note. GPA is grade point average. High School GPA is the GPA as calculated by UC for admission. First-year College Units and GPA are cumulative of the first fall and spring semesters.

In fact, the average high school and first-year college GPAs for students enrolled in first-summer were higher than their peers who did not enroll, and both differences were statistically significant at the less than one percent level. Additionally, the average first-year college cumulative units were higher for students who enrolled in first-summer, though just at the seven percent level of significance. Together, these findings provide a strong argument in support of the Educational Interface model of student persistence, as they suggest an association between feeling prepared for the task at hand and enrolling in summer term early in a student's college academic career. Even though unit accumulation did not meet the threshold for significance, it is possible that unit accumulation was less important than GPA to students in terms of evaluating their personal feelings of academic success. I address this idea later in this study.

In sum, the results of research question one suggests that students who were Local, Asian, or from the School of Natural Sciences were overrepresented in first-summer enrollment, while students who were first-generation, Hispanic, Undeclared, or Social Sciences, Humanities & Arts (SSHA) were underrepresented. Additionally, students who enrolled in first-summer, on average, had a higher first-year college GPAs than those who did not enroll. Perhaps the most interesting outcome is that of School of Engineering students. While Engineering students had the lowest four-year degree completion rate (31%), their first-summer enrollment was only representative of their population, leading me question what their degree completion rates might have been if more Engineering students had enrolled in first-summer.

First-Year Academic Success

My second research question focused on the relationship between first-year academic success and first-summer enrollment. Did students at UC Merced enroll in first-summer because they needed to catch up (improve their GPA or accumulate more units), or were they on track and enrolled for some other reason? In order to address the first aspect of this question, I constructed four groupings of first-

year academic success using the cumulative GPA of 2.0 and 30 academic units. I used the GPA level of 2.0 because most degree programs at UC Merced require at least a 2.0 minimum GPA in major requirements in order to graduate. I used the cumulative unit level of 30 units because most degrees at UC Merced are 120 units, and students need to complete 30 units per year to accumulate 120 units and graduate in four years (*Units Each Semester & Each Year | Bobcat Advising Center*, n.d.).

Table 7 shows the number and percentage of students associated with each of the four Academic Success groups. The bolding is used to identify success levels of concern for the purposes of this study, that is groups with fewer than 30 units and/or less than a 2.0 cumulative first-year GPA.

Table 7

Description of Academic Success Groups 1-4

Groups	*n*	%	First-Year Units Completed	First-Year Cumulative GPA
Group 1	1,695	12.33%	**Fewer than 30 Units**	**Less than 2.0 GPA**
Group 2	7,977	58.04%	**Fewer than 30 Units**	2.0 or higher GPA
Group 3	65	0.47%	30 or more Units	**Less than 2.0 GPA**
Group 4	4,008	29.16%	30 or more Units	2.0 or higher GPA

Note. n. is 13,475.
Bold text identifies Groups with lower first-year academic success who are the focus of this study.

I call attention to the fact that 70.4% of the students in this study accumulated fewer than 30 units in their first year, though it is encouraging that 87.2% earned at least a 2.0 cumulative GPA. Most noticeably, there were only 65 students out of 13,745 who accumulated at least 30 units with less than a 2.0 GPA. This caused me to question using 30 units as a standard of success, given that the average number of units completed in the first year was 24.68 (*SD* 7.13), and consider if 24 units was a more appropriate number. A student who receives federal or state financial aid must maintain SAP, defined at UC Merced as a 2.0 GPA and full-time enrollment of 12 units per semester, averaged over an academic year, which totals 24 units. Since the majority of students receive at least some financial aid, it is possible that students focus on SAP as their standard of a successful year. However, accumulating only 24 units per year increases time to degree into the fifth year, and so I maintain 30 units to define first-

year college success for the purposes of this study. However, it is important to note that a student's idea of success and an institution's idea of success may be different.

Next, I identify how the populations of interest, including Equitable Access (EA) students and students in STEM majors, were associated with the four Academic Success groups. I begin by displaying the number and percentage of total students in the study, in various EA and STEM groupings, to provide a benchmark (see Table 8 columns under "Total Students"). I intentionally include multiple combinations of the EA variables to represent various intersecting identities and decrease the likelihood that the analysis will fail to identify a group that may benefit from specific consideration.

The first row of data in Table 8 shows the number and percentages of students in each of the four Academic Success groups. Then, for each EA/STEM student group, Table 8 shows the number and percentage of those students in the four Academic Success groups (For each student group, the percentages in the Group 1 through Group 4 columns should sum to 100.).

I call attention to the overall percent of students (70.8%) in Groups 1-3 who experienced less academic success across GPA and/or unit accumulation. All but the 65 students in Group 3 accumulated too few units to reach sophomore standing at the beginning of their second year without earning additional units in the summer. Overall, 12.3% of students were in Academic Success Group 1, however only 6.7% of students with no EA characteristic are in Group 1, whereas 13.4% of students with Any EA characteristic are in Group 1. There are not large differences in Group 1 classification based on the specific EA category, but students with all three EA characteristics were most overrepresented in Group 1: 16.2% of students with all EA were in Group 1.

Group 2 students represent 58% of the students in the study. In this Group 2, the differences between non-EA students and those with some EA characteristics are small. Whereas 58.2% of non-EA students were in Group 2, only 57.7% of those with all three EA were in this group. As with Group 1, there are not large differences in being in Group 2 based on the specific EA category and all of

Table 8

Equitable Access and STEM Students in Academic Success Groups 1-4

Group (Units, GPA)	Total Students	Group 1 (<30, <2.0)		Group 2 (<30, ≥2.0)		Group 3 (≥30, <2.0)		Group 4 (≥30, ≥2.0)	
	n	*n*	%	*n*	%	*n*	%	*n*	%
All Students	13,745	1,695	12.3%	7,977	58.0%	65	0.5%	4,008	29.2%
Control (not EA)	2,232	150	6.7%	1,299	58.2%	8	0.4%	775	34.7%
Any EA	11,513	1,545	13.4%	6,678	58.0%	57	0.5%	3,233	28.1%
All 3 EA	5,294	855	16.2%	3,055	57.7%	36	0.7%	1,348	25.5%
First Gen	9,266	1,322	14.3%	5,391	58.2%	48	0.5%	2,505	27.0%
Pell	8,594	1,216	14.1%	4,959	57.7%	48	0.6%	2,371	27.6%
URM	7,506	1,116	14.9%	4,361	58.1%	45	0.6%	1,984	26.4%
1G+Pell	7,058	1,058	15.0%	4,096	58.0%	40	0.6%	1,864	26.4%
Pell+URM	5,903	937	15.9%	3,405	57.7%	40	0.7%	1,521	25.8%
1G+URM	6,186	969	15.7%	3,587	58.0%	40	0.6%	1,590	25.7%
Admit STEM	7,637	964	12.6%	4,730	61.9%	34	0.4%	1,909	25.0%

