Understanding Transfer Student Pathways to Engineering Degrees: A Multi-Institutional Study Based in Texas

Andrea M. Ogilvie

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Engineering Education

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DISSEPTION: Transfer Student Pathways to Engineering Degrees

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Andrea M. Ogilvie, P.E.

ABSTRACT

In recent decades, recruitment and retention efforts to meet workforce demands and broaden participation in colleges of engineering across the country have focused primarily on catering to the needs of first-year, traditional age college students who matriculate from high school into 4-year institutions. While these efforts have moved the needle on enrollment and retention for undergraduate students in engineering, growth and improvement measures have started to taper in recent years. To meet current and future workforce demands for more STEM professionals in the United States, we must be creative about how to move beyond this ceiling effect; and, great potential exists among the growing population of students who begin their pursuit of a higher education at institutions other than 4-year public/private colleges.

The purpose of this study is to increase understanding of engineering transfer students and their experiences at both sending and receiving institutions. Part of a larger mixed methods research investigation, this study draws on survey data from a sample of 1,070 engineering transfer students who transferred to one of four 4-year Texas institutions as new engineering students between 2007 and 2014. Research sites include four of the top ten producers of U.S. Hispanic/Latino engineers; and the framework for transfer student capital was used to organize this study’s data collection and analytical plan.

Structured as a manuscript style dissertation, this investigation offers a synthesis of recent literature on engineering transfer students and yields important findings on engineering transfer student movement through the higher education system at two distinct phases: 1) at the beginning of their higher education pathways in an investigation of students’ reasons for starting at another institution and factors that influence their decisions to transfer; and 2) at the phase immediately following transfer in an investigation of the transition experience for students who transfer to a 4-year institution. For each phase, I identify emergent constructs and explore differences across subgroups of engineering transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation).

This research joins and expands the small body of literature on engineering transfer students and brings data to higher education administrators so they can make more informed adjustments to existing institutional policies and practices that impact students as they transfer to engineering programs at 4-year institutions. Last, findings from this study also advance the current state of community college research on transfer students more generally.
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Andrea M. Ogilvie, P.E.

GENERAL AUDIENCE ABSTRACT

In recent decades, recruitment and retention efforts to meet workforce demands and broaden participation in colleges of engineering across the country have focused primarily on catering to the needs of first-year, traditional age college students who matriculate from high school into 4-year institutions. While these efforts have moved the needle on enrollment and retention for undergraduate students in engineering, growth and improvement measures have started to taper in recent years. To meet current and future workforce demands for more STEM professionals in the United States, we must be creative about how to move beyond this ceiling effect; and, great potential exists among the growing population of students who begin their pursuit of a higher education at institutions other than 4-year public/private colleges.

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This investigation offers a synthesis of recent literature on engineering transfer students and yields important findings on engineering transfer student movement through the higher education system at two distinct phases: 1) at the beginning of their higher education pathways in an investigation of students’ reasons for starting at another institution and factors that influence their decisions to transfer; and 2) at the phase immediately following transfer in an investigation of the transition experience for students who transfer to a 4-year institution. For each phase, I identify emergent themes and explore differences across subgroups of engineering transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation).

This research helps administrators, faculty members, and staff at sending and receiving institutions key in on the more problematic aspects of transfer that require additional attention. Moreover, research findings can be used by administrators, faculty members, and staff at receiving institutions to design or customize programs and services to address pressing needs and further enhance engineering transfer students’ perceptions of fit with their new institutions. Lastly, schools of engineering interested in boosting student enrollment can use findings from this study to better position themselves to appeal to and perhaps capture a larger market of engineering transfer students in the future.
Dedication

To my parents, Chuck and Rose.  
Your love and support have made all the difference.  
Thank you for giving me a blessed and beautiful life.
Acknowledgements

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Chapter 1: Introduction

1.1 Statement of the Problem

For decades, there has been a strong demand for STEM professionals in the U.S. workforce, and based on national rhetoric, the demand for skilled professionals in STEM fields will continue to be on the upswing for many years to come (Jackson, 2003; National Academies, 2007, 2010b). To meet both current and future workforce needs, the President’s Council of Advisors on Science and Technology (PCAST) projects that that the United States will need to produce an additional 1 million STEM professionals by 2025 (PCAST, 2012). In addition to calling for growth in the STEM workforce in overall numbers, both governmental and industry sectors have communicated how it should grow. To build a STEM workforce that is capable of generating creative solutions to 21st Century global challenges, these sectors articulate a need for investing in, developing, and improving programs and partnerships that broaden participation in STEM fields (National Science Board, 2010; PCAST, 2012). By attracting, developing, and nurturing human capital that embodies diversity of skills, perspectives, and experiences, the STEM workforce may increase its capability to develop innovative, inclusive, equitable, and sustainable solutions to complex challenges (Harkavy, Cantor, & Burnett, 2015; National Academies, 2010a).

As we think creatively about how to identify and train human talent to the meet these demands, great potential exists among the growing population of students who begin their pursuit of a higher education within the community college system. According to the National Center for Education Statistics, 41% of postsecondary students and 45% of all U.S. undergraduates during Fall 2014 were enrolled in 2-year public colleges; the headcount total for students enrolled in 2-year public colleges that academic year was 12.3 million students (AACC, 2016). Profile characteristics (i.e., socio-economic status, race, ethnicity, age, prior work experience) for students enrolled in 2-year institutions, which is one type of transfer pathway, tend to be more diverse than students who matriculate directly into 4-year public/private colleges and universities from high school. Demographic data on students enrolled in 2-year public colleges for credit indicate that such students are older (28 is average age, median is 24), majority female (57%), and disproportionately from ethnic/racial groups other than White
(51%). Overall, 36% of these students are first generation, 12% are students with disabilities, and 4% are veterans (AACC, 2016).

