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The First Year of College: Understanding Student Persistence in Engineering

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Author
Hayden, Marina Calvet

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The First Year of College: Understanding Student Persistence in Engineering

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Education

in

Teaching and Learning

by

Marina Calvet Hayden

Committee in Charge:

James Levin, Chair
Pamela Cosman
Christopher P. Halter

2017
The Dissertation of Marina Calvet Hayden, is approved, and is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego

2017
Dedication

To Ian, Sebastian, and Sofia
List of Figures

Figure 1: Comprehensive Model of Influences on Student Learning and Persistence (Adapted from Terenzini and Reason, 2005) ..........................................................................................25

Figure 2: Comprehensive Model of Influences on Student Persistence in Engineering During the First Year of College (Adapted from Reason, 2009) .........................................................29
List of Tables

Table 1: College Graduation Rates in the United States......................................................... 2
Table 2: Graduation Rates at California University .............................................................. 5
Table 3: Preliminary A Priori Codes ................................................................................... 30
Table 4: Description of Codes Used on Survey and Interview Data .................................... 31
Table 5: Data Collection Matrix: Research Questions in Relation to Survey and Interview Questions and Sub-questions ................................................................. 33
Table 6: Major Changes for 2015 Cohort of Engineering Students .................................... 39
Table 7: 2015 Cohort of Students Enrolled in Engineering by API Ranking ................... 41
Table 8: Pre-College Academic Preparation ....................................................................... 42
Table 9: Socio-Economic Background ............................................................................... 44
Table 10: Academic Performance ....................................................................................... 47
Table 11: Student Demographic Information ..................................................................... 49
Table 12: Response Frequencies of Survey Questions vs. Factors ..................................... 50
Table 13: Survey Respondents, Their Majors, and Reasons for Staying or Changing Majors .......................................................... 56
Table 14: Response Frequencies of Survey Question, divided into Positive Experiences and Negative Experiences for Life Transition ............................................... 58
Table 15: Response Frequencies of Combined Survey Question Divided into Positive Experiences and Negative Experiences for Social Life ........................................... 60
Table 16: Response Frequencies of Survey Question Divided into Positive Experiences and Negative Experiences for Academic Life ...................................................... 64
Table 17: GPA at the End of the First Year in College ......................................................... 66
Table 18: Response Frequencies of Survey Question Divided into Positive and Negative Experiences for Organizational Skills and Learning Strategies ........................ 69
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EDUCATION

University of California, San Diego
Doctor in Education in Teaching and Learning

University of San Diego
Master of Business Administration

University of California, San Diego
Bachelor of Science in Electrical Engineering
Minor: Spanish Literature

Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico City
Electrical Engineering (transferred to UC San Diego)

Lycée Franco Mexicain, Mexico City
Diploma: French Baccalauréat Technologique in Electronics (F2)

PROFESSIONAL EXPERIENCE

UC San Diego, Office of the Associate Vice Chancellor for Academic Affairs / Dean of Undergraduate Education
Academic Initiatives, Principal Analyst (Present)
Academic Coordinator, Education Initiative

UC San Diego, Jacobs School of Engineering
Continuing Lecturer (Present)

UC San Diego, School of International Relations and Pacific Studies
Assistant Director of Alumni Programs

UC San Diego, Jacobs School of Engineering
Director, Engineering Student Services
Assistant Director, Engineering Student Services

Melles Griot, Irvine, CA
Senior Applications Engineer
Applications Engineer

Astec America, Oceanside, CA
Applications Engineer
Abstract of the Dissertation

The First Year of College: Understanding Student Persistence in Engineering

by

Marina Calvet Hayden

Doctor of Education in Teaching and Learning

University of California, San Diego, 2017

Professor James Levin, Chair

This research study aimed to expand our understanding of the factors that influence student persistence in engineering. The unique experiences of engineering students were examined as they transitioned into and navigated their first year of college at a public research university in California. Most students provided similar responses
with respect to the way they experienced the transition to college and social life. There was, however, wide student response variation regarding their experience of academic life and academic policies, as well as in their level of pre-college academic preparation and financial circumstances. One key finding was that students’ experiences during the first year of college varied widely based on the extent to which they had acquired organizational and learning skills prior to college.

The study used a mixed methods approach. Quantitative and qualitative data were collected through an online survey and one-on-one interviews conducted with freshman students near the end of their first year of college. The theoretical foundations of this study included Astin’s Theory of Student Involvement and Tinto’s Theory of Student Departure. The design of the study was guided by these theories which emphasize the critical importance of student involvement with the academic and social aspects of college during the first year of college.
Chapter 1: Introduction

Today, more than ever, obtaining a college degree has become a requirement for social mobility and self-sufficiency in the United States (Carey, 2004; Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008). Failure to complete one’s college degree carries significant consequences. Since the late 1960’s, the gap in earnings between people with and without a college degree has dramatically increased and the trend continues. The median earnings of young adults ages 25-34 who earned a bachelor’s degree in 2014 were 66% higher than the median earnings of those with only a high school diploma; additionally, 73% of young adults with a bachelor’s degree worked full time in 2014 compared with 65% of those with only a high school diploma (Department of Education, 2014). Unfortunately, those most affected by this trend are disproportionately low-income and underrepresented minorities (Carey, 2004; Cabrera, Burkum, & La Nasa, 2012).

Given the importance of obtaining a college degree for social mobility and self-sufficiency and a historical lack of improvement in national retention and graduation rates over time (Seidman, 2012; Reason, 2009), this research study aims to expand our understanding of the factors that influence student persistence in college. The study examined the experience of engineering students in their first year of college with particular attention to those from low socio-economic backgrounds.

National Graduation Rates

Nationally, fewer than half of students graduate from American universities in four years. According to the Institute of Education Sciences, for the cohort of first-time,
full-time bachelor's degree-seeking students starting in 2006, the graduation rate at four-year postsecondary institutions was 39% for students graduating within four years and 59% for students graduating within six years (Department of Education, 2013). After six years of enrollment, 41% of students had not graduated from these institutions, despite their categorization as “four-year” institutions. As shown in Table 1, graduation rates were slightly higher for the 2006 cohort than for the 1996 cohort. However, after ten years, there had been an increase of only 5% and 4% for four- and six-year graduation rates respectively.

**Table 1: College Graduation Rates in the United States**

<table>
<thead>
<tr>
<th>All majors nationwide</th>
<th>4-Year</th>
<th>6-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 Cohort</td>
<td>39%</td>
<td>59%</td>
</tr>
<tr>
<td>1996 Cohort</td>
<td>34%</td>
<td>55%</td>
</tr>
</tbody>
</table>

**Local Context**

**California University (CU)**

California University (CU), a pseudonym used for the site of this study, is a four-year public research university located in the state of California, with its own unique student body and organizational context. In 2015, total undergraduate campus enrollment was 26,590 students. Twenty-three percent ($n = 6,246$) of undergraduate enrollment was in engineering majors. The school of engineering is a renowned school which ranks 24th
out of the top 205 undergraduate engineering programs, 17th among the nation's top 215
engineering schools, and 10th in the nation among the top 113 public universities
according (U.S. News and World Report, 2016). As published by the university’s Office
of Student Research and Information, admissions to this university is competitive. In
2015, 78,056 students applied, 34% \((n = 26,509)\) were admitted, and 20% of those
admitted \((n = 5,292)\) registered at CU.

The diversity of students admitted to CU is increasing. As described in a July
2016 university newsletter, compared to 2015, the number of admitted students from
historically underrepresented backgrounds went up by 46% and the number of admitted
students who are the first in their families to attend college went up by 39%. CU also
created a scholarship program in 2013 for students coming from several local high
schools and community-based organizations that help underserved populations, in its
commitment to the local community and the promotion of diversity, equity, and
inclusion. Finally, as published by the university’s Office of Student Research and
Information, approximately 65% of all undergraduate students were expected to receive
some type of financial assistance from a wide variety of programs including federal,
state, university, and other outside sources in the form of loans, grants, work-study, and
scholarships for students starting in 2015.

Students may select to start at CU with an undeclared major. However, if
interested in engineering, students are encouraged to select an engineering major when
they first apply. Students can apply to be admitted to an engineering major after they are
admitted to this university. However, engineering majors are “capped”, meaning that only
a certain number of students can enroll in or switch into those majors. Engineering departments allot a certain number of spaces to accommodate students who may choose to change to another engineering major after the start of the academic year. Once the major is at full capacity, however, departments are not able to accept additional students into the major. It can be difficult, therefore, to switch to an engineering major from undeclared status, another major, or even from a different engineering major, given that all majors are at full capacity. This policy varies by engineering department. Students must submit an application to the department of the major to which they want to apply and must meet minimum academic requirements defined by each department.

**Graduation Rates at CU**

As published by CU’s Office of Student Research & Information, and shown in Table 2, for the 2006 cohort of first-time freshmen, the graduation rate was 57% for students graduating within four years and 86% for students graduating within six years. These graduation rates are higher than the graduation rates at the national level perhaps because “more selective schools tend to have higher student retention than less selective schools” (American Society for Engineering Education, 2012, p. 3). The graduation rate in engineering for the same 2006 cohort of students at CU was 46% for students graduating within four years and 84% for students graduating within six years. Although the six-year rate is clearly an improvement over the four-year rate, there were still 16% of students who either changed to a non-engineering major, left college altogether, or took longer than six years to graduate. The cohort of 2006 included 870 engineering students, 16% of whom \( n = 139 \) did not complete their engineering degrees within six years.
Table 2: Graduation Rates at California University

<table>
<thead>
<tr>
<th></th>
<th>Graduation Rates</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>4-Year</td>
</tr>
<tr>
<td>2006 Cohort</td>
<td></td>
</tr>
<tr>
<td>All majors nationwide</td>
<td>39%</td>
</tr>
<tr>
<td>All majors at CU</td>
<td>57%</td>
</tr>
<tr>
<td>Engineering majors at CU</td>
<td>46%</td>
</tr>
</tbody>
</table>

Additionally, the graduation rates for CU are higher than the national graduation rates, but trail behind two sister campuses that belong to the same university system, which in 2011 had six-year graduation rates of 90% and 91% respectively compared to CU’s six-year graduation rate of 86% as shown in the 2010-2011 Retention and Graduation Report published by CU’s Office of Student Research & Information.

Improving graduation rates is an important focus of CU and is included in CU’s Strategic Plan. On the first page of the Plan, it is stated that California University’s vision includes aligning the university’s efforts to be “student-centered, research-focused, and service-oriented”. The student-centered focus is further emphasized by one of the plan’s listed strategies: “Rethink curriculum and pedagogy to improve retention and graduation rates and increase student and faculty engagement”.

Programs that Address Student Persistence and Success

CU has created programs that aim to help students succeed in college. The programs are offered by residential communities, learning centers, and departmental
units. For example, CU offers an orientation to engineering year-long course series that focuses on the successful transition and orientation of students to the university, particularly those coming from economically or educationally disadvantaged backgrounds. One section of this course includes the development of students’ self-regulation and self-awareness skills and guides them to practice and track their use of learning strategies through a process called Reflect, Monitor, Improve (RMI) (Hayden, 2014). The goal of the course series is to engage students early in their academic programs with the aim of increasing their chances of success.

Engineering students at CU spend most of the first two years in college taking mathematics, physics, chemistry, and programming language requirements as well as fulfilling most of their general education requirements. Students enroll in a larger number of engineering courses in their third and fourth years. Engineering departments offer Introduction to Engineering courses to expose students to content in their majors starting in their Freshman year. Generally, these courses offer the opportunity to participate in hands-on, team-based projects with other classmates and are generally the first exposure to the field of engineering.

In addition to the courses offered by its School of Engineering, CU offers programs that aim to help students successfully transition to college. For example, one student services center on campus offers a year-long transition program for a select group of incoming freshman that begins with a residential component in the summer before they enter and continues throughout the academic year. This program gives priority to students from underperforming high schools. During the summer, students live on
campus, earn college credit, and work on developing a higher level of academic skills and abilities, all at no cost to the students. The program aims to familiarize students with university resources and to help them to better understand the university environment.

Several residential communities called Living Learning Communities have been created to provide students with living environments in which they can interact with students who have similar interests. As stated in the program’s materials, these communities have been created because they are associated with higher grades, deeper learning, increased retention rates, and increase graduation rates. Furthermore, starting in the fall of 2014, a course was offered that had been designed specifically to welcome new freshmen to CU with the intent of providing students with the knowledge to succeed in college and make the most of their undergraduate experience. These are just some examples of how CU has worked to address the needs of its diverse student body and become more student-centered in its educational approach. Additional programs have been recently implemented to offer further academic and transitional support to students.

**Research on Student Persistence**

In looking at the literature on student persistence, it is evident that a great deal of research has been done over the last fifty years with respect to this topic. As a result, many institutions have made efforts to reform and improve their programs. Seidman (2012) describes how “over the years, colleges and universities have designed programs and services to help retain students by trying to ease students’ transition into the academic and social systems of the institution” (p. 267). Seidman lists various programs and services such as orientation programs, counseling and student development,
assessment, remedial, and academic support services, and the development of educational communities within the classroom. Unfortunately, Seidman points out that “in spite of the implementation of these programs and services, the retention data reveal that students are not retained at a higher rate than they were twenty or more years ago” (2012, p. 267). Educational reforms have not demonstrated great success overall in increasing retention and graduation rates (Reason, 2009), which have remained at about 50% for the last 100 years (Demetriou, 2011).