Note. N. is 13745. EA represents Equitable Access. Pell represents Pell eligible at admission, URM is underrepresented minority, 1G is First Generation. Admit STEM are admitted to STEM majors.

the EA characteristic groupings are clustered near the average. Though Group 2 students have accumulated fewer than 30 units, it is possible these students viewed their first year as successful as they remained in good standing for financial aid with at least a 2.0 GPA, provided they earned at least 24 cumulative units. Group 3 trends were similar to that of Group 2, though the group is too small to contribute to this analysis in a meaningful way.

While EA students were overrepresented in Group 1, they were underrepresented in Group 4. Whereas 34.7% of non-EA students were in Group 4, only 28.1% of students with any EA characteristic and 25.5% of students with all three EA characteristics were in this group.

Finally, I consider STEM students. For STEM students, 12.6% were in Group 1, just slightly higher than the representation of all students (12.3%). However, nearly 62% of STEM students were in Group 2,

which is the highest representation of any of the subgroups in Group 2. Conversely, STEM students share of Group 4 was the lowest of the student characteristic groups in Group 4. One possible reason for STEM students to be over-represented in Group 2 (with fewer than 30 cumulated first-year units) and over-represented in Group 4 is STEM students may have been advised or decided on their own to enroll in fewer units in their first year. This may be due to the accepted understanding that STEM courses are challenging for some students, and STEM students may benefit from taking a lighter load in their first year to focus on success in difficult courses.

I looked at the overlap of STEM with URM and All EA because those two student characteristics were associated with overrepresentation in Group 1 and underrepresentation in Group 4. I found that students who were both STEM and URM were slightly overrepresented in Groups 1 and 2 and underrepresented in Group 4. This is not surprising if it is true that STEM students were more likely to enroll in fewer units in their first year, as their percentage representation in Group 2 may infer, and if the curriculum is challenging, which their percentage representation in Groups 1 and 2 may infer[5]. The outcomes of these analyses demonstrate the importance of understanding and exploring the unique struggles and success of intersecting groups and identities within an institution's local context when using quantitative data (López et al., 2018).

First-Year Academic Success Relationship to First-Summer Enrollment

The second part of research question two addressed how first-summer enrollment trends of EA and STEM students varied across the four Academic Success Groups. Academic Momentum research demonstrates that how students begin college is important, and a strong start is associated with eventual degree completion (Adelman, 2006; Attewell et al., 2012). We now understand the majority of students in this study had a strong start in that they enrolled full time (using 12 units per term which is the lower bound for full-time status) and 87.2% of them had at least a 2.0 GPA by the end of their first

[5] I explore STEM and First-year Academic Success through regression later in this study.

year. But what was the association between academic success and first-summer enrollment? The Educational Interface model posits that students must feel self-efficacious and ready for the task at hand if they are to persist (Kahu & Nelson, 2018), suggesting students who were successful in their first year should have been more likely to feel up to the challenge of enrolling in first-summer. For the students in this study, the first-summer enrollment rates support predictions of engagement in the Educational Interface. Group 1 students, those who experienced less success in the first year, were the least likely to enroll in first-summer. Only 7.1% of these students enrolled in summer. Students in Groups 2 and 4 were nearly twice as likely to enroll in first summer (Table 9).

Table 9

Comparison of EA Students in Academic Groups 1-4 by Summer Enrollment

Group (Units, GPA)	total	Group 1 (<30, <2.0)		Group 2 (<30, ≥2.0)		Group 4 (≥30, ≥2.0)	
	n	S1 Yes	S1 No	S1 Yes	S1 No	S1 Yes	S1 No
All Students	13,475	7.1%	92.9%	14.1%	85.9%	13.6%	86.4%
Control (not EA)	2,232	11.3%	88.7%	16.5%	83.5%	13.5%	86.5%
Any EA	11,513	6.7%	93.3%	13.6%	86.4%	13.6%	86.4%
All 3 EA	5,294	5.4%	94.6%	11.8%	88.2%	13.1%	86.9%
First Gen	9,266	5.8%	94.2%	13.4%	86.6%	13.5%	86.5%
Pell	8,594	6.7%	93.3%	14.3%	85.7%	15.1%	84.9%
URM	7,506	5.8%	94.2%	11.4%	88.6%	12.4%	87.6%
1G+Pell	7,058	6.1%	93.9%	14.2%	85.8%	15.0%	85.0%
Pell+URM	5,903	5.4%	94.6%	11.5%	88.5%	13.1%	86.9%
1G+URM	6,186	5.1%	94.9%	11.3%	88.7%	12.5%	87.5%
Admit STEM	7,637	8.8%	91.2%	16.7%	83.3%	17.5%	82.5%

Note. n is 13745. EA represents Equitable Access. Pell represents Pell eligible at admission, URM is underrepresented minority, 1G is First Generation.
Admit STEM are students admitted to STEM majors.
S1 Yes attended first-summer, S1 No did not.
Group 3 was omitted because the numbers are too small to yield meaningful results.

Within Group 1, the highest percentage of first-summer enrollment was found in students who were from the control group (11.3%) and students who were admitted to STEM majors (8.8%) while the

average participation rate for this group was 7.1%. Conversely, all EA characteristics were associated with lower first-summer enrollment, with Any EA and Pell-eligible students being the closest to average enrollment at 6.7%, each.

Group 2 students were, in most cases, approximately twice as likely as Group 1 students to enroll in first-summer. This is as predicted by the theory of student engagement in the Educational Interface because they were more successful in terms of GPA and may have felt more prepared to enroll in summer term. A slightly different pattern emerged among the EA characteristics in Group 2. The lowest enrollment percentage was by students who were both First-Gen and URM (11.3%) while students with all three EA characteristics enrollment percentage was 11.8%, both under the average (14.1%). Of the EA characteristics, only Pell-eligibility was associated with higher than average enrollment share. Following a similar pattern to Group 1, STEM students in Group 2 were more likely to be enrolled in first-summer.