Students from ethnic groups of color enroll in 2-year public colleges at higher percentages than at 4-year institutions. In Fall 2014, 62% of American Indian/Alaska Native students, 57% of Hispanic students, 52% of African American students, and 43% of Asian/Pacific Islander students in undergraduate education were enrolled in 2-year public colleges (AACC, 2016). Because of these high percentages, the National Research Council (NRC) and National Academy of Engineering (NAE) have emphasized for more than a decade that the community college sector must play an important role in broadening participation and expanding pathways to STEM degrees (NRC, 2005; Olson, Labov, & NRC, 2012). Furthermore, bolstering transfer pathways in STEM disciplines from 2-year to 4-year institutions holds positive implications for equity and social justice (Dowd, 2012; McLoughlin, 2012; Terenzini, Lattuca, Ro, & Knight, 2014) because it expands opportunities for a broader spectrum of students (i.e., first-generation, ethnic/racial minorities, veterans, older students, students with disabilities, etc.) to participate in STEM fields and reap financial benefits that often are associated with those kinds of careers (Dowd, 2012).

These efforts to diversify the STEM workforce also yield positive implications for innovation and creativity. Prior studies on heterogeneous team performance concede that diverse perspectives lead to new insights and novel solutions (Gruenfeld, Mannix, Williams, & Neale, 1996; Mannix & Neale, 2005; Nemeth, 1986; Nemeth & Kwan, 1985; 1987; Nemeth, Mosier, & Chiles, 1992; Nemeth & Staw, 1989; Nemeth & Wachtler, 1983; Stasser, Stewart, & Wittenbaum, 1995; Watson, Kumar, & Michaelsen, 1993). Thus, heterogeneous teams have the potential to be more creative and may be better positioned to generate innovative solutions that address the grand challenges for engineering in the 21st Century (NAE, 2008).

Given this tremendous potential, the NRC and NAE hosted a meeting in 2004 with leaders in higher education to explore opportunities and strategies to enhance transfer pathways to 4-year engineering programs for community college students. Meeting participants acknowledged that the transfer student pathway to engineering was not operating at full potential because of: 1) “less than effective articulation agreements” to enable student transfer,
and 2) “a lack of cooperation and coordination” between institutions of education and state higher education agencies (NRC, 2005, p. 2). As a call to action for the educational research community, meeting participants identified a number of areas for further investigation on transfer pathways to engineering degrees (summarized in Table 1) (NRC, 2005).

Table 1. National Research Council (2005) recommendations for future research.

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<td><strong>4-yr Institution Perspectives</strong></td>
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Nearly a decade after the NRC and NAE made these calls to enhance the community college pathway to engineering careers, the body of literature on engineering transfer students is still slim (Dowd, 2012; Ogilvie, 2014; Olson et al., 2012). Most of what is known about this student population is based on community college literature more generally and research focused on transfer students in STEM more broadly (Dowd, 2012). Although prior research on transfer student success in STEM has identified some key challenges facing these students, Dowd (2012) argues that “the body of literature focusing specifically on transfer in STEM is not robust enough to substantiate conclusions about the unique programmatic features that are necessary to design effective STEM transfer pathways” (p. 112).

My dissertation addresses this issue and makes a contribution by expanding the small body of literature on transfer pathways in engineering. Research focused on pathways and outcomes for engineering transfer students is limited, although there have been recent large-scale data collection efforts, such as such as: 1) the California Partnership for Achieving Student Success (Cal-PASS) database (Blash et al., 2012a); 2) the California Postsecondary Education Commission (CPEC) database (Blash et al., 2012a); and 3) MIDFIELD, a multi-institution database comprised of 11 universities from the southeastern part of the United States (Shealy, Brawner,
Mobley, & Layton, 2013; Sullivan et al., 2012). Studies have started to characterize engineering transfer student profiles, pathways, and outcomes (Blash et al., 2012a; Laanan, Jackson, & Darrow, 2010a; Laanan, Jackson, & Rover, 2011; Shealy et al., 2013; Sullivan et al., 2012) as well as explore engineering transfer students’ experiences (Blash et al., 2012a; Mobley & Brawner, 2013; Mobley, Shealy, & Brawner, 2012, 2013). However, that research has only scratched the surface when it comes to understanding engineering transfer students and their experiences. For example, there is a critical need to identify factors that explain why engineering transfer students are successful or not (Laanan, Starobin, & Eggleston, 2010b). Although large-scale quantitative studies using the MIDFIELD database have the potential to identify broad patterns, they are also somewhat limited in providing explanations that can be generalized to small ethnic/racial groups (Sullivan et al., 2012) because Hispanic, American Indian/Alaska Native, and Asian students are underrepresented at MIDFIELD institutions (Sullivan et al., 2012). With research emerging that suggests transfer pathways from 2-year institutions may broaden participation in engineering specifically for Hispanic students (Terenzini et al., 2014), there is still much left to learn about such subpopulations of students and their experiences on the transfer pathway to an engineering degree.