In Chapter 2, the review of research indicates that persistence in engineering has its particular challenges - longer time to degree than other non-engineering majors; higher course load than other non-engineering majors; a general tendency of engineering majors to migrate out of engineering without a mitigating migration into engineering of students from other fields, and difficulty retaining students from underrepresented minorities. The review also points to research that has identified the importance of students’ experiences during their first year of college as critical to their future academic success both in college and in engineering (Tinto, 1998; Hutchison, Follman, Sumpter, & Bodner, 2006; Kuh et al., 2008), as well as the need for better understanding regarding how these experiences influence persistence. Finally, also included in Chapter 2 is a description of the various additional burdens students from low socio-economic backgrounds face as they pursue a college degree and how these burdens negatively affect persistence.

Theoretical Framework

The theories of two major researchers in the field of student persistence were used as a theoretical framework in this study. First, Astin’s Theory of Student Involvement
(1984) was used, with its particular assertion of the importance of students spending adequate time engaging with the various aspects of college. Second, Tinto’s Theory of Departure (1975) was used with its emphasis on examining the experience of students as they transition to college, and their integration into both the academic and the social aspects of college. Reason’s (2009) Comprehensive Model of Influences on Student Learning and Persistence was used as a guide to design and collect data in the specific local context of the study.

**Research Methods**

The population of this research study is comprised of 829 engineering students who started at CU in 2015. All 829 students were emailed a link to a confidential online survey. Eighty-four students responded to the survey. One-on-one interviews were conducted with eight students selected from those who completed the online survey and agreed to participate. Interviewees were selected based on their responses to the survey. The goal was to select both students who had stayed in and who had changed their majors. Using a mixed methods approach, quantitative and qualitative data in the form of student responses were collected through an online survey and one-on-one interviews conducted between the end of respondents’ first year in college and the beginning of their second year in college.

**Research Questions**

This research study pays particular attention to persistence in three specific areas: 1) persistence in an engineering major, which can be considered a promising degree choice in terms of increased social mobility because of the marketplace demand for
engineers and the typically high starting salaries that accompany even entry level
engineering jobs; 2) persistence of engineering students during the first year of college,
which is a critical time for students transitioning from the environment of home and high
school to the new, more independent environment of the university; and 3) persistence of
engineering students from low socio-economic backgrounds, who could potentially
benefit most dramatically from the increased social mobility resulting from an
engineering degree.

The main research question and sub-questions are as follows:

What are the factors that influence student persistence in engineering?

1. How do engineering students experience the first year of college?
2. How do engineering students perceive the institutional resources designed to
   support them?
3. How does socio-economic background shape the experience of engineering
   students in college?
4. What other factors influence persistence in engineering during the first year of
   college?
Chapter 2: Literature Review

The importance of student persistence in college is apparent when one considers the potential effect of a college degree on the lives of students. Kuh et al. (2008) link a bachelor’s degree to cognitive, social, and economic benefits to students that enhance not only the individual student’s quality of life, but also that of “the families of the college-educated persons, the communities in which they live, and the larger society” (p. 540). The authors state that obtaining a college degree has become increasingly important for improving social mobility. They claim that it is not enough anymore to have a high school diploma to achieve self-sufficiency and responsible citizenship.

Failure to complete one’s college degree carries significant consequences. Carey (2004) claims that although graduation rates have remained relatively stable since the late 1960’s at about 67% for the eight-year graduation rate, the consequences of not graduating have critically changed. The author claims that in the past, one could find a solid middle-management job without a college degree and expect to move up the career ladder over time on the basis of experience. However, in the current economy, the gap in earnings between people with and without a college degree has dramatically increased compared to 30 years ago, and the trend continues. The median earnings of young adults ages 25-34 who earned a bachelor’s degree in 2014 were 66% higher than the median earnings of those with only a high school diploma; additionally, 73% of young adults with a bachelor’s degree worked full time, year round in 2014 compared with 65% of those with only a high school diploma (Department of Education, 2014).
Cabrera et al. (2012) suggest that a bachelor’s degree is “now fully acknowledged as the gatekeeper to a myriad of social and individual benefits, ranging from income, employment stability, and occupational prestige, to engagement in civic political activities” (p. 167). Unfortunately, the people most affected by this trend are disproportionately low-income and underrepresented minorities (Carey, 2004; Cabrera et al., 2012).

**Research on Student Persistence**

Researchers have long been interested in understanding the reasons behind students’ decisions to persist in college and to help institutions improve student retention and graduation rates. Since the 1930’s, student retention has been a major focus of educational research. As a result of this work, there has been an increase, most notably since the 1970’s, in the theories and in the implementation of models of student persistence.

Many theories have been developed with the goal of better understanding the factors that influence student persistence - that is, to answer the question of why some students persist in college and others don’t. Some researchers have theorized that student involvement, that is, the amount of time and energy students spend in educational activities might be related to persistence (Astin, 1975, 1984). Others propose that academic and social integration are critical to student persistence (Tinto, 1975, 1998). Others suggest that there might be important factors that influence student persistence that have more to do with institutional practices and policies than with student background characteristics (Terenzini & Pascarella, 1980, Kuh et al., 2008). Additionally,
researchers suggest that differences in ethnic background, gender, and socio-economic status need to be considered if student persistence is to be better understood (Attinasi, 1989; Bean, 1980; Hurtado, Carter, & Spuler, 1996; Rendon, Jalomo, & Nora, 2000). More recently, Tinto (2007) has focused his work on highlighting the importance of supporting students’ sense of connection to the campus, their ability to navigate the culture, meet expectations, and graduate.

Research on college student retention is active and continues to explore issues of student persistence ever more comprehensively. The following section includes a review of research in student persistence in college starting with the work of two of the most cited researchers, Alexander Astin and Vincent Tinto, followed by a short review of subsequent perspectives on student persistence. Reason’s (2009) Comprehensive Model of Influences on Student Learning and Persistence is presented as a useful conceptual model that summarizes current thinking on many of the factors believed to influence persistence. This chapter also includes a description of the research on three specific areas that influence persistence in unique ways: the first year of college, majoring in engineering, and socio-economic background. The theories on these various areas of student persistence were used to guide the design of this study, including the creation of research questions and methods for collecting and analyzing data.

It is important to note that while researchers have tried to understand the factors that influence student persistence, “persistence” can be a rather complex unit of measure. It is also sometimes used interchangeably with the concept of retention. Persistence, though, is what the student does: persist from year to year until graduation. Institutions
retain students from year to year until graduation. Even though both constructs ultimately aim to measure the intermediate steps until graduation, research on persistence generally studies the reasons why students leave or stay in college, whereas research on retention addresses what institutions can do to keep their students in college. An additional aspect of persistence that complicates its measurement is that persistence is not binary; that is, students don’t either stay in college and graduate or leave college and not graduate. Students might leave college temporarily and come back later, referred to as stop-out, persist for longer amounts of time than the pre-set 4 or 6-year graduation timelines, or persist through the first couple of years and then leave college.

The evaluation of these definitions is beyond the scope of this study, which focuses on student persistence in an engineering major from the first to the second year of college. Persistence in this context is understood to mean that students who started in an engineering major as freshmen, stayed in their initial engineering major or changed to an alternative major still within engineering. Students who don’t persist are those who changed to an alternative major outside of engineering or left college altogether.

Astin’s Theory of Student Involvement

In 1975, Astin conducted a longitudinal study with the aim of identifying factors in the college environment that affect student persistence. Astin found that the factors that contributed to persistence suggested involvement, whereas those which contributed to dropping out implied a lack of involvement. Astin formally presented his Theory of Student Involvement in 1984. The author describes student involvement as “the amount of physical and psychological energy that the student devotes to the academic
experience” (1984, p. 297). Student involvement, according to Astin, implies a behavioral component. He states that involvement “is not so much what the individual thinks or feels, but what the individual does” (p. 298). In contrast to the subject-matter theory of pedagogy which tends to place the students in a passive role as recipients of information, the Theory of Student Involvement aims to encourage faculty to spend less time focusing on content and teaching techniques and focus more time on how much time and energy students are devoting to learning. Astin’s (1975) theory also sees student time as a finite and important resource and encourages administrators and policy-makers to recognize that time spent on any activity outside of academics represents a reduction in potential time spent learning.

Astin’s findings showed that students who participated in co-curricular activities were less likely to drop out than those who didn’t. Astin also found that the most significant factor affecting student persistence was the student’s residence. Living on campus was positively related to persistence. Astin stated: “Indeed, simply by eating, sleeping, and spending their waking hours on the college campus, residential students have a better chance than do commuter students of developing a strong identification and attachment to undergraduate life” (Astin, 1984, p. 523).

Interestingly, holding a small part-time job on campus was also found to affect retention in a positive way. Astin argued that although working takes time and energy away from academics, on-campus part-time employment facilitates retention. Astin explained: “Apparently such work, which also includes work-study combinations, operates in much the same way as residential living: The student is spending time on the
Tinto’s Theory of Student Departure

Tinto (1975) formulated a theoretical model that could explain how interactions between students and institutions lead some individuals to drop out and identified dropout behaviors. Similar to Astin’s claim that the degree of student involvement has an effect on persistence, Tinto argued that integration was an important factor affecting persistence.

Additionally, Tinto stated that because colleges are made up of both social and academic systems, it is important to view these two aspects of college experience as distinct. One important reason for this distinction is that a student can integrate into the social system without integrating into the academic one and might then withdraw because of poor academic performance. On the other hand, a student could integrate into academic life and not integrate socially and then withdraw because of insufficient integration into the social system of the institution. Tinto explains that social and academic integration influence students in different ways and theorizes that the differences in academic integration are related to the varying academic and social attributes of the institutions and of the students in those institutions.

Additionally, Tinto (1988) identified the experience that students have when transitioning to college as a core factor influencing student persistence. Tinto argued that this period in the sequence of the college experience has unique difficulties, different from those experienced in later years. Tinto (1988) proposed that student persistence
during the first year of college is related to aspects of becoming a “new member” in a community - in this case, the community of the college. Using a social-anthropological theoretical framework, Tinto described how students pass through three stages - separation, transition, and incorporation - on their path to completing their first year of college. Tinto argued that this last step of incorporation into college life can often be the most challenging for students not only because of the inherent difficulties of integrating into the new community, but also because students are generally left to their own devices to figure this phase out on their own. The author states that during the first year “the impact of involvement upon persistence is greatest in that year, especially during the first ten weeks when the transition to college is not yet complete and personal affiliations are not yet cemented.” (Tinto, 1998, p. 2)

Tinto’s Theory of Student Departure (1975) has created an important foundation for analyzing the multiple factors affecting student persistence. Researchers have tested, improved on, and built on his theories and findings to further understand the reasons behind students staying or leaving college. Tinto’s theories have been both praised and criticized through the years. In general, researchers agree that his model is important because it highlights the social and academic environment and the interactions between the student and the college as important factors in persistence.

A decade after his earlier work, Tinto offered an updated view on the accuracy of his theory, stating that “it now can be said that we do know what factors influence persistence” (1998, p. 1). He argued that involvement matters and cited Astin, among others, when stating that the more academically and socially involved a student is, and
the more he or she interacts with peers and faculty, the more likely he or she is to persist. Although there are some differences in interpretation of certain aspects of Tinto’s theories, there seems to be agreement that: academic and social involvement are crucial for student persistence; that the two interact with each other; that academic integration seems to be the more important of the two; and that they matter somewhat differently in different educational settings and for different students (Tinto, 1998).

Subsequent Theories

More recently, Tinto’s model has been criticized by researchers (Rendon et al., 2000) who state that some of Tinto’s theories were based on the now contested belief in the need for assimilation into the dominant culture. Rendon et al. (2000) claimed that Tinto’s model expects students to separate from their previous communities and integrate into the university community. Although the authors agreed that Tinto’s theories have provided a “workable and testable foundation for analyzing multiple factors involved in student departure” (2000, p.1), the authors argued that his description of the stages of student departure needs to be modified to better support more diverse populations.

In order to understand the needs of more diverse populations, other models of student persistence have aimed to study the experiences of students from specific ethnic backgrounds. For example, Attinasi (1989) focused on better understanding the experience of Mexican American students. The author stated that helping them create cognitive maps of their new environment, providing orientations through their first year, as well as mentors, and more advanced peers, is critical to their success. Hurtado et al. (1996) focused on the importance of adjustment during the first and second years of
school for Latino students. The authors claimed that the students’ experience in college might affect their adjustment far more than their background characteristics. Their findings emphasized the important role that having a strong support network has on their persistence.

**Persistence During the First Year of College**

As described in Tinto’s theories, the transition to college is a very influential time for student persistence. Indeed, the experiences students have during their first year of college play a critical role in determining their chances for persisting to the second year and eventually for graduating. Kuh et al. (2008) conducted a study of 18 universities that included data for 6,193 students. The authors sought to examine if engagement during the first year of college had a significant effect on first-year grades as well as on persistence from the first to the second year of college. They also sought to determine whether or not those effects varied by student race, ethnicity, and high school GPA.

The authors found that, although pre-college characteristics have an effect on first-year grades and persistence, this effect is much smaller than that of first-year college experiences themselves. They also found that engagement has a compensatory effect on first-year grades and persistence; that is, while effective educational practices generally benefit all students, the effects are greater for students who enter college with lower academic scores and for students of color. The study provides evidence that the most significant effect on academic performance and persistence from the first to the second year of college is related to the experiences students have during their first year of college regardless of academic achievement or background characteristics (Kuh et al., 2008).
Mortenson (2012) also suggests that measuring persistence from the first to the second year of college is important because, on the one hand, students find themselves at a vulnerable time in their lives during this period, and, on the other hand, institutions are able to react rapidly with interventions.