Group 4 students experienced the greatest levels of academic success in their first year of college. These students stood out from their Group 2 peers in that they completed at least 30 units and were on track to complete the 120 units needed to graduate in four years based on their first-year unit accumulation. They were, overall, slightly less likely to have enrolled in first-summer (13.6%) than their Group 2 peers (14.1%), perhaps due to their comprehensive first-year success in both GPA and unit accumulation. In this Group, the URM students had the lowest percentage of summer enrollment (12.4%), followed by the combined URM and First-gen variable (12.5%). The STEM group continued to enroll in the greatest percentage, with 17.5% of Group 4 STEM students enrolled in first-summer. This seems to indicate that STEM students were somehow more aware that their degree progress would benefit from early summer enrollment, though that association could be made more definitive through a qualitative study.

Overall, the Educational Interface successfully predicted which students were more likely to enroll in first-summer, though it is important to note students' definition of academic success may prioritize GPA and SAP over completing 30 units, while an institutional definition of a successful first year may include a larger unit-accumulation standard. Those students who experienced more academic success in their first year in terms of GPA were more likely to enroll. Students who were less successful in terms of GPA were less likely to enroll, suggesting the importance of self-efficacy and feeling prepared for the task at hand for engagement and persistence to happen in the Educational Interface. URM students were some of the least likely to enroll across all four Academic Success Groups and were often associated with a lower percentage of enrollment in intersecting EA groups. Prior to the COVID Pandemic, UC Merced offered only one or two fully online/remote courses in the summer, which made it impossible for non-local students to go home and also enroll in UC Merced Summer Session. Finally, STEM students across every Academic Success Group were the most likely to enroll in first-summer, which is not necessarily unusual given the highly structured nature of STEM majors.

First-Summer Enrollment Four-Year Degree Completion

My third research question tested the hypothesis that first-summer enrollment would be associated with an increased probability a student would graduate in four years. To do this, I reported four-year graduation rates for students by whether they attended first-summer and their Academic Success group. I used regression analysis to further control for additional variables related to summer enrollment and also potentially related to four-year graduate rates, for example, race, gender, geography, and STEM.

The four-year graduation rate for the students in this study was 48.2%. This is higher than UC Merced's reported four-year graduation rates, likely because the study data excludes students who did not have cumulative first-year GPA and units which are more likely to be associated with longer time-to-degree. Guided by the relationship between first-year academic success and first-summer enrollment

that has been identified and explained, I explored the relationship between first-summer enrollment and four-year degree completion, considering the EA groups, four Academic Success Groups, and STEM, as identified in Table 10.

Table 10

Four Year Graduation Percentages by Academic Success Groups 1, 2, and 4

Group (Units, GPA)	Group 1 (<30, <2.0)		Group 2 (<30, ≥2.0)		Group 4 (≥30, ≥2.0)		All Students All Groups	
	S1N	S1Y	S1N	S1Y	S1N	S1Y	S1N	S1Y
All Students	10.4%	24.8%	45.1%	46.3%	59.6%	64.8%	44.6%	50.4%
Control	9.0%	47.1%	43.7%	53.7%	55.7%	65.7%	45.3%	57.0%
Any EA	10.5%	21.2%	45.3%	44.6%	60.6%	64.6%	44.5%	48.8%
All 3 EA	10.6%	19.6%	45.9%	43.7%	61.1%	62.1%	43.4%	47.2%
First Gen	10.5%	23.4%	46.2%	45.6%	61.4%	64.9%	44.6%	49.6%
Pell	10.2%	21.0%	45.1%	44.6%	60.3%	63.9%	43.8%	48.7%
URM	10.8%	18.5%	45.0%	42.9%	60.5%	63.8%	43.5%	47.1%
1G+Pell	10.2%	23.1%	45.9%	46.3%	61.3%	64.5%	43.9%	49.9%
Pell+URM	10.6%	17.6%	45.5%	42.8%	60.9%	61.5%	43.3%	46.4%
1G+URM	11.0%	20.4%	45.6%	42.9%	60.6%	63.8%	43.5%	47.3%
Admit STEM	9.2%	20.0%	37.5%	42.2%	51.1%	59.1%	36.8%	45.1%

Note. Four-year graduation rate is 45.35%. S1N did not enroll in first-summer, S1Y did enroll.
Control are students who are NOT from any EA group. 1G is First-Gen.
EA is Equitable Access: First-Generation, Pell-eligible, Underrepresented Minority.
Admit STEM are students who were admitted to STEM majors/schools.
Group 3 is omitted because there are only eight students enrolled in first-summer.

I entered this study most interested in the relationship between first-summer enrollment and four-year degree completion for students in Academic Success Groups 1-3, and STEM students because of the time-to-degree rates associated with first-year GPA and credit accumulation, and for students in STEM majors. Students in Group 1 who attended summer school were over twice as likely to graduate in four years compared to their Group 1 counterparts who did not attend first-summer (24.8% versus 10.4%). This general trend held for Group 1 students who were First-gen and Pell-eligible, and to a lesser

extent for URM students. The graduation rate gap was substantially larger for the control group that had no EA status. Though the numbers behind the percentages were smaller than Groups 2 and 4, the percent increase in four-year degree attainment is important in terms of understanding the behaviors of students who persist and graduate, especially those who did so as outliers in the Educational Interface. Future qualitative study might explore what it is about these students who struggled academically in their first year that also enabled them to be engaged in first-summer enrollment, persist, and graduate in four years.

Group 2 was by far the largest group with 7,977 students. While the institution may be concerned about their degree progress because they had accumulated fewer than 30 units, the students may have considered their first year a success because they had a 2.0 GPA or better and remained eligible for financial aid (if they completed at least 24 units). For this group of students, four-year graduation rates were similar regardless of first-summer attendance: 45.1% of Group 2 students who did not attend summer school graduated in four years, whereas 46.3% of their counterparts who attended first-summer graduated. The differences were more apparent across the EA variable associations, where in all but one case (First-gen + Pell-Eligible), first-summer enrollment was not associated with a higher percentage of four-year degree attainment. This demonstrates that for the majority of Group 2 EA students, first-summer enrollment did not appear to be associated with an increased probability of four-year degree attainment.