Rising costs of higher education and increasing enrollments in post-secondary institutions are just two examples of current issues that drive the critical need to bolster transfer pathways to degree attainment in higher education. Recent reports also indicate that student movement across two or more postsecondary institutions is the new normal in higher education (Marling, 2013; Shapiro et al., 2015). Given these dynamics, this research helps administrators, faculty members, and staff at sending and receiving institutions key in on the more problematic aspects of transfer that require additional attention. In addition, schools of engineering interested in boosting student enrollment by tapping into the broader base of human capital that resides in 2-year public colleges can use findings from this study to better position themselves to appeal to and perhaps capture a larger market of engineering transfer students in the future.
1.2 Purpose of Study

This research provides data to institutions and systems of higher education as they consider policies and practices that impact students as they transfer to engineering programs at 4-year institutions. The purpose of this research is to develop a clearer understanding of transfer student pathways as a potential means to broaden participation in engineering. Structured as a manuscript style dissertation, this investigation focuses on understanding engineering transfer student movement through the higher education system at two distinct phases: 1) at the beginning of their higher education pathways in an investigation of students' reasons for starting at another institution and factors that influence their decisions to transfer; and 2) at the phase immediately following transfer in an investigation of the transition experiences for students who transfer to a 4-year institution. To advance and guide future research, this investigation also includes an in-depth review and synthesis of existing literature on transfer students in engineering. Table 2 provides a high level overview of this dissertation.
Table 2. Overview of Manuscript-Style Dissertation

<table>
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<th>Research Questions</th>
<th>Strategy</th>
<th>Outcome</th>
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<td>Current State of the Literature on Transfer Students in Engineering</td>
<td>RQ1 What is known about transfer students in engineering? (i.e. characteristics, experiences, academic performance, and educational outcomes)</td>
<td>Literature Review</td>
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<td>Reasons for Starting at Another Institution</td>
<td>RQ2 What constructs emerge when engineering transfer students are asked to identify reasons for starting their college educations at institutions other than their current 4-year institutions? What are the differences across subgroups of transfer students? (i.e., open vs. selective enrollment institutions, lateral vs. vertical, Hispanic/Latino vs. non-Hispanic/Latino, first generation vs. non-first generation)</td>
<td>QUAN</td>
<td>Manuscript #2 Pursuing Alternate Pathways to a 4 Year Engineering Degree: Understanding Students’ Reasons for Starting at Another Institution and Factors that Influence Their Decisions to Transfer</td>
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<td>Factors that Influence Decisions to Transfer</td>
<td>RQ3 What constructs emerge when engineering transfer students are asked to identify factors that influenced their decisions to transfer to their current 4-year institutions? What are the differences across subgroups of transfer students? (i.e., open vs. selective enrollment institutions, lateral vs. vertical, Hispanic/Latino vs. non-Hispanic/Latino, first generation vs. non-first generation)</td>
<td>QUAN</td>
<td>Manuscript #3 Problems, Perceptions, and Adjustments: Understanding the Transition Experience for Engineering Transfer Students at 4-Year Institutions</td>
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<tr>
<td>Transitions to Receiving Institutions</td>
<td>RQ4 What constructs emerge when engineering transfer students are asked about their transitions to engineering programs at 4-year institutions? What are the differences across sub-groups of engineering transfer students (i.e., open enrollment vs. more selective admission requirements, vertical vs. lateral pathway, student status as Hispanic/Latino, student status as first-generation college students)?</td>
<td>QUAN</td>
<td>Manuscript #3 Problems, Perceptions, and Adjustments: Understanding the Transition Experience for Engineering Transfer Students at 4-Year Institutions</td>
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1.3 Brief Overview of Methods

Part of a larger mixed methods research investigation (Ogilvie et al., 2015, 2016, 2017), this study draws on survey data from a sample of 1,070 engineering transfer students who transferred to one of four 4-year Texas institutions as new engineering students between 2007 and 2014. Study sites include four of the top ten producers of U.S. Hispanic engineers (ASEE, 2012). The sample is unique because it is comprised of a disproportionately large percentage of Hispanic/Latino students, which is one of the faster growing demographic groups in the country and a demographic group that the engineering field is seeking to attract and support.

The framework for transfer student capital (Laanan & Hernández, 2011; Laanan et al., 2010b) organized this study's data collection and analytical plan (described in detail in Chapter 2). Survey data were collected using a web-based instrument entitled the Engineering Transfer Student Survey, which is an adaptation and compilation of items from the Laanan transfer students' questionnaire (L-TSQ) (Laanan, 2004, 2007; Moser, 2012), surveys from the NSF-funded Prototype to Production (P2P) project (Lattuca, Terenzini, Litzinger, & Walser, 2006), and the STEM Student Success Literacy survey that was developed for a multi-phase study entitled, Measuring Constructs of STEM Student Success Literacy: Community College Students’ Self-Efficacy, Social Capital, and Transfer Knowledge (Myers, Starobin, Laanan, Russell, & OCCRP, 2012; Johnson, Starobin, Laanan, Russell, & OCCRP, 2012). The final survey instrument includes 45 multiple choice-style and open-ended questions that capture information in six primary areas: 1) personal background data; 2) enrollment status and transfer pathway; 3) experience with the transfer process; 4) experience at sending institution; 5) experience at receiving institution; and 6) comparison of experiences at each institution.