**Persistence in Engineering**

Research on student persistence in engineering is part of a larger body of research on engineering education. Its purpose is to gain an understanding of the specific issues engineering students face while pursuing their majors. The most common arguments for conducting research in engineering education are: an unmet demand for engineers (Marra Rodgers, Shen, & Bogue, 2012), a need for engineering graduates to be effectively prepared for the critical challenges our world faces (Atman et al., 2010), and the need to better retain students, particularly underrepresented students, in engineering majors (Atman et al., 2010; Bernold, Spurlin, & Anson, 2007; Chubin, May, & Babco, 2005). In other words, the objective of this research is to help improve the effectiveness as well as the number and diversity of graduating students in engineering.

Atman et al. (2010) suggest that to more effectively prepare a more diverse community of engineering students it is fundamental to conduct research on the student experience during college. The authors propose that understanding the student experience goes beyond thinking about student learning, extending to thinking about students’ “motivation, their identification with engineering, their confidence, and their choices after graduation” (p. 11). Various researchers have aimed to better understand the student experience in college and particularly in engineering. Hutchison et al. (2006), through the
lens of social-cognitive theory, examined how first-year experiences of engineering students influenced their success, while Marra et al. (2012) set out to identify a set of factors describing the experience of students in engineering that influence persistence.

Comparisons between the experiences of students pursuing engineering degrees and those of students pursuing other majors show that engineering majors report significantly more time preparing for class and less time participating in educationally enriching experiences (Lichtenstein, McCormick, Sheppard, & Puma, 2010). Lichtenstein et al. propose that different educational outcomes between majors are the result of programmatic differences. The authors suggest that the packed engineering curriculum requires students to make trade-offs between gaining practical/marketable skills and participating in educationally enriching activities.

Research in engineering education, and specifically in persistence in engineering, suggests that there is a great variety of factors that influence whether or not students persist in engineering. Notably, some researchers propose that having a better understanding of the student experience, particularly during their first year of college, and using this information to develop approaches that are welcoming to a larger student population could help improve the number as well as the effectiveness and the diversity of students graduating in engineering (Atman et al., 2010; Hutchison et al., 2006).

Atman et al. (2010) also suggest that, even if the retention rate of engineering students were the same as that in other majors, the number of students migrating to engineering from other majors is low. In other words, whereas students migrate to and from other majors, engineering students generally migrate out of engineering and
students from other majors do not usually transfer in. This results in a net loss of students in engineering that is greater than that recorded for most other majors (Atman et al., 2010).

Another complicating factor identified by Atman et al. is that students who leave engineering are disproportionately from groups underrepresented in the field, including first-generation students, which results in graduating classes in engineering that are less diverse at the time of graduation than they were at the time of admission. This trend is particularly troublesome given that engineering is a promising degree choice in terms of increased social mobility because of the typically high starting salaries that accompany even entry level engineering jobs (Department of Education, 2003). Researchers propose that having a better understanding of the student experience could help not only to improve enrollment and retention rates, but could also result in greater diversity of graduating students in engineering (Atman et al., 2010; Hutchison et al., 2006; Marra et al., 2012).

**Persistence and Socio-Demographic Background**

By the beginning of the 20th century, access to higher education, shaped by social, political, and economic forces, had been significantly democratized and become inclusive of a more socio-economically diverse American population. For example, as a result of an increasingly industrial and urban society during the first decades of the century, institutions experienced both a major increase in enrollment and a shift in focus to producing graduates who would meet society’s demand for university-trained scientists (Goldin & Katz, 1999). By mid-century, access to college was further expanded as a
consequence of governmental policies such as the GI Bill, which had been introduced in 1944, as well as social movements such as the Civil Rights Movement and the War on Poverty.

These political, social, and economic changes acted as major forces in opening access to college to a socio-economically broader population that included students from a greater variety of cultural, ethnic, and racial backgrounds. One of the unintended complications of this increased access to higher education has been that such access has not necessarily meant greater affordability. In other words, for low-income students in the United States, higher education still represents a significant financial burden (Bozick, 2007).

Bozick (2007) argues that for students with limited means, the transition to college doesn’t look like the romanticized rite of passage depicted in popular media. Bozick lists several issues that low-income students face. First, rising tuition costs and an intimidating financial aid system are burdens for low-income students and their families who have to develop a series of strategies to afford college. In addition, low-income students often do not apply for financial aid either because they don’t think they qualify or because financial aid may come in the form of loans, which makes it unappealing to individuals who are already burdened financially. Finally, low-income students are less likely to be supported financially by their families (Bozick, 2007).

In order to address these challenges, low-income students generally need to: 1) work to pay for tuition, and 2) live at home to save on rent while attending college. Unfortunately, these two actions have repercussions on how students experience the
academic and social aspects of college and also on the time they are able to spend on academic tasks (Bozick, 2007). In a study of 788 institutions nationwide, Bozick found that among the 12,000 students in the sample, those who worked more than 20 hours a week to pay for tuition costs were 45% less likely to persist in college compared to those who worked fewer than 20 hours. The author also found that students who lived at home were 41% less likely to persist than their peers who lived on campus. Unfortunately, Bozick also found that those students with the fewest economic resources tended both to live at home and to work over 20 hours a week.

**Conceptual Models of Student Persistence**

Various authors have attempted to create conceptual models of student persistence to explain the factors that influence student persistence. Terenzini & Reason (2005) created a conceptual model for understanding the impact that multiple interrelated forces have on student academic success. They built their model on the foundation of prior theories of student persistence by recognized authors in the field such as Astin 1985, 1993; Tinto, 1975, 1993; Pascarella, 1985; Berger & Milem, 2000. Reason (2009) used that model of student success as a guide to examine more specifically the factors that influence student persistence in college. Reason’s Comprehensive Model of Influences on Student Learning and Persistence is shown in Figure 1.
Reason’s (2009) model seems promising in that it includes a wide variety of interconnected factors that influence students’ decisions to continue pursuing their majors from year to year. As shown in Figure 1, the model considers various personal characteristics of new students as they enter college, such as socio-demographic traits, pre-college academic preparation, and student dispositions, as well as characteristics of the specific organizational context into which these new students are entering. The model also includes the peer environment students will experience, including such features as campus, academic, and racial climates, as well as the experiences that students will have not only inside of the classroom, but outside as well. Furthermore, the model makes connections between those factors to show how, all together, they influence student persistence. Finally, in order to effectively address student persistence, Reason (2009) suggests that the study of persistence needs to be conducted in the local context, which includes the local organizational context and the local peer environment. Other
researchers have similarly suggested that persistence needs to be examined at the institutional level (Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton, 2008).

**Conclusion**

There are still many questions about how institutions can effectively address student persistence for an ever more diverse student population. Astin’s (1984) Theory of Student Involvement, emphasized the importance for students to spend adequate time engaging with the various aspects of college. Tinto’s Theory of Departure (1975) placed its emphasis on examining the experience of students as they transition to college, including their integration into both the academic and the social aspects of college. Research on persistence in engineering, persistence during the first year of college, and socio-economic influences on persistence revealed specific challenges in each of these areas. Finally, Reason (2009) proposed that both personal characteristics and institutional factors need to be considered to understand student persistence. These theories were used as a framework to design this study and as a guide to collect and analyze data in the specific local context of the study.
Chapter 3: Research Methodology

The main goal of this research study is to expand our understanding of the factors that influence student persistence in engineering. As discussed in Chapter 2, researchers studying persistence, both in college and in engineering, claim that student experience, especially during the first year of college, has a great effect on student persistence and state the need for conducting further research to better understand what shapes these experiences and how they influence persistence (Kuh et al., 2008; Tinto, 1998; Hutchison et al., 2006). Additionally, researchers suggest that in order to effectively address student persistence, studies need to be conducted in the local context (Reason 2009; Ohland et al., 2008). The claim that student experience influences persistence and the recommendation that research be conducted in the local context were taken into account in the design of this research study which explores student persistence in engineering through an examination of their reported experience during the first year of college in a specific context: a four-year public research university located in California. The pseudonym used for this university is California University (CU).

Research Questions

The three areas of research on persistence detailed in Chapter 2 - the first year of college, persistence in engineering, and socio-economic background - were used in the creation of the following main research question and four sub-questions:

What are the factors that influence student persistence in engineering?

1. How do engineering students experience the first year of college?
2. How do engineering students perceive the institutional resources designed to support them?

3. How does socio-economic background shape the experience of engineering students in college?

4. What other factors influence persistence in engineering during the first year of college?

To better distinguish between the different features of the first year of college, the main research question was broken down into four sub-questions. Question 1 was created in light of the literature which points to this time in students’ lives being critical to persistence and, thus, to better understand how students perceive their experiences during the first year. Question 2 was designed to better understand how students perceive the institutional resources specifically created to help them succeed in college. Question 3 was included in light of the literature which points to socio-demographics as an important factor that influences persistence. Question 4 was added to capture additional relevant data that may not have been elicited by questions (1-3).

**Conceptual Framework**

Reason’s (2009) Comprehensive Model of Influences on Student Learning and Persistence, as shown in Figure 1 of Chapter 2, was used as a conceptual framework to guide the data collection and analysis phases of this study. Therefore, this study collected and coded information in each of the four domains included in Reason’s model: student pre-college characteristics and experiences, the institutional organizational context, the
peer environment, and individual student experiences. Reason’s conceptual model was
described in more detail in Chapter 2.

Reason’s model was adapted to explore the particular factors that influence
students’ persistence during the first year of college in engineering. In Figure 2, the
section titled Student Precollege Characteristics & Experiences focuses, in this study, on
Socio-demographics and Educational Background. Within the First Year of College
section, Organizational Context and Individual Student Experiences were divided into the
seven factors found relevant to CU. Academic Life and Academic Policies are included
under the Organizational Context section. Life Transition, Social Life, Pre-College
Academic Performance, Organizational Skills and Learning Strategies, and Financial
Circumstances, are included under the Individual Student Experiences section. Chapter 4
includes findings for each of these seven factors.

**Figure 2:** Comprehensive Model of Influences on Student Persistence in Engineering
During the First Year of College (adapted from Reason, 2009).
Research Design

The combination of a priori (or predetermined) codes and emerging codes was used to analyze the data. Grounded theory (Corbin & Strauss, 2008) was used to identify emerging themes during the data analysis phase. A priori codes are shown in Table 3.

Table 3: Preliminary A Priori Codes

<table>
<thead>
<tr>
<th>Theme</th>
<th>A priori Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supportive to Students</td>
<td>SS</td>
</tr>
<tr>
<td>Not Supportive to Students</td>
<td>NSS</td>
</tr>
<tr>
<td>Socio-economic Background</td>
<td>SES</td>
</tr>
<tr>
<td>Institutional Resources/ Org. Context</td>
<td>IR</td>
</tr>
<tr>
<td>High School Academic Preparation</td>
<td>HAP</td>
</tr>
<tr>
<td>Time Management</td>
<td>TM</td>
</tr>
</tbody>
</table>

The first two codes, SS and NSS, were created to identify what students found supportive and non-supportive of their success as students. The next three codes, SES, IR, and HAP, were added based on Reason’s model. Given the claim that engineering generally requires more study time and takes away from other activities (Lichtenstein et al., 2010), time management was added with the code TM to identify instances when students described their need to balance or prioritize work hours and school work. As student answers to the survey and the interview questions were reviewed and analyzed, the a priori codes were modified to better match the emergent themes. SS and NSS were kept as sub-codes. SES, IR, HAP, and TM were renamed Financial Circumstances,
Academic Life, Pre-College Academic Preparation, and Organizational and Learning Skills respectively. The Academic Policies code was added in light of the student responses. Table 4 shows the final list of codes that was used throughout the rest of the data analysis phase to code the data collected from the survey and interview questions. During the data analysis phase, each of these coded categories was further separated into “supportive” and “non-supportive” sub-categories. The code Pre-College Academic Preparation, not included in Table 4, was used to analyze quantitative data.

**Table 4: Description of Codes Used on Survey and Interview Data**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Transition</td>
<td>This code was used when students talked about or expressed their feelings about being in college (e.g. being independent, having more responsibility, being excited)</td>
</tr>
<tr>
<td>Social Life</td>
<td>This code was used when students mentioned relationships with friends, family, and social activities (not organized or provided by the institution).</td>
</tr>
<tr>
<td>Academic Life</td>
<td>This code was used when students mentioned their experiences with their classes, majors, curriculum, pedagogies, etc., as well as when students talked about institutionally-provided resources intended to support them academically, psychologically, emotionally, and spiritually.</td>
</tr>
<tr>
<td>Organizational Skills and Learning Strategies</td>
<td>This code was used when students referred to self-regulation skills such as time management, learning strategies, and ability to prioritize their work, social activities, and studies.</td>
</tr>
<tr>
<td>Financial Circumstances</td>
<td>This code was used when students mentioned financial resources, including concerns about paying for college, obtaining financial aid, etc., as well as general statements about having adequate financial resources.</td>
</tr>
<tr>
<td>Academic Policies</td>
<td>This code was used when students mentioned making decisions about their persistence based on a university policy.</td>
</tr>
</tbody>
</table>
Data Collection

In order to address the main research question, the study was designed to elicit students’ experiences during the first year of college. The study used a mixed-methods approach to data collection. Creswell (2009) suggests that mixed-methods studies reside somewhere in the middle of a continuum between more qualitative and more quantitative studies, and incorporate elements of both approaches. In this study, an online survey with both open-ended and multiple choice questions, as well as semi-structured one-on-one interviews, were used to collect data. The survey collected both quantitative and qualitative data. The quantitative data describe the demographics of the study sample and the qualitative data, also collected during the interviews, reveal perceptions and experiences of students in the sample.