The differences in Group 2 graduation based on first-summer enrollment were more notable for the STEM classification, where first-summer was associated with a five percentage point higher graduation rate. It is important to note that through summer 2014 there was a throughput issue related to first-semester general chemistry, a course required by all STEM majors. The issue was resolved in academic year 2014/2015, which decreased enrollment demand by first-year students in summer 2015. The data used for this study did not include specific course enrollment information and it was not

possible to determine the impact of a specific course (first-semester general chemistry) on first-summer enrollment or four-year degree attainment; however, the large participation in first-summer enrollment (Table 5) by School of Natural Sciences students was important to consider further. I begin to address this through regression in the appendices to this study.

Finally, Group 2 students included UC Merced's "murky middle" (*The Murky Middle Project | EAB*, 2015), that is students in the 2.0 – 3.0 GPA range who did well enough to be missed by interventions intended to help students who are struggling academically, but did not excel to the point that they might have been noticed for opportunities or recognition that can be provided to higher-achieving students. This is important to understand in the institutional context as it provides an opportunity for the institution to improve how it supports students on their educational journey.

Group 4 students who enrolled in first-summer demonstrated increased probability of graduating in four years across the EA and STEM variables. Overall, students who participated in first-summer were 5.8 percentage points more likely to graduate in four years compared to their peers who did not enroll. The graduation rate advantage for first-summer ranged from 3.6 percentage points to 8.3 percentage points, depending on the EA and STEM classification.

Regression Models

The prior analysis demonstrated that first-summer participation seemed potentially beneficial for many students, and especially so for the Group 1 students. This section explores this association further using regression analysis to simultaneously control for the many factors related to first-summer participation and four-year graduation rates. I estimated a series of regressions leading to the full model specified in Equation 1. The dependent variable in each model is Grad4, which indicates whether the student graduated in four years. The first model includes first-summer only, and I sequentially added variables. Table 11 contains the results of these five models.

In Models 1-5 of Table 11, first-summer was statistically significant at the less than one percent level. Model 1 demonstrated a 5.8 percentage point increase in four-year degree completion associated with first-summer enrollment (i.e., the "all students" column of Table 10 shows this gap). When controlling for the EA variables in Model 2 first-summer remained positive and statistically significant, and associated with an increased likelihood of four-year graduation, though the magnitude of the coefficient decreased slightly. However, it is important to consider the individual EA variables. Only First-generation demonstrated a positive association in this model, statistically significant at the less than 10% level, while both Pell-eligible and URM status had negative and statistically significant associations.

The addition of the STEM variable in Model 3 is related to overall lower four-year graduation rates; however, controlling for STEM increased the magnitude of the coefficient on the first-summer variable, increasing the likelihood of four-year graduation by 7.8 percentage points. Pell-eligible and URM status coefficients remained negative and statistically significant at the less than one percent level.

These are especially important findings in terms of research question 3 which specifically questioned the relationship between first-summer enrollment and four-year degree attainment for EA and STEM students.

Model 4 builds on Model 3 variables and incorporates the individual race variables (instead of the single URM variable), omitting White. Additionally, it includes Female, omitting Male and Other, representing gender variables, and Local representing geography. This model demonstrated a 7.2 percentage point statistically significant increase in the likelihood of four-year degree completion associated with first-summer enrollment. This model also demonstrated the association for the specific race groups and deepens the understanding of the relationship for URM groups. Both African American/Black and Hispanic variables had negative and statistically significant coefficients.

Table 11

Four-Year Graduation Rates on First-Summer Enrollment for All Students, Models 1-5

	Model 1	Model 2	Model 3	Model 4	Model 5
Enrolled, First-Summer	0.058***	0.056***	0.078***	0.072***	0.049***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)
First-generation		0.018*	0.011	0.001	0.018*
		(0.010)	(0.010)	(0.011)	(0.010)
Pell-eligible		-0.021**	-0.027***	-0.035***	-0.023**
		(0.010)	(0.010)	(0.010)	(0.010)
Underrepresented Minority		-0.027***	-0.038***		
		(0.009)	(0.009)		
Admitted to STEM			-0.171***	-0.149***	-0.130***
			(0.008)	(0.009)	(0.008)
African American/Black				-0.072***	-0.041**
				(0.022)	(0.021)
Native American				-0.089	-0.102
				(0.087)	(0.085)
Asian				0.016	0.019
				(0.015)	(0.015)
Hispanic				-0.037***	-0.014
				(0.014)	(0.014)
International				-0.010	0.012
				(0.023)	(0.023)
Pacific Islander				-0.049*	-0.042*
				(0.025)	(0.024)
Two or More Race				0.052	0.067
				(0.051)	(0.050)
Other Race				-0.001	0.009
				(0.043)	(0.039)
Female				0.128***	0.121***
				(0.009)	(0.008)
Local				-0.005	0.000
				(0.011)	(0.010)
Academic Success Group 1					-0.467***
					(0.011)
Academic Success Group 2					-0.135***
					(0.009)
Academic Success Group 3					-0.410***
					(0.047)
Constant	0.446***	0.462***	0.569***	0.503***	0.601***
	(0.005)	(0.009)	(0.010)	(0.015)	(0.015)
Observations	13,745	13,745	13,745	13,745	13,745
R^2	0.002	0.003	0.032	0.048	0.124

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Conversely, Female was associated with a positive and statistically significant coefficient.

Model 5 includes Academic Success Groups 1-3, with Group 4 as the omitted category. Even in this model with multiple controls, first-summer was associated with a 4.9 percentage points higher likelihood of graduating in four years. The coefficients on Groups 1-3 were statistically significant at the less than one percent level, and all three were associated with a decrease in likelihood of graduating in four years relative to Group 4 students. The decrease was considerably larger for students in Groups 1 and 3, which include students with less than a 2.0 cumulative GPA for their first year of college. On average, students in Group 1 had a graduation rate 47 percentage points lower than those in Group 4, holding all else equal. First-gen status was statistically significant at the less than ten percent level, as it was in Model 2. Pell-eligibility was statistically significant and negatively associated with four-year degree attainment where it appears in Models 2-5. The STEM variable was also negative and significantly associated where it is included in Models 3-5. Conversely, female was positively associated with four-year degree attainment where it was included in Models 4 and 5 and was significant at the less than one percent level.

Model 5 demonstrates a significant and negative association between four-year degree completion and Academic Success Groups 1-3. These students struggled across some aspect(s) of academic success in their first year and it is important to understand the association of the variables, especially first-summer to four-year degree completion for the individual groups. It is important to note that the addition of the Academic Success Groups 1-3 was associated with a decrease in the magnitude of negative association for the African American/Black and Hispanic group variables, with the Hispanic variable no longer associated with a meaningful result and African American/Black students' likelihood of four-year degree completion increased from -7.2 percentage points to -4.1 percentage points, statistically significant at the less than five percent level.