1.4 Significance of Research

According to the American Association of Community Colleges (AACC), an increasing number of students begin their pursuits of higher education at schools other than 4-year public/private colleges for a variety of reasons (AACC, 2015). Moreover, scholars argue that student transfer between institutions of higher education is the new normal in higher education, as the postsecondary student population is becoming more diverse (Marling, 2013). With 41% of first-time postsecondary students beginning their pursuits of higher education at
institutions other than 4-year public/private colleges (AACC, 2016), it is critical to support pathways into engineering from those other institutions to broaden participation in the field. The dearth of research on experiences and outcomes for transfer students in engineering is problematic because policy makers and higher education administrators (i.e., deans, department chairs, and admissions officers) must operate under untested assumptions in the absence of data. Findings from carefully constructed research would help them understand the barriers and perceptions that prevent more students from transferring into engineering at 4-year institutions, which could lead to empirically based policies and practices designed to enhance this pathway. This study, focused on transfer students in Texas, aims to meet that objective by extending prior work on transfer student capital into a new context.

1.4.1 Implications for Research. Findings from this study: 1) advance the current state of community college research on transfer students more generally; and 2) expand the body of literature on engineering transfer students. Manuscript 1 identifies areas worthy of future research through a synthesis of recent literature on transfer students in engineering. In Manuscript 2, findings on reasons and factors that influence engineering transfer students’ postsecondary pathway decisions extend prior community college research on STEM transfer students and transfer students more generally by investigating differences across sub-groups of students (e.g., Hispanic/Latino versus non-Hispanic/Latino students). Manuscript 3 contributes to a shift in research on transfer students from an agenda that primarily focused on input/output models for predicting transfer students’ outcomes to one that focuses on increasing understanding of transfer students’ experiences with post-transfer transition processes.

The study also has a unique sample, as it is comprised of a disproportionately large percentage of Hispanic/Latino students. Thus, the research also makes a significant contribution to literature on historically underrepresented ethnic/racial groups in STEM fields. In addition to generating new knowledge specific to engineering transfer students, this study also investigates similarities and differences between multiple groups of students within the engineering transfer student population (i.e., transfer students at open enrollment institutions versus those at more selective institutions; vertical versus lateral transfers; Hispanic/Latino
versus non-Hispanic/Latino; first generation versus non-first generation). This study provides additional evidence to illustrate the importance of disaggregating data during research analyses, especially to meet the goal of increasing understanding and awareness of areas of variation for sub-groups of engineering transfer students (Lichtenstein, Chen, Smith, & Maldonado, 2014; Ro & Knight, 2016; Ro, Knight, & Loya, 2016).

Finally, this research also serves as foundational work for a larger investigation that explores the relationships between transfer student capital and both academic achievement and degree attainment for engineering transfer students (NSF EEC - 1428502). Manuscripts 2 and 3 develop composite variables included in the Transfer Student Capital framework that will be used in analytical models for the larger study on engineering transfer students (Ogilvie et al., 2015, 2016, 2017).

1.4.2 Implications for Policy. Amidst national rhetoric of state disinvestment in public higher education, performance based funding models, institutional productivity, and amassing student loan debt, leveraging transfer pathways for higher education continues to garner increased interest from multiple stakeholders of higher education – students, policy makers, administrators, and citizens whose taxes help subsidize public higher education. Moreover, streamlined pathways to the workforce, institutional productivity, and student success also continue to be top policy issues in higher education in 2017 (Harnisch & Opalich, 2017). Thus, my dissertation on engineering transfer students is timely and relevant to this national dialogue for institutions of higher education.

As described, there is a limited body of literature available to determine if articulation agreements are an effective means to facilitate vertical transfer. Some researchers argue that current policy is weak, varied, and key terms are loosely interchanged (Bers, 2013), and others claim that articulation agreements are insufficient for transfer in STEM disciplines (Dowd, 2012). Transfer into STEM, and other academic disciplines that are characterized by a sequential curriculum, are further hampered by poorly aligned curricula (Packard, Gagnon, & Senas, 2012) and a lack of collaboration among faculty across institutions (Fann, 2013)

This study sheds light on reasons and factors that influence engineering transfer students’ postsecondary pathway decisions (Manuscript 2). It additionally highlights some of
the areas in which transfer students found their adjustments to be more challenging (Manuscript 3). Findings from this research can: 1) be used by higher education leaders and public officials to make improvements and revisions to existing policy, and 2) serve as a guide for states and institutions that are looking to adopt new policies that promote transfer.

1.4.3 Implications for Practice. Scholars contend that the “body of literature focusing specifically on transfer in STEM is not robust enough to substantiate conclusions about unique programmatic features that are necessary to design effective STEM transfer pathways” (Dowd, 2012, p. 122). My research brings data to higher education administrators (i.e., deans, department chairs, and admissions officers) so that: 1) they may better understand the barriers and perceptions that prevent more students from transferring into engineering at 4-year institutions, and 2) they can make more informed adjustments to their existing institutional practices. Findings from Manuscript 2 can help engineering programs at 4-year institutions that are interested in broadening participation by informing future efforts to attract, recruit, and connect with prospective engineering transfer students. Findings from Manuscript 3 help engineering programs at 4-year institutions identify opportunities and practices to build receptive and supportive environments that ease the transition for engineering transfer students. Finally, findings from this study can inform decisions on how to allocate limited resources (i.e., financial and human) so that those resources have the largest possible impact on increasing the number and diversity of students who transfer into and succeed in engineering at 4-year institutions.