Table 5 shows how each survey and interview question addressed the main research question and its sub-questions. There were 19 survey questions, identified in Table 5 as Q1 through Q19. Students were asked to elaborate on their answers to these questions in the interviews. They were also asked to provide one piece of advice for a hypothetical incoming freshman (Q20). Therefore interview questions in Table 5 include Q1 through Q20. The full description of the questions are included in the appendix.
Table 5: Data Collection Matrix: Research Questions in Relation to Survey and Interview Questions and Sub-questions

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Sources: Survey (Q1-19) and Interviews (Q1-20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the factors that influence student persistence in engineering?</td>
<td>Q1, Q2, Q3: major changes &amp; reasons</td>
</tr>
<tr>
<td>How do engineering students experience the first year of college?</td>
<td>Q4: units taken</td>
</tr>
<tr>
<td></td>
<td>Q5: Pre-College Academic preparation</td>
</tr>
<tr>
<td></td>
<td>Q8, Q10: Best and most supportive</td>
</tr>
<tr>
<td></td>
<td>Q9, Q11: Challenging and least supportive</td>
</tr>
<tr>
<td></td>
<td>Q12: Additional supports</td>
</tr>
<tr>
<td></td>
<td>Q15: GPA</td>
</tr>
<tr>
<td></td>
<td>Q19: Other factors</td>
</tr>
<tr>
<td></td>
<td>Q20: Advice to high school student</td>
</tr>
<tr>
<td>How do students perceive the institutional resources designed to support them?</td>
<td>Q6: Summer programs</td>
</tr>
<tr>
<td></td>
<td>Q7: First-year program</td>
</tr>
<tr>
<td></td>
<td>Q8, Q10: Best and most supportive</td>
</tr>
<tr>
<td></td>
<td>Q9, Q11: Challenging and least supportive</td>
</tr>
<tr>
<td></td>
<td>Q12: Additional supports</td>
</tr>
<tr>
<td></td>
<td>Q19: Other factors</td>
</tr>
<tr>
<td>How does socio-economic background shape the experience of students in college?</td>
<td>Q8, Q10: Best and most supportive</td>
</tr>
<tr>
<td></td>
<td>Q9, Q11: Challenging and least supportive</td>
</tr>
<tr>
<td></td>
<td>Q12: Additional supports</td>
</tr>
<tr>
<td></td>
<td>Q13: Residence</td>
</tr>
<tr>
<td></td>
<td>Q14: Work</td>
</tr>
<tr>
<td></td>
<td>Q17: Pell Grant</td>
</tr>
<tr>
<td></td>
<td>Q19: Other factors</td>
</tr>
<tr>
<td>What other factors influence persistence in engineering during the first year of</td>
<td>Q8, Q10: Best and most supportive</td>
</tr>
<tr>
<td>college?</td>
<td>Q9, Q11: Challenging and least supportive</td>
</tr>
<tr>
<td></td>
<td>Q12: Additional supports</td>
</tr>
<tr>
<td></td>
<td>Q16 Ethnicity</td>
</tr>
<tr>
<td></td>
<td>Q18 Gender</td>
</tr>
<tr>
<td></td>
<td>Q19: Other factors</td>
</tr>
<tr>
<td></td>
<td>Q20: Advice to high school student</td>
</tr>
</tbody>
</table>

Quantitative data

Multiple choice questions in the online survey asked students about their majors, their plans to continue or not in their majors and in college, and number of courses taken.
Students were asked to rank how well they felt their high schools prepared them for college, with 1 being poorly to 6 being very well. They were also asked whether or not they had participated in summer programs for incoming students or first-year orientation courses. Finally, they were asked to report GPA range, where they lived during the first year of college, their gender, hours worked per week, if they were Pell Grant recipients, and their ethnicity.

Qualitative data

There were seven open-ended questions in the online survey and in the interviews that allowed students to express in more detail why they had decided to stay or leave their majors, what were the best aspects and the most challenging aspects of college, what was most and least supportive of their success as students during their first year, and what else could have helped them to succeed. They were also asked to include any other information about things that were important to them but had not been covered in the survey or the interview. These questions were intended to elicit from students what they thought was supportive and not-supportive of their success as students during the first year of college. The questions also allowed for patterns to emerge during the data analysis process that indicated areas of particular importance to the student participants.

During the interviews, students were asked to elaborate on their answers to the survey. Additionally, they were asked to provide one piece of advice for a hypothetical incoming freshman. Given the semi-structured design of the interviews, other questions were asked, when relevant, to gain further insight into the experience of students during their first year of college.
Research Procedures

The study took place over a twelve month period between May 2016 and May 2017. Data for this research study was collected in two phases. The first phase consisted of a confidential online survey created in Google Forms. The second phase consisted of semi-structured, one-on-one interviews. Toward the end of their first year of college, 829 freshman engineering students were emailed a link to the confidential online survey that they could complete at their convenience. Eighty-four students responded to the online survey. One-on-one interviews were conducted with a sub-sample of students who completed the survey phase and who had agreed to participate in the interview phase. Eight students were selected for the interview phase out of 41 students who agreed to be interviewed.

Survey

The survey was designed to take no more than 20 minutes to complete. Before taking the survey, students completed a research subject consent form approved by the Institutional Review Board (IRB) that was linked to the online survey and that they could print out for their records. At the end of the survey, students indicated their interest in participating in the interview phase by providing their names and contact information. Otherwise, the online surveys were completed anonymously.

Interviews

Seven of the one-on-one interviews were conducted by me in a quiet group study room at the university library at a mutually agreed upon time. One interview was
conducted by video call because the student was not available to meet in person at the time. The interviews were designed to last no longer than 60 minutes. The actual duration of the interviews varied between 25 minutes and 50 minutes with an average duration for all eight interviews of 40 minutes. Before starting the interview, students read and signed participation and audio recording consent forms approved by IRB. The interview questions were designed with a semi-structured approach with the intent of gaining meaningful data regarding students’ experiences during their first year of college. Each student who participated in the interview received a $25 gift card for their willingness to participate in the interview phase of the study. No compensation was given to those participants who only completed the initial online survey.

**Data Reduction Strategies**

**Sampling**

Miles, Huberman and Saldaña (2014) advise against “sampling too narrowly” (p. 36) and argue that researchers should talk to people who are not central to the phenomenon. This approach allows for obtaining contrasting and comparative information that can help us better understand the phenomenon at hand. In this study, this approach was used when selecting the interviewees. Instead of focusing narrowly on students who had left their engineering majors or on those who had persisted in their majors, both sets of students were invited to participate in the interviews. This allowed for the collection of narratives not only about why students leave engineering, but also about why they stay. It also allowed for collecting contrasting experiences of the first year of college.
Data Reduction

Student responses were divided into those who agreed to be interviewed and those who didn’t. The group that agreed to be interviewed was examined with an eye towards finding students who had changed or were planning on changing to a major outside of engineering. The plan was to interview eight students, four who stayed in engineering and four who had left their engineering majors. Also, ideally, students in this sample would have varied socio-economic backgrounds.

In the survey sample, there were only three students who had left their majors and had also agreed to be interviewed. I contacted them first. I also selected a fourth student who had wanted to change to a different engineering major but hadn’t and who happened to also be the only one in that group from a lower API high school. Finally, I selected four students who had not changed majors and had not expressed any desire to do so. These last four students were selected based on their responses to the survey (positive and negative responses related to their educational background, financial situation, or current academic performance).

Data Analysis

After the survey was closed, all survey data was downloaded into spreadsheets to facilitate the computation of descriptive statistics (frequency counts) for the entire cohort of students, for those who responded to the survey, and for those who were interviewed. The statistical descriptions were grouped into tables based on several categories: First-Year Persistence in Engineering, Pre-College Academic Preparation, Socio-Economic Background, Academic Performance, and Demographic Information.
As soon as each interview was completed, I listened to the audio recording and made field notes. The interviews were transcribed and the transcriptions were uploaded to the software program MAXQDA (VERBI, n.d.) for analysis. Once uploaded, I listened to the audio recording again while adding timestamps, making corrections to the transcript, and making notes for myself about any new insights that emerged while listening to the recording.

All survey questions and interview transcripts were coded using the system presented previously in this chapter. The coding was developed over time and refined with feedback from other researchers. Blinded copies of random interview transcript extracts were given to seven people to code. In a group setting, we compared and discussed our coding decisions. After further analysis and comparison of their codings to mine, I streamlined the codes and revised their descriptions for clarity.

After the coding phase was complete, I performed several analyses using MAXQDA that allowed me to compute frequency counts for each code and to separate each coded category into what was supportive and non-supportive to students during their first year at this institution. The tables created through this stage of data analysis are included in the following sections.

**Participants**

The population of this research study is the 829 engineering students who started at California University (CU), a pseudonym, in 2015. The survey sample includes 84 students. The interview sample, which was drawn from the survey sample, includes 8 students. A more detailed description of CU can be found in Chapter 1.
First-Year Persistence in Engineering

As shown in Table 6, of the 829 students who enrolled in engineering in 2015, 93% (n = 767) were still enrolled in their original major or a different major within engineering at the start of their second year in Fall 2016 at CU. Six percent of students (n = 51) changed to a major outside of engineering. Of these 51 students, 51% (n = 26) stayed within STEM majors and 49% (n = 25) changed to non-STEM majors. One percent of students (n = 11) were not registered at CU in Fall 2016. Whether they had transferred to another institution or had left college altogether is not known.

Table 6: Major Changes for 2015 Cohort of Engineering Students

<table>
<thead>
<tr>
<th>Number of students at the end of first year</th>
<th>Fall 2015</th>
<th>Fall 2016</th>
<th>Survey</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>829</td>
<td>767</td>
<td>77</td>
<td>5</td>
</tr>
<tr>
<td>Stayed in same Major</td>
<td>576</td>
<td>67</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Changed within Engineering</td>
<td>191</td>
<td>10</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Changed out of Engineering</strong></td>
<td><strong>51</strong></td>
<td><strong>6</strong></td>
<td><strong>3</strong></td>
<td><strong>11</strong></td>
</tr>
<tr>
<td>Stayed in STEM</td>
<td>26</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Changed outside of STEM</td>
<td>25</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Didn’t Register</strong></td>
<td><strong>11</strong></td>
<td><strong>1</strong></td>
<td><strong>0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>829</strong></td>
<td><strong>84</strong></td>
<td><strong>8</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 also shows that 92% (n = 77) of the 84 survey respondents were still enrolled in an engineering major in Fall 2016. Sixty-seven stayed in their original
engineering majors and 10 changed from one engineering major to another engineering major), 7% \( (n = 6) \) changed to a major outside of engineering, and only 1 student was not registered at CU in Fall 2016. Finally, of the 8 interviewees, 63% \( (n = 5) \) were still enrolled in an engineering major in Fall 2016 and 37% \( (n = 3) \) changed to a major outside of engineering. All three of these students, although no longer in the engineering field, chose an alternative major within STEM. Two students chose Mathematics - Computer Science under the Division of Physical Sciences and one student chose Physiology and Neurosciences under the Division of Biological Sciences.

Pre-College Academic Preparation

The 2015 cohort of freshman engineering students \( (N = 829) \) attended high schools across the full range of academic performance rankings, as indicated by the Academic Performance Index (API), which is based on statewide assessments of schools. As described by the California Department of Education: “The API is a single number, ranging from a low of 200 to a high of 1000, which reflects a school’s (...) performance level, based on the results of statewide assessments. Its purpose is to measure the academic performance and improvement of schools” (California Department of Education, n.d., p. 1).

High schools in the first, second, and third quintiles are classified as “well above average”, “above average”, or “about average” respectively compared to high schools with similar opportunities and challenges (California Department of Education, n.d., p. 4). High schools in the fourth and fifth quintiles of API rankings are classified as “below average” or “well below average” respectively compared to high schools with similar
opportunities and challenges. High schools in the fourth and fifth quintiles are generally considered to be not only under-performing but also under-resourced. The list of students from the 2015 cohort of freshman engineering students \((N = 829)\) was separated into two groups based on the API rankings of the high schools they attended. One group included students from high schools in the first, second, and third quintiles. The second group included students from high schools in the fourth and fifth quintiles. The objective of this separation was to allow for analysis of how differences in students experiences during their first year of college in engineering might vary based on socio-economics and pre-college academic preparation.

As shown on Table 7, of the cohort of 829 students, 76\% \((n = 632)\) attended high schools in the top three API quintiles, 7\% \((n = 59)\) attended high schools in the lower API quintiles, and 17\% \((n = 138)\) attended high schools that were not ranked. High schools are generally not ranked when they are independent or out of state.

**Table 7: 2015 Cohort of Students Enrolled in Engineering by API Ranking**

<table>
<thead>
<tr>
<th>High School API</th>
<th>Fall 2015</th>
<th>Survey</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher performing</td>
<td>632</td>
<td>62</td>
<td>4</td>
</tr>
<tr>
<td>Lower performing</td>
<td>59</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Not ranked</td>
<td>138</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>829</strong></td>
<td><strong>84</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>
Table 7 also shows that of the 84 students who responded to the survey, 74% \((n = 62)\) attended high schools in the top three API quintiles, 4% \((n = 3)\) attended high schools in the lower API quintiles, and 23% \((n = 19)\) attended high schools that were not ranked. Finally, of the 8 students who were selected for interviews, 50% \((n = 4)\) attended high schools in the top three API quintiles, only one student attended a high school in the lower API quintiles, and 38% \((n = 3)\) attended high schools that were not ranked.