The next series of models of four-year degree completion consider the relationships separately for Groups 1, 2, and 4, and including the individual race variables rather than URM (Table 12). Given the small sample size of Group 3, I did not conduct a separate regression for those students. When estimating models separately by Academic Success Group, first-summer was significantly related to four-year graduation for Group 1 and Group 4 students, but not Group 2 students (I explore Group 2 further in Appendix B). This mirrors the trends in Table 10, but while controlling for a variety of factors and computing statistical significance. For Group 1 students, first-summer was related to a 14.8 percentage point higher four-year graduation rate. For Group 4 students, the difference was smaller at 7.2 percentage points. For evidence that the differences between these percentages was significant at the less than 10% level, see Appendix B, Table B.1.

Considering individual variables in Models 6-8, Female was the only statistically significant variable across all three groups; it was associated with an increased likelihood of four-year graduation, ranging from 7.7 percentage points for Group 1 to 13.4 percentage points for Group 2. For all models, the coefficient for Female was significant at the less than one percent level. Of the EA variables, Pell-eligible was statistically significant at the less than five percent level in Group 2, but not in Groups 1 or 4, and First-generation was not statistically significant in any of the models.

In Models 6 and 8, considering the race variables associated with URM status, neither African-American/Black, nor Hispanic demonstrated a significant outcome. However, both were associated with a decreased likelihood of graduating in four years for students in Model 7, representing Group 2 students. I disregard discussion of Native American because the small number (*n.* 30) in the data set would not yield a meaningful statistical outcome.

It is important to keep in mind that the EA variables are highly correlated, therefore it is difficult to isolate their individual relationships with graduation rates in a regression model. However, controlling for First-gen, Pell-eligible, and the race variables separately did help isolate the relationship between

first-summer and four-year graduation, which was the primary goal of this study. The STEM variable has a negative association across all three models and was statistically significant at the less than one

Table 12

Four-Year Grad. Rates on First-Summer Enrollment for Academic Success Groups 1, 2 and 4

	Model 6 Academic Success Group 1	Model 7 Academic Success Group 2	Model 8 Academic Success Group 4
Enrolled, First-Summer	0.148***	0.026	0.072***
	(0.040)	(0.016)	(0.022)
First-generation	-0.009	0.022	0.022
	(0.021)	(0.014)	(0.019)
Pell-eligible	-0.015	-0.030**	-0.015
	(0.021)	(0.014)	(0.018)
Admitted to STEM	-0.024	-0.152***	-0.132***
	(0.016)	(0.012)	(0.016)
African American/Black	-0.030	-0.073***	0.024
	(0.035)	(0.028)	(0.041)
Native American/Alaska Native	-0.047*	-0.133	-0.041
	(0.026)	(0.104)	(0.162)
Asian	0.052*	0.011	0.025
	(0.028)	(0.020)	(0.026)
Hispanic	0.037	-0.035*	0.000
	(0.024)	(0.019)	(0.026)
International	0.069	-0.019	0.041
	(0.048)	(0.031)	(0.041)
Pacific Islander	-0.030	-0.070**	-0.003
	(0.042)	(0.033)	(0.044)
Two or More Races	0.116	0.007	0.130
	(0.136)	(0.068)	(0.083)
Other Race	-0.081***	-0.042	0.120*
	(0.029)	(0.058)	(0.070)
Female	0.077***	0.134***	0.114***
	(0.016)	(0.011)	(0.016)
Local	-0.035*	-0.001	0.022
	(0.020)	(0.014)	(0.021)
Constant	0.072***	0.495***	0.576***
	(0.027)	(0.020)	(0.025)
Observations	1,695	7,977	4,008
R^2	0.040	0.049	0.041

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

percent level for Groups 2 and 4, demonstrating a gap in four-year degree attainment for students seeking STEM degrees.

The R-square value for these models is extremely low, suggesting low predictive value of these variables alone. However, the significance level of the association remains important to consider in terms of developing structured interventions to improve four-year degree completion in the institutional context, as well as for future research.

Chapter 6

CONCLUSION

Summary

Institutions committed to improving access and outcomes for students from groups that have been historically underrepresented in higher education can learn a great deal by looking longitudinally and analytically at participation and engagement trends. Such has been my experience with this study of the impact of first-summer enrollment on four-year degree completion at UC Merced. My interpretations of the outcomes of this study continue to evolve as do my ideas for future studies and/or interventions around early summer participation. Identifying the best support structures and interventions for Group 2 students may be the greatest challenge due to the group's size but may also achieve the greatest gains in terms of improving educational outcomes including four-year degree completion.

The results of this study confirm that early summer enrollment at UC Merced was positively associated with many students' journeys to four-year degree completion, and this happened without an institution-wide structured intervention or commitment to summer term. My first question explored the demographics of students who have historically enrolled in summer term at UC Merced. Because UC Merced serves large populations of historically underserved students, I wanted to understand if any particular groups had not been represented in first-summer enrollment, which would have indicated an access issue that needed to be addressed. First-generation, URM, and Social Sciences, Humanities and Arts (SSHA) students were less likely to enroll in first-summer and future research will need to be conducted to understand why that was the case. Engineering students were not more likely to enroll, which should be explored given their low four-year degree completion rates. I believe service to non-local students can be improved by the addition of post-pandemic online summer course offerings, but

again, it will be important to directly access student voice in order to learn from them what they need and how to serve them.

The second question of this study explored students' first year academic success using first-year cumulative GPA and units as benchmarks, and the relationship of first-year academic success to first-summer enrollment. I used the GPA of 2.0 and 30 cumulative units as the lower bounds for a successful first year. I chose 2.0 GPA because students need a cumulative GPA of 2.0 or better in the courses required for their degree in order to graduate. Similarly, I chose 30 units because students need to complete 30 academic units per year to graduate in four years with 120 unit degree, which is common at semester-based institutions. What I discovered was my benchmarks for success likely do not align with students', which seem to be grounded in GPA and possibly SAP (in terms of units) to remain eligible for financial aid. Though the average cumulative first-year GPA was higher for students who enrolled in first-summer, I was surprised to find that only 29.9% of the students in this study completed 30 units in their first year, and that the average number of units completed was similar for the first-summer enrolled compared to those not enrolled (Table 6). This contradicts the idea that students only enroll in summer term if they have failed or are behind and that highly successful students do not enroll in summer term because they do not need to. Conversely, there was no evidence derived from first-summer enrollment analyses that indicated students were concerned with accumulating fewer than 30 units in their first year. These findings, especially those related to GPA, are compatible with the Educational Interface frame in that students must feel prepared and ready in order for them to engage.