1.5 Limitations

The population under investigation in this study includes students who enrolled as new transfer students in engineering between 2007 and 2014 at four Texas 4-year institutions. However, the study does not include perspectives from students who initially wanted to transfer into engineering but were unsuccessful in their efforts. Research on this latter group of students is worthy of future investigation and will require 2-year institutions to play a central role in facilitating access to potential participants.

Focusing this study on a small number of institutions in one large, growing state with a sizeable Hispanic population limits the generalizability of findings. Texas, however, is a majority-
minority state which may be potentially relevant and applicable to the broader population of Hispanics in the United States. According to 2010 data from the U.S. Census Bureau (2012), there are 50.5 million Hispanics in the United States, of which 63% are of Mexican origin. In Texas, the largest Hispanic origin group is Mexican, and the same is true for 39 additional states (U.S. Census Bureau, 2012). In seven of the top ten largest Hispanic states, Mexican is the largest Hispanic origin group, ranging from 61% share of the Hispanics in Georgia to 91% in Arizona (Pew, 2013). Thus, studies like this one that are focused on the Hispanic population in Texas have the potential to provide insight on a broad segment of Hispanics who share similar origins but reside in states distributed across the United States.

Similarly, evidence supports the argument that research findings from this Texas based study are potentially relevant and applicable to states that are not currently majority-minority. Based on 2013 data from the U.S. Census Bureau (2014), Hispanics represent 17% of the population in the United States and 38% in Texas. By 2050, it is projected that this figure will grow to more than 30% of the U.S. population (U.S. Census, 2012). The fastest growing Hispanic states from 2000 to 2011 are primary located in the southeastern part of the United States (U.S. Census Bureau, 2012), and the top ten fastest growing Hispanic states experienced more than a 100% change in Hispanic population between 2000 and 2011, ranging from a 103% change in Georgia to a 158% change in Alabama (Pew, 2013). Nationwide, 40 states have experienced more than 50% change in Hispanic population between 2000 and 2011 (U.S. Census, 2012). To plan for the future, states with fast growing Hispanic populations may look to Texas for examples of best practices and lessons learned in workforce development; findings from this study may be relevant and applicable as states strategically plan for future growth.

Additional limitations of this study are acknowledged within the context of each manuscript included in this dissertation (detailed in Chapter 4 and 5).

1.6. Research Bias

My biases as a researcher originate from more than a decade of work experience and service to support students historically underrepresented in engineering. From 2001 to 2012, I served as the director of the Equal Opportunity in Engineering (EOE) Program at The University of Texas at Austin, an experience which informs my understanding of and access to engineering
transfer student communities. To gain access to the proposed research sites in Texas, I called on personal contacts from my professional network. During the research design and data collection phase of the project, I also drew on my prior expertise to inform, guide, and enhance our research efforts. For example, I was able to use my knowledge of institutional record data to identify and request specific student data that could be useful in our efforts to explore relationships between variables in the framework for transfer student capital (Laanan & Hernández, 2011; Laanan et al., 2010b). Based on my prior knowledge and experience with preparing and sending electronic communications to students, I also understood the importance of crafting customized and compelling messages to invite participants (students and alumni) to contribute to our study. I led project efforts to craft messaging for participant invitations and I partnered with administrative leaders at each study site to ensure that customized invitations were released by a local contact at the institution who served as a local champion for the research project.

I acknowledge that my prior work experience and personal background play a role in shaping my interpretation of the data. To reduce my bias, I used established survey instruments from the field instead of developing my own items which might have collected data that I would be looking for because of my lens. In addition, I used peer debriefing to check my interpretation of the data and improve accuracy of the findings (Creswell, 2014).

1.7 Key Terms

In this section, key terms are defined to increase clarity, meaning, and understanding of the context under investigation. Personnel from participating institutions contributed to this list by clarifying terms that carry unique meaning from an institutional perspective (Ogilvie et al., 2015).

- **Transfer student capital.** Accumulation of knowledge about higher education that develops in a student as he or she interacts with faculty, receives academic advising/counseling, studies for coursework, navigates through university transfer policies to fulfill academic requirements, and proceeds through the transfer process from a 2-year institution to a 4-year institution (Laanan et al., 2010b).
• **Sending Institution (SI).** The institution where a student was enrolled prior to transfer. In this study: 1) *sending institution* can either be a 2-year or 4-year institution; 2) the term *sending institution* is synonymous with *previous institution* (see *previous institution versus receiving institution*).

• **Receiving Institution (RI).** The institution where a student is enrolled after transfer. In this study, the receiving institution is one of the four 4-year institutions in the study.

• **Previous institution versus receiving institution.** The terms *previous institution* and *receiving institution* are used in the survey instrument to capture and compare students’ experiences. For cases in which students attended more than one institution prior to transferring, *previous institution* is defined as the college or university in which the student spent the most time. Based on this working definition, the student was invited to identify his or her previous institution. In this study, the term *previous institution* is synonymous with *sending institution* (see *sending institution*); partner institutions thought students would better understand “previous institution” when answering the survey.

• **Non-transfer student.** A student who matriculates from high school to a 4-year institution; a non-transfer student is also identified as a “native” student to the 4-year institution (Glass & Harrington, 2002). For this study, the term *non-transfer student* will be used in place of *native student*.