Students were also asked to rank how well they felt their high schools prepared them for college, with 1 being poorly to 6 being very well. As shown in Table 8, of the 84 survey respondents, 80% \((n = 67)\) responded 4 or above and 20% \((n = 17)\) responded 3 or below. Of the 8 interviewees, 63% \((n = 5)\) responded 4 or above and 37% \((n = 3)\) responded 3 or below.

**Table 8:** Pre-College Academic Preparation

<table>
<thead>
<tr>
<th>High school preparation</th>
<th>Survey</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 4</td>
<td>67</td>
<td>5</td>
</tr>
<tr>
<td>&lt;= 3</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>8</td>
</tr>
</tbody>
</table>

**Socio-Economic Background**

In addition to tracking the API ranking of the high schools students attended, students were also asked if they received Pell Grant assistance during the first year of college. Receipt of a Federal Pell Grant was taken as a marker of financial need because to qualify, students need to demonstrate financial need. As shown in Table 9, of the 84
students in the survey sample, 36% ($n = 30$) students were Pell Grant recipients. Of the 8 interviewees, 75% ($n = 6$) students were Pell Grant recipients.

Also, as a possible marker of financial need, students were asked if they had held employment, and if so, to specify the range of hours they worked per week. Of the 84 survey respondents, 75% ($n = 63$) did not work in a paying job during their first year of college, 23% ($n = 19$) worked between 1 and 20 hours, and one student worked over 31 hours a week. Of the 8 interviewees, 7 students did not work in a paying job during their first year of college and 1 student worked between 11 and 20 hours.
### Table 9: Socio-Economic Background

<table>
<thead>
<tr>
<th></th>
<th>Survey</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pell Grant (Y)</strong></td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td><strong>Worked in a paying job</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>63</td>
<td>7</td>
</tr>
<tr>
<td>1-10 hrs.</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>11-20 hrs.</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>21-30 hrs.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31-40 hrs.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On campus</td>
<td>78</td>
<td>6</td>
</tr>
<tr>
<td>Off campus - parents</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Off campus - roommates</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No data</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

It has been noted (Bozick, 2007) that students who have financial need often, out of necessity, choose to live at home while going to college. Therefore, students were asked where they lived during their first year of college. Of the 84 students in the survey sample, 93% \((n = 78)\) lived on campus, 5% \((n = 4)\) lived off campus with parents, and 1 lived off-campus with roommates. Of the 8 interviewees, 6 students lived on campus, 1 lived off-campus with parents, and 1 lived off-campus with roommates.
Academic Performance

At the end of the first year of college, as shown in Table 10, of the 84 students in the survey sample, 40% \((n = 34)\) of students had a GPA over 3.5 out of a total of 4 points, 37% \((n = 31)\) students had a GPA between 3 and 3.49, 19% \((n = 16)\) had a GPA between 2.5 and 2.99, and 2% \((n = 2)\) had a GPA between 2 and 2.49. No students reported GPAs below 2.0. One student’s GPA data was not reported. Of the 8 students in the interview sample, 1 student had a GPA over 3.5, 3 students had a GPA between 3 and 3.49, 3 had a GPA between 2.5 and 2.99, and 1 had a GPA between 2 and 2.49. No students reported GPAs below 2.0.

Like most students at this university, survey respondents were all full-time students. At this institution, a student who enrolls in 12 units (generally three courses) per quarter is considered full time. Some students pursuing majors outside of engineering can graduate in four years taking 12 units per quarter. However, for most engineering students, graduating in four years requires taking at least 16 units per quarter. Even so, the most recent four-year graduation rate in engineering at this institution was 49% compared to 55% for all majors. The six-year graduation rate was 87% which is the same as the average rate for all majors.

The need to take between 12 and 16 units per quarter was reflected in the survey responses of the 2015 cohort of freshman engineering students. With the exception of 1 student, who took fewer than 12 units for one quarter, all survey respondents were full-time students. Of the 84 student respondents, 26% \((n = 22)\) took between 12 and 16 units, 50% \((n = 42)\) took over 16 units per quarter for at least one quarter, and 23% \((n = 19)\)
enrolled in over 16 units all three quarters. That is, 73% of students enrolled in over 16 units per quarter for at least one quarter during their first year. Of the eight interviewees, 63% ($n = 5$) took between 12 and 16 units and 37% ($n = 3$) took over 16 units per quarter for one to two quarters.

Regarding participation in summer or first-year programs, of the 84 survey respondents, 17% ($n = 14$) participated in pre-college summer programs and 38% ($n = 32$) participated in first year orientation programs. Of the 8 interviewees, 50% ($n = 4$) participated in pre-college summer programs and 37% ($n = 3$) participated in first year orientation programs.
### Table 10: Academic Performance

<table>
<thead>
<tr>
<th>First-year GPA range</th>
<th>Survey</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5+</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>3-3.49</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>2.5-2.99</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>2-2.49</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Number of units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 12 for one quarter</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Between 12 and 16</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>16 or more (1 or two quarters)</td>
<td>42</td>
<td>3</td>
</tr>
<tr>
<td>16 units or more (all three quarters)</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Participated in summer program for incoming admitted students</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Participated first-year program</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td><strong>84</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

**Demographic Information**

*Gender:* Students had the choice of selecting between the following categories: Female, Male, and Other. If they selected “Other,” they were also given the opportunity to further describe their gender category. As shown in Table 11, the survey sample included 35
females, 46 males, and 3 participants of gender that was either marked “Other” or who did not answer. The interview sample included three females, four males, and 1 participant of gender that was marked as “other”.

*Ethnicity:* Given the multitude of ways people can think about race, ethnicity, and national origin, rather than providing preset categories, respondents were asked to write in their own ethnicity. Answers to this question were then grouped into general categories based on student responses: Asian, Asian/Indian, Chinese, Filipino, Hispanic/Latina(o), White/Caucasian, Mixed, and Other/not stated. Interviewees identified with six different ethnicities: Asian, Asian/Indian, Hispanic/Latino(a), White, Chinese, and Mixed.
Table 11: Student Demographic Information

<table>
<thead>
<tr>
<th></th>
<th>Survey</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>Male</td>
<td>46</td>
<td>4</td>
</tr>
<tr>
<td>Other/Unknown</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Asian/Indian</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Chinese</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Filipino</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Hispanic/Latina(o)</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Mixed</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Other/Not stated</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

Qualitative Data Summary

The analysis of student survey responses and their interview transcripts resulted in a general understanding of what students perceived to be supportive and not supportive during their first year of college. Additionally, these data provided insight into how very different the experiences of students during their first year of college can be.
Answers to the seven open-ended questions from the survey and from the interview questions were coded using the codes and code definitions previously shown in Table 4 in Chapter 3. The frequency of each of the codes for each open-ended question is shown in Table 12. The data contained in this table is analyzed in Chapter 4 to describe the findings for this study. The full survey questions can be found in the appendix.

Table 12: Response Frequencies of Survey Questions vs. Factors

<table>
<thead>
<tr>
<th>Factors/ Survey Questions</th>
<th>Q8 Best of college</th>
<th>Q9 Most challenge</th>
<th>Q10 Most support</th>
<th>Q11 Least support</th>
<th>Q12 Other support</th>
<th>Q19 Other aspects</th>
<th># of students who mentioned category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Transition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of students</td>
<td>24</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>% of students</td>
<td>29%</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>30%</td>
</tr>
<tr>
<td>Social Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of students</td>
<td>29</td>
<td>8</td>
<td>36</td>
<td>9</td>
<td>4</td>
<td>9</td>
<td>61</td>
</tr>
<tr>
<td>% of students</td>
<td>35%</td>
<td>10%</td>
<td>43%</td>
<td>13%</td>
<td>6%</td>
<td>35%</td>
<td>73%</td>
</tr>
<tr>
<td>Academic Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of students</td>
<td>30</td>
<td>35</td>
<td>24</td>
<td>41</td>
<td>43</td>
<td>13</td>
<td>72</td>
</tr>
<tr>
<td>% of students</td>
<td>36%</td>
<td>43%</td>
<td>29%</td>
<td>58%</td>
<td>60%</td>
<td>50%</td>
<td>86%</td>
</tr>
<tr>
<td>Org. Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of students</td>
<td>0</td>
<td>34</td>
<td>22</td>
<td>19</td>
<td>24</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>% of students</td>
<td>0%</td>
<td>41%</td>
<td>27%</td>
<td>27%</td>
<td>33%</td>
<td>15%</td>
<td>70%</td>
</tr>
<tr>
<td>Financial Circ.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of students</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>% of students</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
<td>1%</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>82</td>
<td>83</td>
<td>71</td>
<td>72</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>(417 codings)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Positionality

Given the importance of researchers recognizing how their own backgrounds can shape the interpretation of their research (Creswell, 2009), I would like to present my
positionality within this study. I have worked with students on both ends of the spectrum of pre-college academic preparation during my career in academia. At the start of my career, and for seven years, part of my work entailed developing and managing a scholarship program that provided full-ride scholarships to the very top academic students admitted to the university. Over the last ten years, I have taught a course series that focuses on the successful transition and orientation of students to engineering. Although the course series is open to any student who is interested in learning more about engineering, it is specially recommended to first-year students who come from economically and educationally disadvantaged backgrounds. Although the students in my classes are the best performing students from their high schools and come with impressive GPAs, they have a significantly different preparation from the students I worked with during the first seven years of my career.

Through teaching this course series I have become aware of the difficulties some students face. I have heard many stories about financial hardship, lack of academic preparation, and lack of organizational skills. I see how some students get disheartened when just three months prior they were the best students at their high schools and now they are hardly able to pass their classes. These experiences have shaped how I see the world of education. I see large disparities, and I also see students who are placed in extremely difficult competition with their peers. My intent for this study, however, is not to confirm my own theories, but rather to dig deeper into the actual experiences of students, and to create a better understanding of what their experiences are like and how those experiences influence the decisions they make going forward as they pursue their degrees.
In order to minimize any potential bias about what I think might be influencing student persistence, I have based my research design as much as possible on my review of the literature and on what is already known from that research about the influences on persistence - not on my personal thoughts, professional experiences, or resulting convictions. Finally, I have sought the input of others as I have analyzed the data to get various perspectives and explanations about what this data might be revealing about the influences on student persistence.

Limitations

The purpose of this study is to bring to light a unique challenge: understanding how students from various academic and socio-economic backgrounds (facing a variety of hurdles in completing their majors) on their path to obtaining an engineering degree (a longer-to-complete major with lower retention rates) experience their first year of college and how that experience influences their decision to persist in their majors. The goal, in other words, is to explore how students in this particular social and institutional context, navigate through their first year of college, and what decisions they make along the way on their path to graduation with respect to persistence in their chosen path of university study.

By design, this study is conducted in a specific context and focuses on a particular set of students and therefore may have limited generalizability to other institutions. However, the design and findings of this study can provide insight into how to explore and understand the unique experience of various groups of students as they pursue college and how these experiences influence their intent to persist in their majors and in
their pursuit of a university education. As such, this information can be used by researchers, administrators, and institutions to further support students in other contexts on their journey toward obtaining college degrees.
Chapter 4: Findings

This research study aimed to understand how the experience of first-year college students, as well as other factors, influences these students’ persistence in their engineering majors. As described in Chapter 3, a mixed-methods approach was used to collect both quantitative and qualitative data through an on-line survey and one-on-one interviews. This chapter describes the findings that resulted from the analysis of the data for the main research question and sub-questions described in Chapter 3 and listed here:

Research Questions

What are the factors that influence student persistence in engineering?

1. How do engineering students experience the first year of college?
2. How do engineering students perceive the institutional resources designed to support them?
3. How does socio-economic background shape the experience of engineering students in college?
4. What other factors influence persistence in engineering during the first year of college?

Findings

As described in Chapter 3, 93% \((n = 767)\) of the cohort of 829 engineering freshmen who started in 2015 were still enrolled in an engineering major by the end of their first academic year. Similarly, of the 84 students from this cohort who responded to the survey, 92% \((n = 77)\) were still enrolled in engineering majors by the end of their first year. The
other 8% of the students who responded to the survey changed to majors outside of engineering, except for one who left the university altogether.

The analysis of student responses to a direct survey question about why they decided either to continue or to leave their engineering majors indicates that students make decisions about staying or leaving engineering based mostly on their feelings about the major and whether or not they perceive themselves to “like” the academic content. More specifically, the most common reasons given by respondents for persisting in their majors were related to engineering being what they enjoy, want to do, or are excited about.

As shown in Table 13, of the 77 students who were still enrolled in an engineering major by the end of their first year of college, 67 had stayed in their original engineering majors and 10 had changed to other majors within engineering. Of the 67 students who stayed in their original majors, 81% (n = 54), when asked to elaborate on their decisions, gave responses that reflected their perceived emotional responses to their experience of their studies thus far. Several representative responses are: “I like the topics that are taught in the engineering classes”; “I like what I'm studying”; “I enjoy what I'm doing”; “I like my major”; “I am excited about my major”; “It’s fun”.