The third question tested and analyzed the relationship of first-summer enrollment to four-year degree completion. There was a positive relationship, but it was complicated, and the results varied across the EA, Academic Success Groups, and association with a STEM major. It was disappointing to learn that Group 2, the largest group in my study, had only a small positive relationship between first-

summer and four-year degree completion that was not statistically significant[6]. However, the positive relationship between summer enrollment and four-year graduation rates for Group 1 students, even after controlling for a variety of other factors (Table 10), was encouraging. This was potentially one of the most important findings of this study. Group 1 students, with their below-2.0 GPAs coupled with their below-30 cumulative units, are students who an equity-minded institution that serves a large share of historically underserved students should be most concerned with retaining. Future research should be conducted to understand more about these students, and their remarkable and likely-untold stories of students' perseverance and success at UC Merced.

Limitations

These findings are most applicable to other four-year institutions of higher education with similar student demographics; however, institutions interested in improving their service to historically-underserved students may consider these findings in structuring interventions and programs to improve four year degree completion rates for specific groups. UC Merced is one of five University of California campuses to be recognized as a Hispanic-Serving Institution (HSI). Other campuses include Riverside, Santa Cruz, Santa Barbara, and Irvine. Davis is anticipated to reach HSI status soon.

This study is limited by relying solely on quantitative data to understand a phenomenon (decision or ability to enroll) that may not be satisfactorily addressed without direct student voice. Future study should include qualitative research to help increase institutional understanding of how students decide to take summer coursework or are kept out of summer coursework in their first summer after matriculation, and their own explanations of their decision process and concerns.

I address my own bias in this work because I am Director for Summer Session at UC Merced and as such, understanding and being able to demonstrate potential value of summer enrollment may

[6] The result is significant at the less than five percent level for STEM and Undeclared students. Appendix B. Table B.1, Model 12

directly benefit my department. To help counter my bias, I ground this study in Attewell et al.'s, (2012) framing of Academic Momentum, research conducted using national longitudinal databases collected by the Institute of Educational Sciences, National Center for Education Statistics, within the U. S. Department of Education.

Implications for Policy, Practice, and Future Research

I believe this study demonstrates the potential for summer term to be utilized strategically by institutions of higher education to improve degree completion, though it is likely important to structure student-centered incentives and initiatives, such as greater access to grant aid and high-quality online courses. The associations realized without structured intervention between first-summer enrollment and four-year degree completion for Group 1 students who struggled in their first year of college, and for Group 4 students who excelled in their first year of college expand institutional understanding of who has benefited most from early summer enrollment. However, it is important to note there are many additional factors this study does not account for that also may influence individual student degree completion. It also demonstrates the importance of considering thoroughly who has participated and who has not, which may be especially important for institutions with smaller populations of historically underrepresented and/or underserved students for whom they seek to help improve persistence and four-year graduation rates.

There is more to be learned about Group 1 students who went on to graduate from UC Merced in four years. These students almost certainly encountered barriers to first-summer enrollment due to their first year academic outcomes, both in terms of GPA and unit accumulation. Student persistence literature tells us these students are amongst the most likely to leave the institution. These students are outliers in the Educational Interface, and much could be learned from understanding the circumstances that led them to participate in first-summer, and how they feel it impacted their degree trajectory.

The outcomes for the largest group of students, Group 2, are important for different reasons. These outcomes demonstrate to me the importance of understanding an institution's "murky middle", that is students who are successful enough to miss being flagged for academic interventions, but who are not necessarily excelling academically. The four-year degree outcomes were different for students in the higher GPA range of Group 2, as opposed to the lower GPA range (Appendix B, Table B.1). Again, this demonstrates the importance of understanding who participates in summer enrollment and their subsequent education outcomes. Group 2 students have participated in early summer enrollment, but the strength of association with four-year degree completion was weak for the group as a whole, though the relationship was different for Group 2 STEM and Undeclared students, as demonstrated in Appendix B. It is important to learn why the outcome was so different for Group 2 students, and more importantly what interventions might be implemented at the institutional level to improve the impact of early summer enrollment for those students who participate. This is an institutional responsibility in the Educational Interface. Now that there is a deeper understanding of demographics and outcomes for these students, interventions can be structured for similar students and their degree progress can be monitored to determine the effect of the intervention.

This study reflects the need for adequate grant-based financial aid support for summer term for institutions with large populations of Pell-eligible and middle-income students. Though summer session is technically a state-supported endeavor at the University of California, and the student credit hours may be used by a campus to help a campus make its institutional enrollment goals, summer is not a traditional tuition and fees-based term. Rather, students pay per-unit to enroll in addition to locally-approved campus-based fees. The only institutional-based grant aid for summer comes directly from revenue generated in that summer term and is referred to as return to aid (RTA). Students with a low-to-very low expected family contribution (EFC) level, may receive less grant aid by percentage of their total bill in the summer than they do in the regular academic year, and may be asked to pay more out-

of-pocket in the summer than they pay during the regular academic year. The added cost of living away from home during the summer on top of the cost of summer attendance are obstacles to attendance many students are unable or unwilling to overcome, even if it lengthens their time in college. It is important for policy-makers to understand the association of summer enrollment when considering options for expanding grant aid options for year-round college attendance.

Prior research into Academic Momentum by Attewell et al. (2012) and Adelman (2006), used White, male and not-first-generation to represent the historical concept of a traditional student. However, as Cuellar's work (2014, 2015) work predicted, Hispanic is potentially a more accurate omitted variable at UC Merced, challenging the idea of what a traditional student is in the institutional context. Future research at the institution guided by the QuantCrit Theoretical Frame should explore using Hispanic as the omitted race variable in regression models. Doing so will not change the overall outcome of a model, nor the magnitude of the relationship of first-summer to four-year degree attainment in the case of this study. However, it will acknowledge and validate what is normative at the institution and allow student data to be analyzed from a lens reflecting the largest student group.

Finally, the Educational Interface predicted that students who had been more successful in their first year of college would be more likely (engaged) to enroll in first-summer. A useful future study might explore students' perceptions of how the policies and practice of an institution impact their engagement in early summer enrollment and persistence to degree completion.