• **First-time in college (FTIC) student.** Common term used at 4-year institutions to identify students at the institution who are attending college for the first time at the undergraduate level (i.e., non-transfer students). Includes students enrolled in the fall term who attended college for the first time in the prior summer term. Also includes students who entered with advanced standing (college credits earned before graduation from high school). Definition adapted from College Board, Peterson's, and U.S. News & World Report (2015) and Putnam and National Center for Education Statistics (1981).

• **First-time postsecondary student.** A student attending any institution for the first time at the postsecondary level. Includes students enrolled in the fall term who attended a postsecondary institution for the first time in the prior summer term. Also includes
students who entered with advanced standing (college credit earned before graduation from high school). Definition adapted from College Board et al. (2015) and Putnam and National Center for Education Statistics (1981).

- **Vertical transfer.** Describes student migration from a 2-year institution to a 4-year institution (Laanan & Zhang, 2011; Peng & Bailey, 1977; Shealy et al., 2013).

- **Upward transfer.** *Upward transfer* is synonymous with *vertical transfer* (see vertical transfer); terms are used interchangeably in the literature (Bahr, 2009; Bahr, Toth, Thirolf, & Massé, 2013; Laanan & Zhang, 2011; Peng & Bailey, 1977; Shealy et al., 2013). For this study, the term *vertical transfer* will be used in place of *upward transfer*.

- **Lateral transfer.** Describes student migration from one 4-year institution to another 4-year institution (Bahr, 2009; Shealy et al., 2013).

- **Swirl transfer.** Describes a migration pattern in which the transfer student returns to his or her original sending institution (Shealy et al., 2013).

- **Double-dipping.** Describes a migration pattern in which the transfer student is concurrently enrolled at both a 2-year institution and a 4-year institution (Shealy et al., 2013).

- **Dual enrollment versus concurrent enrollment.** Dual enrollment describes high school students who are enrolled in dual credit/early college high schools; concurrent enrollment describes postsecondary students enrolled in multiple institutions of higher education at the same time (Ogilvie et al., 2015).

- **Co-enrolled versus concurrently enrolled.** Co-enrolled describes student participants in formal co-enrollment programs, such as the Texas A&M Engineering Academy (Cortez, Reed, Imbrie, McMullen, & Perez, 2015; Perez, Yoon, Reed, & Lawley, 2016). Students admitted into this academy have applied to Texas A&M University and receive a coordinated admissions offer to co-enroll in both Texas A&M University and a partner 2-year institution. Unlike co-enrolled students, concurrently enrolled students have separate admission offers from multiple institutions (Ogilvie et al., 2015).

- **Counselor versus academic advisor.** The terms *counselor* and *academic advisor* are used interchangeably at 2-year institutions to refer to professional staff hired to advise
and assist students with their academic plans. At 4-year institutions, the more common term is *academic advisor* (Ogilvie et al., 2015).

1.8 Overview of Remaining Chapters

Chapter 2 introduces key concepts that form the theoretical underpinning of the study. Chapter 3 provides a synthesis of recent literature focused on characteristics, outcomes, and experiences for transfer students in engineering (Manuscript 1). Chapter 4 explores reasons and factors that influence engineering transfer students’ postsecondary pathway decisions (Manuscript 2). Chapter 5 investigates engineering transfer students’ experiences with post-transfer transition processes and their adjustments at receiving institutions (Manuscript 3). Finally, Chapter 6 summarizes key findings and plans for future work.
Chapter 2: Theoretical Underpinnings

2.1 Introduction

This chapter provides an explanation of key theories that form the underpinning of the study (section 2.2) and introduces the theoretical framework of Transfer Student Capital (section 2.3). That framework organized the study's data collection and analysis.

2.2 Theories of Capital

In A Review and Critique of the Literature on Community College Students’ Transition Processes and Outcomes in Four-Year Institutions, Bahr et al. (2013) highlight that education researchers have employed multiple theories of capital to understand and explain differences in students' preparation, performance, and degree attainment in educational settings. The authors posited that studies employing theories of capital offer a new approach for understanding and explaining long-standing equity issues in higher education (i.e., access, persistence, performance, retention, and graduation). Such an approach differs from previous explanations that were based on a student’s “lack of preparation or failure to adapt” (p. 496), especially for students from underrepresented groups in higher education. Common forms of capital cited in education research include cultural capital (Bourdieu, 1986), social capital (Bourdieu, 1986; Coleman, 1988; Lin, 2001) and human capital (Becker, 1993). Bahr et al. (2013) point out that these common forms of capital have inspired the development of new concepts, such as academic capital (Hagedorn & Kress, 2008; Núñez, 2009; St. John, Hu, & Fisher, 2011), emotional capital (McGrath & Van Buskirk, 1999), and transfer student capital (Laanan et al., 2010b).

A small number of studies specific to transfer students in engineering have employed theories of capital to investigate students’: 1) academic and career choices (Martin, Simmons, & Yu, 2013; Trenor, Yu, Waight, & Zerda, 2008); 2) support received from their families (Mobley, Brawner, Long, & Ohland, 2014a); 3) experiences with navigating the transfer process (Mobley et al., 2013); and 4) adjustment to receiving institution(s) (Laanan, Jackson, & Rover, 2011). Findings from each of these studies illustrate how students’ experiences differ with respect to varying levels and forms of capital. The sections that follow introduce three forms of capital
that inform my research and serve as guides for collecting, interpreting, and analyzing quantitative data for this study and qualitative data for the larger NSF funded project (Ogilvie et al., 2015, 2016, 2017).