A smaller number of students (n = 4) gave responses that presented an emphasis on pragmatism and practicality. They elected to stay in engineering because they saw it as a good career choice or, as one student said, because, it “provides me with the skills to make a big impact in the world.” In contrast, four additional students stated that they had chosen to stay in their original engineering majors, not by personal choice, but because they could not switch to a different engineering major that they thought would be more suitable for
them. They were not able to switch because their grades did not meet the minimum departmental requirement to change majors. These are some of their responses: “Too hard to transfer into other impacted majors”; “My GPA is not good enough to switch majors”; “My grades aren't high enough to switch”.

**Table 13: Survey Respondents, Their Majors, and Reasons for Staying or Changing Majors**

<table>
<thead>
<tr>
<th>Reason for staying or leaving major</th>
<th>Number of Students at the end of first year – Survey (84)</th>
<th>Number of Students who Stayed in an Engineering Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stayed in an Engineering Major</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Changed within Engineering</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Changed out of Engineering</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Left college</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Of the 10 students who elected to change from the engineering major they had chosen at the time of admission to an alternative major in the engineering school, all stated reasons for wanting to change that expressed the realization that their original engineering major choice was not well suited to them or that they didn’t like it. The 6 students who left engineering for a major in a different division described coming to the realization that their choice of major was not well suited to them. However, their experience went beyond
simply a lack of interest or passion for their chosen major, and involved either finding something more attractive outside of engineering or, in some cases, the perception that engineering was too difficult. Several representative responses are: “I enjoy the arts more”; “I realized I did not like the sciences very much”; “lack of interest”; “This is too difficult and I don't feel passionate about this”; “too hard and not interested”. These were the student responses to a direct question about their decision to stay or leave their majors.

Further analysis of the data revealed that other factors were also at play in influencing student persistence in engineering. These factors were introduced in Chapter 3. The analysis of these factors and corresponding findings are presented in the following sections. There were seven factors found to influence persistence: Life Transition, Social Life, Academic Life, Pre-College Academic Preparation, Organizational Skills and Learning Strategies, Financial Circumstances, and Academic Policies.

**Life Transition**

As students transition from high school to college, they encounter a new academic environment that presents them with new expectations and challenges. One common characteristic expressed by engineering students in this study was a sense of excitement about their lives in college. The students cited their newly acquired independence and feelings of increased responsibility as exciting and motivating aspects of college life. As shown in Table 14, of the 84 survey respondents, statements related to their transition to college were mentioned by 30% ($n = 25$) of students.
Table 14: Response Frequencies of Survey Question, divided into Positive Experiences and Negative Experiences for Life Transition

<table>
<thead>
<tr>
<th>Life Transition</th>
<th>Positive Experience</th>
<th>Negative Experience</th>
<th>Total # of Students who mentioned this category</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students</td>
<td>24</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>% of students</td>
<td>29%</td>
<td>5%</td>
<td>30%</td>
</tr>
<tr>
<td># of codings</td>
<td>24</td>
<td>4</td>
<td>28</td>
</tr>
</tbody>
</table>

Although the Life Transition factor was not brought up by the majority students, those students who did mention this transitional phase stated that it was a positive time in their lives. Of the 84 survey respondents, 29% ($n = 24$) thought the best part of college had to do with becoming more independent and responsible. One student reported that “experiencing independence” was the best part of college; others said that the best part of their first-year college experience was: “beginning to become independent and doing things for myself.”; “becoming more independent and forging meaningful relationships”; or “being introduced into a completely new environment than from where I was from. People were invested and interested in their education, and many people were very friendly and mature.” Only 5% ($n = 4$) of respondents thought that adjusting to this newly acquired independence was the most challenging aspect of college. In short, the transition to college was described positively by 29% of students compared to 5% of students who described this transition as negative.
Finding 1

When students talked about the transition to college, they described a time in their lives when they experienced increased independence and freedom. Although sometimes challenging, most students welcomed and enjoyed this aspect of college.

Social Life

Friends and family, but especially the topic of friends, was a recurrent theme among students’ responses. As shown in Table 15, of the 84 survey respondents, 73% \((n = 61)\) mentioned the social aspect of college in at least one of their responses. Making friends, having friends, or being both supported and distracted by friends seemed to be foremost in students’ minds as they thought of their experiences during the first year of college. Of all survey respondents, as shown in Table 12 in Chapter 3, 43% \((n = 36)\) found friends, family, and social groups in general to be what best supported them as students during their first year. Additionally, 35% \((n = 29)\) thought that the best part of college was related to relationships with friends. One student reported that “the friends I have made here are directly experiencing the same struggles that I am, so having empathy for one another helped us know that we were not alone. My parents also helped me through the year by supporting what I did well and letting me know that I always have potential even when I do poorly.” Another student stated: “My friends motivated me the most to persevere through my classes.” Another representative example of this point of view was expressed by this student: “I think that my friends and family were the most supportive of my success. They all helped me with staying focused and not dwelling on the bad grades.” A relatively small number of students, \((n = 16)\) found that lack of
friends, distraction from friends, and the task of making new friends to be either the least supportive part of college or its most challenging aspect.

**Table 15: Response Frequencies of Combined Survey Question Divided into Positive Experiences and Negative Experiences for Social Life**

<table>
<thead>
<tr>
<th>Social Life</th>
<th>Positive Experience</th>
<th>Negative Experience</th>
<th>Total # of Students who mentioned this category</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students</td>
<td>56</td>
<td>16</td>
<td>61</td>
</tr>
<tr>
<td>% of students</td>
<td>67%</td>
<td>19%</td>
<td>73%</td>
</tr>
<tr>
<td># of codings</td>
<td>78</td>
<td>17</td>
<td>95</td>
</tr>
</tbody>
</table>

To further understand what students found positive (supportive) and negative (non-supportive), responses to survey questions were combined as shown in Table 15 for Social Life. As shown in Table 15, social life was described positively by 67% of students compared to 19% of students who described social life as challenging.

**Finding 2**

Most students in this study found that the social aspect of college and the support they received from family and friends were critical to their success during their first year in college.

**Academic Life**

For the purpose of this study, Academic Life includes the academic curriculum, course content, pedagogies, and related aspects of teaching and learning, as well as institutional resources. Institutional resources are programs and activities provided by the
institution to support students. They include organized learning communities, free
tutoring programs, recreational activities, and other organized activities offered by the
university to support students academically, psychologically, emotionally, and spiritually.
Students participate in these activities in addition to their regular courses.

As shown in Table 16, of the 84 survey respondents, 86% (n = 72) of the students
mentioned academic life in at least one of their responses. As shown in Table 12 in
Chapter 3, 36% (n = 30) of survey respondents thought that the best part of college
related specifically to academic life. Students expressed excitement over being exposed
to a new and interesting curriculum, “a lab seminar with hands on work”; “taking classes
that were actually interesting to me”; “finally being able to write code for programming
assignments that were potentially useful”; “learning about a subject I've never learned
before.” Some students found their new academic life was a welcome change from high
school. For example, one student stated: “I enjoyed many of my hands on lab classes;
they were very different from high school and allowed me to apply what I knew.”

Students also cited institutional resources as the best part of their first year of
college. For example, students cited learning communities, student organizations, and
recreational and residential activities as the best part of college. Some students stated that
these institutional resources brought a welcome relief from the challenges of academic
life. One student stated: “I'm very thankful for all the event planning that goes on within
the school, clubs, and individual colleges. They made my college experience much more
exciting, despite my heavy course load.” Another student stated: “Participation in my
Christian group; my Christian brothers and sisters were the most supportive people
during difficult times.” Another student responded: “It was incredibly beneficial to get advice from older students (...) and get a peek at what it is like beyond the first year of college which is overwhelming. It definitely allowed me to gain more confidence. Joining an engineering related club (IEEE) was also crucial in helping me decide where my passions in engineering lied.”

On the other hand, 43% ($n = 35$) of survey respondents found the curriculum (specifically mathematics and physics) and other academic aspects of college to be the most challenging aspect of their first year. Some students referred to: “tutors/TA/ambiguous assignments and instructions”; “the pacing and rigor of the courses”; “classes, especially computer science, were really difficult”; “the course curriculum was the most challenging for me”; “all of my classes were very difficult”.

Interestingly, 58% ($n = 41$) of survey respondents thought that they were least supported by precisely those resources that were meant to provide them with additional help. As one student put it, the least supportive aspect of college was “student resources aimed toward helping students succeed at school.” Another student carefully described “the one thing that was least supportive during my first year (at times) were my TAs (not all of them). Although TAs are supposed to help undergraduate students learn, many times (not all the time) my TAs were not at all supportive and were not very helpful in helping me learn the topic at hand. At times, they were even condescending and did not make a conducive learning environment.” Other examples of responses of this type include: “Some of the teachers were extremely vague on what they wanted and so it became difficult to prioritize what information needed to be studied and what was a
tangent”; and “The administration is not really that supportive. The advisers were not that helpful in selecting classes and helping out with advice.” These students cited either that academic resources or support systems were inadequate or that they didn’t have enough information about them. When asked what else could have supported them during their first year in college, 60% of students ($n = 43$) felt that more or better resources could have been provided by the institution.

When asked about what aspects of their first year experience were most supportive of their success, 29% ($n = 24$) of respondents mentioned aspects related to academic life. The importance of having appropriate resources was apparent in the responses of some students. One student who was experiencing a personally difficult time stated that, thanks to faculty and staff realizing he needed help and reaching out to him, he was able to find the help he needed. The student stated: “At one point, that's like the point where I didn't shower, I didn't eat, I didn't sleep. I just kind of laid there in bed forever. I think I went to one-third of my classes during first quarter.” He continued: “One of the director people, eventually was like, ‘Okay, so you're meeting with me and we're going to go get you help.’” The student further described: “They put blocks on everything I could possibly do until I actually went to talk to him, so I eventually actually had to get help, which is actually super useful because I know I would not have actually done it without some sort of external motivation.” Another student also reported being supported in a very meaningful way by a university resource center: “I was part of a coming out group through the LGBTQ Resource Center that really helped me
emotionally and mentally throughout this year as it was a place I could be my true self without the fear of judgment.”

**Table 16: Response Frequencies of Survey Question Divided into Positive Experiences and Negative Experiences for Academic Life**

<table>
<thead>
<tr>
<th>Academic Life</th>
<th>Positive Experience</th>
<th>Negative Experience</th>
<th>Total # of Students who mentioned this category</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students</td>
<td>55</td>
<td>67</td>
<td>72</td>
</tr>
<tr>
<td>% of students</td>
<td>65%</td>
<td>80%</td>
<td>86%</td>
</tr>
<tr>
<td># of codings</td>
<td>62</td>
<td>124</td>
<td>186</td>
</tr>
</tbody>
</table>

As shown in Table 16, academic life was described in a positive light by 65% of students compared to 80% of students who described academic life as challenging.

**Finding 3**

Student descriptions of academic life and the resources provided to support them were somewhat split. They varied from finding, on the one hand, that academic life and resources provided to them are the best part of college, to finding, on the other hand, that academic life is too challenging and supports are inadequate. This finding indicates that students come to college with a diversity of needs which require a type of support from the institution that is individualized and differentiated for each student’s needs.

**Pre-College Academic Preparation**

In their freshman year, students are transitioning between what are in many respects two very different institutions - high school and college. In addition to the most
obvious differences, high schools differ from one another, often dramatically, and as a result provide very different levels of academic preparation, expectations for academic success, and resources for achieving academic goals. The academic preparation students acquire in high school is considered important for college performance. This is apparent in college admissions decisions which are generally known to give high consideration to test scores and high school GPAs. Students respondents were asked to rank how well they felt their high schools had prepared them for college, with 1 being poorly to 6 being very well. As shown in Table 8 of Chapter 3, of the 84 survey respondents, 80% of students responded 4 or above and 20% of students responded 3 or below.

As published by CU’s Office of Student Research and Information, the average high school GPA for the entire 2015 freshman cohort (all undergraduate majors) was 4.08 (Note: high school GPAs can exceed 4.0 due to credit for honors courses, in which an “A” counts as a “5” instead of a “4” as in the case of regular courses). Three-fourths of this cohort had a high school GPA of 4.0 or higher. However, the average GPA for this cohort after the first quarter in college was 3.16, with only 28% of students having a GPA of 3.5 or higher. Although high school and college GPAs are not directly comparable, what these data reveal is that most students coming into this university were top performers in their high schools. However, once in college, the academic performance of these students becomes quite varied.

Similarly, at the end of the first year of college, as shown in Table 17, of the 84 students in the survey sample, only 40% \((n = 34)\) of students had a GPA over 3.5 out of a total of 4 points, 37% \((n = 31)\) students had a GPA between 3 and 3.49, 19% \((n = 16)\) had
a GPA between 2.5 and 2.99, and 2% \((n = 2)\) had a GPA between 2 and 2.49. No students reported GPAs below 2.0. One student’s GPA data was not disclosed. Given that most student respondents believed their high schools to have prepared them at least adequately, one would have expected that their college GPAs would mirror to some degree their high school GPAs.

**Table 17: GPA at the End of the First Year in College**

<table>
<thead>
<tr>
<th>GPA range</th>
<th># of Survey Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5 or above</td>
<td>34</td>
</tr>
<tr>
<td>3.00 - 3.49</td>
<td>31</td>
</tr>
<tr>
<td>2.50 - 2.99</td>
<td>16</td>
</tr>
<tr>
<td>2.00 - 2.49</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
</tr>
</tbody>
</table>

**Finding 4**

The academic performance of students after their first year of college is varied. Some students were able to keep performing at a high level and some didn’t. Although most students came in with a high school GPA of 4.0 or higher, 60% of survey respondents after their first year of college had a university GPA of 3.5 or lower. These statistics are noteworthy given that 80% of student respondents thought their high schools had adequately prepared them for college. This reveals not only that the actual degree of college preparation provided in high schools is variable, but also, and possibly more
importantly, that some students are not aware of where they stand with respect to college readiness as they begin college.