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Appendices

Appendix A.

Correlations

In order to understand the magnitude of the relationship between the student characteristics and first-summer enrollment, I conducted a correlation analysis of first-summer enrollment with the variables that were found to be statistically significant and important in the local context of UC Merced (Table A.1). The correlations between first-summer enrollment and the student characteristics, most of which were statistically significant at the 0.05 level, though this study did not test a structured intervention of first-summer. All things considered; two statistically significant correlations stood out. The first is the correlation between Hispanic and First-Generation (0.371), which was stronger than that of both, Asian (-0.208) and the URM group (0.162). The second is the correlation between first-year cumulative units and first-year GPA (0.351). This indicates a significant (0.05) and positive association between the number of units earned and GPA.

Table A.1
Correlations

Correlations of Variables to First-Summer Enrollment

	1st Sum Yes	Pell-El	First-Gen	URM	Female	Male	Other	Resident	Local	UNDEC	SNS	SSHA	SOE	1st Yr GPA	1st Yr Units
1st Sum Yes	1														
Pell-El	0.0122	1													
First-Gen	-0.0306*	0.4055*	1												
URM	-0.0738*	0.3653*	0.3510*	1											
Female	0.0037	0.0972*	0.1120*	0.1186*	1										
Male	-0.0047	-0.0974*	-0.1103*	-0.1128*	-0.9904*	1									
Other	0.0074	0.0016	-0.0123	-0.0424*	-0.0725*	-0.0659*	1								
Resident	0.0405*	0.2484*	-0.0866*	0.2125*	-0.0305*	0.0315*	-0.0070	1							
Local	0.1316*	0.0719*	0.0573*	0.0011	0.0296*	-0.0288*	-0.0060	0.0184*	1						
UNDEC	-0.0389*	0.0205*	0.0144	0.0019	0.0301*	-0.0306*	0.0031	-0.0120	-0.0123	1					
SNS	0.0989*	-0.0362*	-0.0398*	-0.0537*	0.1163*	-0.1141*	-0.0169*	0.0270*	0.0803*	-0.3258*	1				
SSHA	-0.0731*	0.0598*	0.0724*	0.1045*	0.1919*	-0.1922*	0.0013	-0.0260*	-0.4560*	-0.2808*	-0.4172*	1			
SOE	0.0019	-0.0411*	-0.0448*	-0.0516*	-0.3586*	0.3567*	0.0147	0.0081	-0.0304*	-0.2555*	-0.3797*	-0.3273*	1		
1st Yr GPA	0.0663*	-0.1215*	-0.1685*	-0.1721*	0.0001	0.0018	-0.0138	0.0185*	0.0141	-0.0318*	-0.0038	0.0612*	-0.0310*	1	
1st Yr Units	0.0155	-0.0318*	-0.0422*	-0.0452*	-0.0022	0.0047	-0.0179*	-0.0084	-0.0230*	0.0257*	-0.0678*	0.0568*	-0.0074	0.3541*	1

Note. *<0.05. 1st is used to represent first, Sum is summer, Yes is enrolled in first-summer. Yr is Year. First-Year GPA and Units are cumulative first year of college.

Appendix B

Additional Regression Estimates Academic Success Groups and Group 2

Models 6 through 8 estimate the relationship between four year graduation rate and first summer separately by academic success group and found that first-summer was statistically significantly different than zero (0) for groups 1 and 4. To determine whether the first summer coefficient is statistically significantly different between groups 1 and 4, Model 9 includes interaction variables for Academic Success Groups 1-3 times First-Summer to identify the association of first-summer enrollment to four-year degree attainment for each of these three Groups (Table B.1). The interaction variable of Group 1 times first-summer, which captures the different in graduation rates Group 1 and Group 4 first summer participants was statistically significant at the less than 10% level. First-summer appears to have a larger relationship for Group 1 students compared to Group 4 students.

The outcome and association were different for Group 2. The interaction variable result for Group 2 times first-summer was -4.9% and statistically significant at the less than 10% level. First-summer had a smaller relationship to four-year graduation rates for Group 2 students compared to Group 4 students. This negative and significant association with first-summer reinforces the need to explore Group 2 further. I disregard the outcome for the interaction of Group 3 and first-summer because the number of Group 3 students is small (*n.* 65) and the number of students who enrolled in first-summer was eight, which is too small to provide a meaningful statistical outcome.

Next, given the large size of Group 2 (*n.* 7,977 of 13,745) and that the GPA range for these students was large (2.0 to 4.0), I considered Group 2 in greater depth to see if the association of first-summer was the same for students in the lower and higher bounds of the Group's GPA range. Models 10 and 11 separate Group 2 into Group 2A, including students with a GPA of 2.0-2.99, and Group 2B, including students with a GPA of 3.0-4.0. Both groups have less than 30 first-year accumulated units

which means they were not on track to accumulate 120 units and graduate in four years. First-summer maintained a positive though not statistically significant relationship for both Group 2A and 2B, similar to their combined outcome. There are several ideas to be considered regarding this outcome. The constructs and bounds I used to define the four Academic Success Groups yielded a very large "murky middle" with Group 2. I explored the cumulative first-year units of Group 2 students and found that 38.8% had fewer than 22 cumulative first-year units. These students needed to take more than two, four-unit courses in the first summer to complete 30 units prior to their second year. However, as a practitioner in this space, I would be hesitant to advise students who struggled in their first year of college to enroll in two or more courses in the summer without a robust structured advising and support program in place to help them choose and then be successful in summer courses. Conversely, 43% of Group 2 students could have started their second year on track with 30 or more units if they had taken one four-unit summer course. Taking one summer course is likely a more reasonable workload, though financial aid eligibility may impact students' ability to enroll in a single summer course. In the institutional context of UC Merced, understanding the association of first-year unit accumulation with four-year degree attainment, even when controlling for a variety of variables, can help the institution work strategically to provide information and support for students to help them achieve their degree completion goals.

Due to the negative association of STEM to four-year degree completion rates, I estimated a regression including the full Group 2, but only including those who are STEM or Undeclared (Model 11). I retained Undeclared students because some subset of them become STEM majors. For the STEM/Undeclared sub-set of Group 2 students, first-summer enrollment became statistically significant at the less than five percent level. While first-summer may not be meaningfully related to four-year degree completion for students from the social sciences and humanities, again, the positive relationship between first-summer and four-year graduation for Group 2 STEM and Undeclared students provides

opportunity to utilize early summer enrollment to improve four-year degree outcomes for students with these characteristics.