2.2.1 Cultural Capital. Since the early 1980s, researchers have used cultural capital theory to inform studies in education research. Cultural capital refers to one’s accumulation of knowledge, know-how, behavior, tastes, and preferences that are valued and acknowledged by the dominant group in a society (Bourdieu, 1986). According to Bourdieu (2001), class-linked, cultural knowledge is primarily passed down through families from one generation to the next. This concept of cultural capital is derived from Bourdieu’s work in social reproduction theory, which contends that ideas and beliefs of dominant groups are imposed on subordinate groups as a societal norm (Bourdieu, 1986). Bourdieu asserts that ideological beliefs of the dominant class are reproduced as societal norms through pedagogical action (e.g., teaching, education) (Bourdieu, 1986; Bourdieu & Passeron, 1977). His research links student outcomes to varying levels of cultural capital and contends that students with more cultural capital tend to perform better academically than those with lesser amounts of cultural capital.

Approaches to operationalize cultural capital have varied widely across studies (Lareau & Weininger, 2003). Bahr et al. (2013) highlight both quantitative (Wassmer, Moore, & Shulock, 2004) and qualitative studies (Trujillo & Diaz, 1999; Valadez, 1993, 1999; Wolf-Wendel, Twombly, Morpewh, & Sopcich, 2004) that use cultural capital theory to investigate the experiences of community college students and their transitions to 4-year institutions. For example, Wassmer et al. (2004) found “disparities in transfer rates according to the racial/ethnic composition of the student body” at community colleges in California. Community colleges with higher representations of Hispanic and Black students also had lower 6-year transfer rates. To interpret their findings, the researchers used race/ethnicity as a proxy for cultural capital. They posited that variations in transfer rates could be linked to differences in cultural capital since it is not uncommon for students from underrepresented ethnic groups to be the first in their families to attend college. Although these studies focus on community college students more generally, their research findings and use of cultural capital theory are germane to future studies on transfer students conducted in the engineering context. Taking
students’ ethnicity/race and parent education status into consideration, cultural capital theory is used in my study to explain differences in engineering transfer students’ reasons for starting their educations at institutions other than their final receiving institutions as well as factors that influenced their decisions to transfer.

### 2.2.2 Social Capital

A number of scholars have contributed to the conceptualization and advancement of social capital theory (Bourdieu, 1986; Coleman, 1988; Lin, 2001; Portes, 1998), which is defined as one’s access to resources that are embedded within a social network (Lin, 2000). Although leading scholars in social capital theory maintain different perspectives on social capital accumulation and how to assess whether beneficiaries are at the individual actor level (Lin, 2001) or the collective group level (Bourdieu, 1986; Coleman, 1988), they agree that “social capital is conceptualized as quantity and/or quality of resources that an actor (be it an individual or group or community) can access or use through its location in a social network” (Lin, 2000, p. 786). The following sections provide brief overviews of the varying perspectives on social capital held by Bourdieu (1986), Coleman (1988), and Lin (2001).

**Bourdieu’s perspective - group level.** Bourdieu (1986) approaches the study of social capital from the perspective of how groups accumulate, maintain, and reproduce social capital. He uses the theory to explain how social and economic elites collectively maintain power and status in society. Bourdieu (2001) contends that capital can present itself in one of three forms: economic, cultural, and social. He asserts that “economic capital is at the root of all other types of capital” (Bourdieu, 1986, pp. 252-253) and that social capital can be converted into economic capital. This perspective means that relationships matter; who you know and how you are connected can lead to profitable economic opportunities. Like cultural capital, Bourdieu’s conceptualization of social capital originates from his research on social reproduction theory (Anyon, 2011). Bourdieu contends that ideological beliefs of the dominant class are reproduced as societal norms through pedagogical action and that this process enabled the reproduction of social and economic elites in France (Bourdieu, 1986; Bourdieu & Passeron, 1977).

In an education context, researchers have used Bourdieu’s theories on capital to explain how institutions of education play a role in reproducing social ideology and economic inequality in the United States. The system rewards students who accumulate or possess knowledge,
know-how, behavior, tastes, and preferences that are valued and acknowledged by the dominant group in a society (Anyon, 1980; Apple, 1990; Bowles & Gintis, 1976; Giroux, 1981). This concept is applicable to my study, especially as it relates to institutionalized policies, practices, and procedures at 4-year institutions that may prevent more transfer students from pursuing an undergraduate degree in engineering and are counterproductive to broadening participation in the field.

**Coleman’s perspective – group level.** Coleman (1988) similarly approaches the study of social capital from the perspective of how groups accumulate, maintain, and reproduce social capital. However, he uses the theory to explain how communities come together to share resources (e.g., information and social support) that benefit the collective group (Coleman, 1988). Coleman describes social capital as having two elements. First, “it is an aspect of social structure”; second, social capital “facilitates certain actions of individuals within a structure” (Coleman, 1990, p. 302). This conceptualization means that within a community, actors can benefit by interacting and exchanging resources. Coleman (1988) used the concept of social capital to demonstrate how an adult community in and around a school setting provides social support to students and results in improved student outcomes. This concept is applicable to my study, especially as it relates to understanding how academic peers, faculty, and staff at both the sending and receiving institutions can help and support students as they navigate transfer to and transitions at their receiving institutions.