Organizational Skills and Learning Strategies

As described in Chapter 3, engineering students generally take more courses per quarter than other majors at this university. As shown in Table 10 of Chapter 3, most of the students in this study took well beyond the minimum requirement of three courses per quarter. Given their higher course enrollment, it would be reasonable to assume that organizational skills would likely be particularly important for engineering students. Time management, learning strategies, as well as related topics such as procrastination, prioritization of work, and balance of academic and social life were very common topics in student responses.

As shown in Table 18, out of the 84 survey respondents, 70% \((n = 59)\) mentioned organizational skills and learning strategies. These responses were divided, however, between those respondents who recognized how helpful organizational skills they had previously developed were during their first year of college, and those who recognized their lack of organizational skill as a source of frustration. As shown in Table 12, in Chapter 3, of all survey respondents, 27% \((n = 22)\) thought that what best supported them to succeed as students had to do with already having good study habits, self-discipline, and other similar self-regulating skills. Students who had acquired organizational skills in high school reported benefiting from it: “Good studying habits (plus lack of existing social life) carried over from high school means barely any procrastination;” or “Study habits I developed in high school translated really well to college learning.”
On the other hand, 27% (n = 19) of respondents thought that what was least supportive was not having these study and time management skills and 41% (n = 34) found that the most challenging part of college was, again, issues related to these organization and self-regulation skills. Students repeatedly described these challenges: “Developing study skills and habits that were appropriate for college”; “time management and organization”; and “managing my time effectively in order to have enough time to focus on classes while also devoting time to my other extracurriculars.” Other representative examples of student descriptions of the most challenging aspect of college are: “trying to manage my time”; or “understanding how to properly study”; or “learning to manage my time properly and figuring out how to study for tests”; or “the most difficult aspect of college was understanding what was required for a class, what amount of effort and studying that was needed.”

The transition between the expectations of their high schools and those of California University were also noted in the responses of these students. The following are representative respondent statements about this transition: “Studying for exams. I did not really develop good study skills in high school so college exams were a rude awakening”; “Trying to catch up to the college workload; I was not at all prepared for the amount of work, nor did I know how to study well”; “Adjusting to classes of this level of difficulty. I didn't know how to properly study for difficult classes and especially not for final exams.” One respondent correlated the difficulty of the transition with the challenging nature of the engineering curriculum: “The transition from high school to college is difficult, especially when you are taking difficult classes as is the case with most engineering students.” Another respondent identified a perceived lack of targeted
pedagogy as a cause of the difficulty in transitioning to college: “I wish professors were more understanding of incoming freshmen. We don't know things like how much we need to study, that it's important to do things like going to office hours, or that our high school study habits will prove ineffective. We are treated like we are already familiar with college-level work.”

Finally, 33% \((n = 24)\) of students thought they would have derived significant benefits during their first year had they taken time to work on their study skills, been more disciplined in their study habits, and taken the initiative to talk with professors. Interestingly, although the perceived potential benefit of these skills became clear for these students while already engaged in their university studies, none of these skills are valuable only in the context of college-level work, nor is acquiring them something only possible in the college context. On the contrary, each of these skills could be learned in high school and be ready to employ on day one of the first year at the university.

**Table 18: Response Frequencies of Survey Question Divided into Positive and Negative Experiences for Organizational Skills and Learning Strategies**

<table>
<thead>
<tr>
<th>Organizational Skills &amp; Learning Strategies</th>
<th>Positive Experience (Had and valued Skills)</th>
<th>Negative Experience (Didn’t have and missed having skills)</th>
<th>Total # of Students who mentioned this category</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students</td>
<td>25</td>
<td>51</td>
<td>59</td>
</tr>
<tr>
<td>% of students</td>
<td>30%</td>
<td>61%</td>
<td>70%</td>
</tr>
<tr>
<td># of codings</td>
<td>25</td>
<td>78</td>
<td>103</td>
</tr>
</tbody>
</table>
As shown in Table 18, having acquired effective organizational and learning skills was described as very supportive by 30% of students compared to 61% of students who described their perceived lack of organization and learning skills as a cause of difficulty and a source of first-year challenge.

Finding 5

Students in this study appreciated the value of having acquired organizational and learning skills during high school. The students who had not yet acquired these skills described substantial struggles during the first year of college relative to the experience of those students who had already acquired them.

Financial Circumstances

Financial issues did not come up as often as other categories. As shown in Table 12, in Chapter 3, only a handful of students brought up aspects related to financial resources in their answers. However, for those who did, financial resources were described either as a source of relief that added positively to their first-year experience or as a burden that took away from their experience and reduced their potential for success. For example, a student who had to work while going to college and lived off campus with parents thought that financial issues were the most challenging aspect of college and that financial aid would have greatly supported his success as a student. Another respondent who also lived at home and worked to generate income thought that financial issues were a burden and prevented her from becoming more involved in college. This respondent
was particularly burdened by not being able to afford living on campus. She had to commute by bus 2 hours during the week and three hours on weekends.

Another respondent had a sister who was helping pay for her college expenses and was thus able to afford living on campus. However, some of her friends from high school who had also enrolled in this university were not able to afford to live on campus and so were living at home. She said: “I actually have friends that commute every day from where they live, and they don't have a car and they commute an hour-and-a-half to two hours with the trolley and the bus. Every time they came on campus I'd say, ‘Dude you can come over and I'll give you some food or anything you need.’ I always try to do that, but seeing them commute, I think that's way too much.” She explained how sometimes one of her friends needed to stay on campus to complete assignments: “Sometimes he didn't make it back home, so he had to call his parents in the middle of the night. He was like, "Mom, come pick me up. I'm at the trolley station." She continued: “Seeing how ... you need to have time to go to professors, and discussions, and the fact that they didn't have that time, I thought (...) that they were missing out a lot. I was just like, I would just hope that they could move closer to, that they wouldn't commute so far, because it is really tough on them, but everything falls where the money is at. That's the thing.”

For some students, having their financial need resolved allows them to engage with their studies in a way they otherwise would not be able to. One student described his high school in the following way: “I am from (...) in California. I guess it’s a very impoverished area, usually. The people here are primarily Mexican. I went to all public
school. I went to the high school close by. (...) I graduated fourth in my class.” This student, who excelled in his high school, was awarded a full-ride scholarship. He said that this scholarship for him was what most supported him in college. He thought he could have not otherwise been able to pay for it. Most importantly the scholarship allowed him the possibility to fully engage with college. He said: “Not having to worry about financial problems, I could focus on school solely”

Studying engineering is sometimes attractive because it promises a well-paid job as reflected in this first generation college student’s reason for selecting engineering: “I wouldn't be able to support myself by pursuing my true passion of literature”, or “I am interested in chemistry, but decided to pursue that interest in a way that I found to be more potentially rewarding in the financial sense.” Unfortunately, studying engineering is not always a viable choice because it usually takes longer to graduate. For example, another student explains her reason for changing her major: “I'm a financial aid student, I wanted be able to actually graduate in four years. That was my main concern because I can't afford to keep going here for longer”. These students’ stories reflect the additional burdens some students face while attending college and the critical importance for them of receiving financial assistance.

Finding 6

Students in this study who have financial need and those who don’t both acknowledged the impact that having to work or to live far away can have on their ability to dedicate themselves fully to their studies. The burden of financial need takes away from time they could otherwise spend studying and engaging in college life.
Academic Policies

Student experiences during their first year of college can influence their persistence in engineering. However, aspects related to student experiences are not the only factors that influence persistence in their majors. Academic policies can also influence student persistence in engineering. At CU, the academic policy that regulates the option of changing from one engineering major to another once admitted to the university is perceived by some students as only allowing those with high GPAs to change majors and to leave those who have not done as well academically unable to pursue the engineering major they truly desire.

The general policy stipulates (although there is some variation by department) that students must submit an application to the department of the major to which they want to change. They must also meet minimum academic requirements defined by that department. The minimum academic requirements generally entail a GPA calculation that includes grades for courses taken in mathematics and physics, as well as grades for any lower division coursework required for the major to which the student would like to change.

A common understanding expressed by student respondents about the university policy regarding switching from one engineering major to another is that this option is only available to students with high overall GPAs. However, it is not unheard of that even students with relatively high overall GPAs are not able to move from one engineering major to another. This circumstance is the result of the “capped” nature of engineering majors. Departments commonly allot a certain number of spaces to
accommodate students who may choose to “switch in” after the start of the academic year. Once the major is at full capacity, however, departments can’t accept additional students into the major regardless of how good a student’s overall GPA may be.

As shown in Table 6, in Chapter 3, of the 829 students who enrolled in engineering in 2015, 6% \( (n = 51) \) changed to a major outside of engineering. Of the 84 students who responded to this study’s survey, 4 respondents stated that they wanted to change their majors to another engineering major but didn’t because they couldn’t. Some of the quotes included earlier in this chapter, such as “My GPA is not good enough to switch majors” reflect this situation. Similarly, out of the 8 interviewed students, four wanted to change majors during the first year of college. One student had a very strong GPA and was able to change. Two others left engineering because their understanding was that their GPAs were too low to change to another engineering major. The fourth student, who also had a low GPA that prevented him from changing to a different engineering major, decided to stay in an engineering major in which he didn’t particularly want to stay.

Students reported feeling frustrated by this policy because it prevented them from changing to an engineering major they believed would be better suited for them. This was especially true for students who found themselves struggling in one engineering major and who wanted to pursue a different engineering major in which they thought they might be able to perform better academically. They felt that they were not given the chance to actually do better in another major. They might also have interpreted their inability to
change majors as a failing to perform well academically and decide to leave their engineering majors altogether.

**Finding 7**

The way academic policies are perceived by students can influence student persistence in engineering. Allowing students to change majors based on academic performance can be interpreted by students with lower academic performance as a reason why they should leave engineering.

**Summary**

The aim of this study was to find the factors that influence student persistence in their engineering majors. This was accomplished through dividing the main research question into sub-questions that would lead to: 1) understanding of what the experiences of students are like during the first year of college; 2) insight into how pre-college academic preparation, institutional resources, and socio-economic forces shape these experiences; and 3) clarity regarding what other factors might influence student persistence. Survey and interview responses were analyzed, resulting in the emergence of the following factors that influence persistence: Life Transition, Social Life, Academic Life, Pre-College Academic Preparation, Organizational Skills and Learning Strategies, Financial Circumstances, and Academic Policies.

To better understand how these factors influence persistence, it is important to recognize that, although student respondents reported experiencing certain aspects of college in similar ways, students were divided in their responses regarding other aspects.
of college. For example, students had similar attitudes in relation to the transition from high school to college. When students described this transition in their lives, they generally had a positive attitude and welcomed their newfound freedom and increased responsibilities. As previously described in this chapter, the transition to college was described positively by 29% of students compared to 5% of students who described this transition as challenging. Similarly, when describing the social aspect of college and the support they received from family and friends, most students indicated that these supports were critical to their success during their first year in college. Social life was described positively by 67% of students compared to 19% of students who described social life as challenging.

On the other hand, when students described aspects of their first-year experience related to academic life and the resources provided to support them by the institution, the responses were split. Students had both positive and negative comments about academic life. Academic life was the aspect of college most mentioned by students, both positively or negatively. Some students reported finding, on the one hand, that academic life and resources provided to them were the best part of college. Other students, on the other hand, found that academic life was too challenging and supports were inadequate.

There were also differences between students’ academic performance in high school compared to their academic performance in the first year of college. Three quarters of all incoming freshmen had high school GPAs of 4.0 or higher. By the end of their first year of college, however, only 40% of the student respondents were able to maintain a GPA of 3.5 or higher.
Students’ responses regarding Organizational and Learning Strategies, as described in Table 4 of Chapter 3, were similar in that they generally reported that having these skills was critical during the first year of college. However, the students who had not yet acquired these skills described substantial struggles during the first year of college relative to the experience of those students who had already acquired the skills. These skills were described positively by the 30% of respondents who claimed they already had these skills, compared to 61% of students who described their perceived lack of organization and learning skills as a cause of difficulty and a source of first-year challenge.

Although Financial Circumstances were not often mentioned, when students reported having financial issues, these issues had a high impact on their ability to engage in the academic and social aspects of college. Students in this study who have financial need as well as those who don’t both acknowledged the impact that having to work or living far away can have on their ability to dedicate themselves fully to their studies. The burden of financial issues took away from the time they could otherwise have spent studying and engaging in college life.

Finally, several respondents reported that the university policy regarding eligibility for change of majors was an influence on their determination to persist in engineering. These students perceived that students who performed well in their first year were not affected by this policy because, if they so desired, they were able to change to another engineering major. However, they thought that because they had not been able to achieve a high GPA in college, they did not have the option of switching, and some of
them, as a result, chose to leave engineering rather than remain in a major choice for which they thought they were ill-suited.

Student responses revealed that they experienced certain aspects of college in similar ways, and that they were divided regarding other aspects of college. The consequence for the institution is that as much as students can be supported in similar ways regarding some aspects of college, there needs to be more individualized and differentiated support regarding other aspects, particularly when addressing organizational and learning skills, pre-college academic preparation, and financial circumstances.
Chapter 5: Conclusion

This research study aimed to expand our understanding of the factors that influence student persistence in engineering. The unique experiences of engineering students were examined as they transitioned into and navigated their first year of college at a public research university, referred in this study as California University (CU). Seven factors were found in this study to shape the experience of students during their first year of college: Life Transition, Social Life, Academic Life, Pre-College Academic Preparation, Organizational and Learning Strategies, Financial Circumstances, and Academic Policies.