Finally, I explored the association of cohort year for School of Natural Sciences (SNS) students. Earlier I discussed a throughput issue related to general chemistry that affected cohort years 2009-2013, but that was resolved beginning with cohort year 2014 in summer 2015. The throughput issue caused students who had grades less than C- in general chemistry in their first year to be pushed to enroll in chemistry in the summer, or risk not having access to enroll in the fall of their second year. This created an untended "intervention" using first-summer to solve an academic year course access problem. In Models 15 and 16 (Table B.2), I ran the Model 4 regression estimate for only SNS students. Model 15 includes cohort years 2009-2013, for whom the first-summer would have been summers 2010-2014. Model 16 includes cohort years 2014-2017, for whom the first-summer term would have been summers 2015-2018.

First-summer increased the predicted value that a SNS student would have graduated in four years, though the magnitude of the relationship was much smaller for students in Model 15, some of whom may have been pushed to enroll in first-summer because of the chemistry access issue. The first-summer coefficient is 0.043 and statistically significant at the less than ten percent level, predicting a 4.3% increased likelihood of four-year graduation if the student enrolled in first-summer. Comparatively, the first-summer coefficient for Model 16 was 0.114 and statistically significant at the less than one percent level, predicting a 11.4% increase in the likelihood of four-year graduation associated with first-summer. Model 15 is associated with statistically significant and negative coefficients for students who are Pell-eligible, African American/Black, and Hispanic, suggesting these students may have been affected to a greater extent than other students by this institutional practice. Hispanic students remained significantly and negatively associated in Model 16. The coefficient on Pell-eligibility was negative and significant at the less than five percent level in Model 15 but was not significant in Model

16. The coefficient on Female remained positive and statically significant at the less than one percent level in both models.

It is important to note that without course enrollment data, it was not possible to identify how many of the students in Model 15 also enrolled in general chemistry in first-summer. Similarly, it was not possible to know if students felt pressured to enroll without qualitative data to represent direct student voice. However, the differences in the magnitude of the relationship between first-summer and four-year degree completion for SNS students are interesting and could be explored further in order to gain a deeper understanding into the association of the general chemistry summer enrollment practice with students' persistence and degree completion outcomes. It may also suggest that institutions seeking to release pressure related to an academic year capacity issue through summer enrollment, should proceed with caution and consider how it may affect students. Finding positive methods to incentivize enrollment, such as increased access to grant aid and intentionally developed online courses may have better long-term outcomes than enrollment incentivized through a deficit-oriented justification, such as non-passing grades.

Table B.1

*Regression Estimates: Academic Success Groups * First-Summer, and Group 2*

		Group 2A	Group 2B	Group 2 STEM & Undeclared
	Model 9	Model 10	Model 11	Model 12
Enrolled, First-Summer	0.074***	0.020	0.019	0.036**
	(0.022)	(0.020)	(0.027)	(0.018)
First-generation	0.019*	0.027	0.045*	0.015
	(0.010)	(0.017)	(0.024)	(0.016)
Pell-eligible	-0.023**	-0.031*	-0.017	-0.041***
	(0.010)	(0.016)	(0.023)	(0.015)
Admitted to STEM	-0.130***	-0.154***	-0.123***	
	(0.008)	(0.014)	(0.020)	
African American/Black	-0.042**	-0.015	-0.092*	-0.074**
	(0.021)	(0.034)	(0.051)	(0.033)
Native American	-0.100	-0.197	-0.102	-0.109
	(0.085)	(0.123)	(0.144)	(0.124)
Asian	0.019	0.067***	-0.045	0.000
	(0.015)	(0.025)	(0.031)	(0.022)
Hispanic	-0.015	0.032	-0.078***	-0.057***
	(0.014)	(0.023)	(0.030)	(0.021)
International	0.011	0.035	-0.018	-0.037
	(0.022)	(0.036)	(0.055)	(0.036)
Pacific Islander	-0.043*	-0.070*	-0.064	-0.077**
	(0.024)	(0.040)	(0.051)	(0.036)
Two or More Races	0.068	0.009	0.132	0.043
	(0.050)	(0.077)	(0.115)	(0.080)
Other Race	0.008	-0.039	-0.051	-0.029
	(0.040)	(0.071)	(0.089)	(0.064)
Female	0.121***	0.154***	0.093***	0.133***
	(0.008)	(0.013)	(0.020)	(0.013)
Local	0.001	-0.024	0.021	0.002
	(0.010)	(0.017)	(0.024)	(0.016)
Academic Success Group 1	-0.471***			
	(0.012)			
Academic Success Group 2	-0.128***			
	(0.010)			
Academic Success Group 3	-0.395***			
	(0.052)			
First-Summer * Group 1	0.081*			
	(0.044)			
First-Summer * Group 2	-0.049*			
	(0.027)			
First-Summer * Group 3	-0.116			
	(0.123)			
Constant	0.598***	0.382***	0.614***	0.373***
	(0.015)	(0.024)	(0.031)	(0.019)
Observations	13,745	5,378	2,599	6,019
R^2	0.124	0.061	0.033	0.023

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Table B.2

Regression Estimates: SNS Cohort Years 2009-2013 & 2014-2017

	Model 15 Cohorts 2009-2013	Model 16 Cohorts 2014-2017
Enrolled, First-Summer	0.043*	0.114***
	(0.025)	(0.031)
First-generation	-0.011	-0.009
	(0.024)	(0.027)
Pell-eligible	-0.056**	-0.018
	(0.024)	(0.026)
African American/Black	-0.179***	-0.08
	(0.046)	(0.059)
Native American	-0.143	0.155
	(0.165)	(0.214)
Asian	-0.047	0.02
	(0.033)	(0.039)
Hispanic	-0.105***	-0.116***
	(0.033)	(0.037)
International	-0.136	-0.056
	(0.084)	(0.058)
Pacific Islander	-0.024	-0.135**
	(0.060)	(0.067)
Two or More Race	0.075	-0.147
	(0.115)	(0.118)
Other Race	-0.101	-0.021
	(0.089)	(0.155)
Female	0.080***	0.064***
	(0.020)	(0.022)
Local	-0.034	0.007
	(0.024)	(0.026)
Constant	0.435***	0.538***
	(0.030)	(0.037)
Observations	2314	2169
R^2	0.024	0.027

Robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010