As described in Chapter 4, student responses regarding some of these factors were consistent. For example, most students provided similar responses with respect to the way they experienced the transition to college and social life. On the other hand, there was significant student response variation regarding their experience of academic life and academic policies as well as in their level of pre-college academic preparation and their financial circumstances. Most interestingly, however, students’ experiences during the first year of college varied widely based on the extent to which they had acquired organizational and learning skills prior to college. This is an area not as thoroughly explored or recognized in current research.

Connections to Prior Research

The research on student persistence that guided the design of this study claims that the amount of time and energy students spend in educational activities is related to persistence. Astin’s (1984) Theory of Student Involvement and Tinto’s (1975) Theory of
Student Departure specifically substantiate the central relevance of student involvement in both the academic and social aspects of student life on campus. In this study, students not only brought up the academic and social aspects of their first-year experiences in college numerous times, but the data also revealed, in line with prior research, that these experiences varied significantly among students based on pre-college academic preparation and socio-economic background.

In line with research that points to the influence that pre-college academic preparation has on persistence (Reason, 2009), this study found that there is a large disparity in academic preparation based on high school attended. That is, the K-12 system does not uniformly prepare students for college. This was seen in the fact that most students admitted to CU were performing at the top of their high schools, however, once in college, there was high variation of students’ GPAs. Also, in line with research that points to the unique burdens that students with financial need face (Carey 2004; Bozick, 2007), some students in this study brought up the challenges of having to live off campus and of having to work to pay for college expenses. They expressed their regret over not being able to be more involved with the academic and social aspects of college because of the reduced time they were able to be on campus.

Research on student persistence in college has also claimed that factors that influence student persistence might have more to do with institutional practices and policies than with student background characteristics (Terenzini & Pascarella, 1980, Kuh, 2008). One of the findings in this study was in line with this research claim. The academic policy regarding eligibility for changing majors in engineering influenced some
students’ determination to persist. This academic policy uses academic performance as a measure for accepting students into an engineering major. However, the ability for students to change majors is also based on the restricted amount of spaces available for students to switch to an engineering major. Unfortunately, students with lower GPAs sometimes interpreted their inability to switch majors as an indication that their academic performance was not good enough and used it as a reason to leave engineering altogether.

New Insights

The findings presented in Chapter 4 are for the most part in line with prior research on student persistence. However, current research on student persistence in engineering does not highlight relative development of organizational skills as an important factor influencing student persistence. This study found that organizational skills and learning strategies, including the ability to prioritize assignments, balance work and social life, or manage one’s time were very valuable to students. Students who self-reported possessing well-developed organizational skills as well as those who reported lacking these skills expressed the critically important role that the ability to organize themselves played in their first-year studies, as an asset for those who had them and as a liability for those who did not.

Research on persistence in engineering claims that engineering students spend significantly more time preparing for class than students in other majors and less time on other enriching experiences (Lichtenstein et al., 2010). Many students in this study were challenged by the heavier-than-average course load required by their engineering majors and the critical need to effectively schedule their time and create balance between the
academic and social aspects of their lives. Organizational skills seem, therefore, to be important, not only for college in general, but possibly even more critically for engineering students because of the more time consuming nature of their majors. This finding highlights the importance for institutions to have a system in place that can identify areas of improvement for each student and that ensures that students who are lacking these skills can quickly learn them and effectively apply them.

**Recommendations**

CU’s Strategic Plan includes becoming more student-centered and improving graduation rates. This institution is also moving toward admitting an ever more diverse student population each year. In order to better understand and address student persistence in engineering, CU could consider the following:

**Organizational and Learning Skills**

Students not only come to CU with a variety of levels of academic preparation, but also with a variety of levels of organizational skills. At CU, the academic side of this issue is taken care of to some extent by requiring placement exams in different content areas. However, the mastery of organizational skills is not easily recognizable and, as a result, goes mostly unaddressed. The School of Engineering at CU already offers an orientation to engineering course where time management and learning strategies are learned and practiced. This course includes the development of students’ self-regulation and self-awareness skills and guides them to practice and track their use of learning strategies (Hayden, 2014). However, the number of students who have not mastered these skills extends beyond the small set of students who choose to take this elective course. In
2016, CU instituted a new program that utilizes success coaches to provide students with mentorship, personalized study skills, time and stress management, goal setting, and effective utilization of campus resources. Unfortunately, there is still currently no mechanism to identify whether students already possess these skills.

CU may need to further acknowledge the need not only to provide remediation for academic content, but also to address on a wider scale the need for supporting students in using effective organizational skills and other executive functions. Organizational skills could possibly be addressed as another academic topic. There are currently no known placement or diagnostic tests that have been created for such a purpose. CU could first create an inventory of organizational skills for students at CU to master and then seek to develop such diagnostic tools. CU could require students to take these diagnostic tests upon entrance to the university along with content-based placement exams.

CU could also look into developing an online system for students designed to help them to master those skill areas that are fundamental to success in academic pursuits (e.g. a mastery-based curriculum in self-regulation similar to mastery-based curricula in other content areas). Once a student’s level of organizational skills is better understood, the student could access different topic-based modules in this system that would be most relevant to him or her based on the results of the diagnostic tests or questionnaire taken at the start of college.

Currently, there are apps that help students get organized as well as lists of tips and strategies. Those tools can be helpful. However, the ultimate purpose of this online system would not be simply to inform students about effective strategies or to give them
an organizing tool or app, but rather to provide a platform through which students could learn, practice, progressively master, and ultimately use such skills and strategies effectively. Organizational skills and other executive functions essential to first-year success would then become integrated into the first-year student’s curriculum, and would thus be imbued through institutional recognition with the level of importance this study proposes that they deserve.

Pre-College Academic Preparation

Although students come to this institution with the best GPAs from their high schools and are expected to perform very well academically, not all students have benefited from the same academic preparation or have the same life circumstances. CU should continue to address the issue of varying levels of pre-college academic preparation. Identifying student academic preparation based on high school GPA is problematic because, theoretically, every student could arrive at CU with a 4.0 GPA from high school and yet represent vastly different levels of readiness for university-level work. API ranking helps differentiate to some extent, but is not a precise indicator primarily because the performance of the school does not necessarily represent the preparation of individual students. Taking into consideration the Math SAT (Scholastic Assessment Test) score of students as well as whether they passed AP (Advanced Placement) Computer Science and Calculus courses might offer some additional information regarding preparedness.

CU could also identify students who might have attended high schools that did not offer these courses and provide them with additional information about introductory
courses and other resources. CU is already able to identify preparedness through placement exams which can identify students who need to be placed in remedial math or writing courses. More disciplines might need to be covered by such placement testing and more introductory courses offered, such as basic courses in computer science or programming that some high schools already offer, but that high schools with fewer resources are not able to afford.

Financial Circumstances

Financial need can become a real burden and negatively affect students’ capacities to be engaged with college and thus persist to graduation, particularly when pursuing an engineering degree. CU could consider thinking about financial aid through a wider lens, not just as a means of meeting financial need, but also as a means of allowing for students to live on campus and be more engaged with their studies. Although working takes time away from educational activities, with increasing tuition costs, it may not be possible to provide financial aid that meets all financial needs. A middle step would be to more intentionally create and inform students of existing opportunities for student employment on campus, which would reduce commute time to other forms of employment located off campus.

Academic Policies

It may be important for CU to recognize that students are brought into the university through a competitive process of university admissions that considers their academic performance in their local context. However, once admitted, students, depending on their educational background, can be subjected to a very different
competitive standard. Students’ decisions about what path to follow are then informed by the “survival of the fittest” model represented by GPA-based choice options. Could the engineering departments account for students’ previous local context in making decisions about such things as change-of-major requests, at least during the first year of college? This first year is just when students are in the middle of the period of most extreme adjustment from their previous academic environment (high school) to their new one (college).

As described earlier in this study, students who are admitted to CU are generally at the top of their high school graduating classes. When such students do not perform as well in college as they had become accustomed to performing in high school, it often comes as a shock. Students might attribute this lower academic performance to having simply made a wrong choice of major at a time during which they had limited information about the actual experience of university-level work. They might also interpret their inability to change majors as a failing to perform well academically and decide to leave their engineering majors altogether. If a change in this academic policy is not possible, CU could at least take the requests from students to change majors as an opportunity for discussing with them their academic goals, to help them better understand what pursuing an engineering major entails, and how to best approach their current majors.

Final remarks

This study found that the degree to which students were able to be involved in academic life on campus varied based on educational and socio-economic factors.
Students who came well prepared to college, both academically and with effective organizational skills, were more immediately and effectively able to engage with college than students who did not come as well prepared. These latter students had additional challenges as they needed to spend critical time looking for resources and “catching-up”. In addition, for students who had financial need and who could not afford to live on campus, who had to commute for hours each day to and from home, and who had to work to pay for tuition, the time available for engaging in college life sharply diminished.

Based on the claim that the degree to which students can engage with college influences their persistence, some of these students were at a disadvantage from the beginning, particularly when they were both educationally and financially disadvantaged.

As CU continues to address the needs of its increasingly diverse student population, it will be important for the university to continually learn more about its changing student body and the complex array of needs a diverse student body brings with it. Faculty, too, need to be aware of how critical the first-year experiences of their students are in determining whether or not those students will persist in their majors, or even whether or not they will continue their studies at all. Faculty can play a significant part in helping students to access campus resources and better understand the nature of the engineering field they have chosen to study. Just as it is critically important for the university to understand the nature and challenges characteristic of the first-year of college for incoming students, it is also equally vital that it be understood by faculty.

Only by being aware and knowledgeable about this stage in a student’s university experience can faculty head off the negative consequences that result when students
interpret their difficulties as a sign that they are not fit for pursuing engineering or even higher education more generally. If faculty can become more aware that student experiences and persistence vary significantly among individual students based largely on their educational and socio-economic backgrounds and try to better understand who their students are, they might be able to positively change the experience of those students by encouraging them and providing them with information on how to best navigate their new environment.

Universities find themselves in a difficult situation. The K-12 system does not consistently prepare students for college. At CU, this situation leads to a tremendous disparity in the academic performance of admitted students once they begin their course of study. As a result, CU is tasked not only with continuing to provide a high quality university education, but also at the same time with providing classes and programs that address the uneven preparation of first-year students. While CU does provide resources for equalizing differences in content knowledge and skills, the university does not currently fully recognize the additional and more fundamental need of its first-year students for programs that address organizational and learning skills. Far from being merely an additional concern, these needs are fundamental and prerequisite for any subject-specific remediation to be successful. If universities, such as CU, are not able to address this set of fundamental first-year student needs, the pursuit of a college education and its promise of increased social mobility will remain for some, elusive at best, while at worst, an empty promise.
Appendix
Survey and Interview Questions

The First Year of College: Understanding Student Persistence in Engineering

Question 1: What was your major upon entering the university?

Question 2: Which of the following applies to you?
- I will continue in my original major
- I did change to a different major within engineering this year
- I will change to a different major within engineering next year
- I did change to a major outside of engineering this year
- I will change to a major outside of engineering next year
- I will transfer to a different college or university
- I will not be pursuing college
- Other: __________

Question 3: What’s your reason for this choice?

Question 4: How many total units did you take this year (by quarter)?

Question 5: How well do you think your high school prepared you for college? (1 = very poorly to 6 = very well)

Question 6: Which of the following summer programs for incoming admitted students did you participate in before college?

Question 7: Which of the following first-year programs have you participate in this year?

Question 8: Thinking about your first year, what was the best part about college for you?

Question 9: Thinking about your first year, what was the most challenging aspect of college for you?
Question 10: What was the one thing that best supported your success as a student during your first year?

Question 11: What was the one thing that was least supportive of your success as a student during your first year?

Question 12: What else could have supported your success as a student during the first year of college?

Question 13: During the first year, did you live…
- On campus
- Off campus - with roommates or alone
- Off campus - with parents or family members

Question 14: On average, during this academic year, how many hours per week did you work in a paying job?
- Didn’t work in a paying job
- 1-10 hrs. per week
- 11-20 hrs. per week
- 21-30 hrs. per week
- 31-40 hrs. per week
- Over 40 hrs. per week

Question 15: What is your GPA?
- 3.50 or above
- 3.00 to 3.49
- 2.50 to 2.99
- 2.00 to 2.49
- 1.99 or below

Question 16: What is your ethnicity?

Question 17: Were you a Pell Grant recipient during your first year? (Y/N)

Question 18: Select your gender
- Female
- Male
- Other: _________
Question 19: Are there any other aspects of your experience during the first year of college that were important to you that you would like to include?

Optional – Interview Phase:

Would you like to participate in the one-on-one interview phase of this study? Interviews will last no longer than 60 minutes and will be scheduled at a mutually convenient time and location. Eight students will be selected and will each receive a $25 gift certificate after their participation in the interview. The purpose of the interviews is to better understand your experience as an entering engineering student during the first year of college. (Yes/No)

Name and email address (if interested in being interviewed)

Additional question for all interviewees:

Question 20: If you had to give advice to an incoming freshman, someone who is ready to start this quarter, about how to succeed in college, what would you say? You can think of someone from your own high school.
References


California Department of Education, Analysis, Measurement, and Accountability Reporting Division, (n.d.). Executive Summary Explaining the Academic Performance Index (API)