**Lin’s perspective – individual level.** Lin (2001) argues that social capital should be viewed within a social network context, and his approach explores how an individual accesses and activates embedded resources in a social network. From Lin’s (2001) perspective: 1) resources are embedded in the social relations of a network, not within an individual; and 2) access and use of embedded resources is dependent on the actor. He posits that resources are strategically located throughout a network and that access to these resources is dependent upon one’s position within the network or organization and the strength or weakness of one’s ties. Lin (2000) highlights a multitude of studies to support claims that “social capital is differentially distributed across different social groups” (p. 787) and that “minority groups and females tend to be embedded in social networks deficient in resources or in social capital” (p. 19).
789). Making connections beyond routine social circles is one strategy that minority groups and females can use to overcome deficiencies in resources or in social capital (Lin, 2000).

This perspective on social capital has surfaced in an engineering education context. Martin et al. (2013) apply Lin’s network theory of social capital to understand the experiences of four Hispanic females in engineering who were also first-generation college students (three of the four participants were transfer students). The researchers identified that, for these students, a “lack of available family social capital was supplemented mostly by school personnel” and that “delayed recognition or identification of available resources slowed access and activation of resources, lead[ing] to difficult university transitions” (p. 227). Martin et al. (2013) used social capital theory to present an anti-deficit perspective on the experiences of a sub-population group of students who are underrepresented in engineering – first-generation, Hispanic females.

In summary, studies that employ social capital theory (in a postsecondary education context) have taken multiple perspectives and offer new ways to understand student behaviors and educational outcomes. The theory has the potential to offer new interpretations of the variations in experiences for engineering transfer students - based on who they know (Bourdieu, 1986), what support groups they belong to (Coleman, 1988), and how they access resources within a network (Lin, 2000). Each of these perspectives on social capital theory inform and guide my interpretation of findings.

2.2.3 Transfer Student Capital. The term transfer student capital was coined by Laanan during an interview with the New York Times about transfer students and their experiences with navigating a new institution post-transfer (Pappano, 2006). Four years later, Laanan collaborated with an expanded team of researchers to further develop and operationalize his concept (Laanan et al., 2010b). They defined transfer student capital as the accumulation of knowledge about higher education that develops in a student as he or she interacts with faculty, receives academic advising and counseling, studies for coursework, navigates through university transfer policies to fulfill academic requirements, and proceeds through the transfer process from a 2-year institution to a 4-year institution. According to the literature, Laanan’s transfer student capital concept is based on Becker’s (1993) theory of human capital – simply
defined as accumulation of education and training to improve performance and productivity that can be used to negotiate and garner increased wages. Laanan et al. (2010b) operationalized transfer student capital using four composite variables that account for: 1) academic counseling experiences; 2) perceptions of the transfer process; 3) experiences with faculty at the 2-year institution; and 4) learning and study skills acquired at the 2-year institution. The theory suggests that students who accumulate larger amounts of transfer student capital are more apt to transfer successfully from a 2-year institution to a 4-year institution (Laanan, 2007; Laanan et al., 2010b).

Researchers have started to use the concept of transfer student capital to investigate engineering transfer students’ experiences and their adjustments to their receiving institutions (Laanan, Jackson, & Rover, 2011; Mobley et al., 2014a), but applications have been limited. Mobley et al. (2014a) explored transfer student capital from a qualitative perspective, but their investigation focused solely on parent education status and how that demographic characteristic influences students' experiences as they navigate the transfer process. The authors concluded that “transfer student capital is comprised of many different factors” and proposed that other elements, beyond parent education status, should be explored more fully. Laanan, Jackson, and Rover (2011) employed a mixed methods approach and used transfer student capital theory to understand characteristics, experiences, and outcomes for transfer students in engineering. Although the researchers published descriptive statistics for transfer student capital using the four composite variables previously identified, their analysis was limited to 157 engineering transfer students from one U.S. research institution in the Midwest. Moreover, this small sample was predominantly White (78%) and male (96%). To further explore the relationship between transfer student capital and engineering transfer student adjustment, a larger and more representative sample is critical. My research responds to this need.
2.3 Organizing Theoretical Framework - Transfer Student Capital

Theories of capital offer a lens to investigate longstanding issues in higher education, especially for underrepresented groups (Bahr et al., 2013). Studies employing theories of capital illustrate how certain groups can be at a disadvantage when institutions of higher education place value on certain types of capital (Martin et al., 2013; Mobley et al., 2014a; Mobley et al., 2013; Trenor, Yu, Waight, & Zerda, 2008; Trujillo & Diaz, 1999; Valadez, 1993, 1999; Wassmer et al., 2004; Wolf-Wendel et al., 2004). Moreover, theories of capital provide a different perspective that can be used to understand and explain how students’ experiences can vary in relation to forms and quantity of capital they possess or to which they have access.

The forms of capital summarized in the preceding sections inform data analyses and interpretation for my dissertation. In Manuscript 2, theories of cultural and social capital are used to tease out, understand, and interpret findings on engineering transfer students’ reasons for starting at another institution and factors that influence their decisions to transfer. For Manuscript 3, theories on cultural capital, social capital, and transfer student capital are used as lenses to investigate, understand, and interpret findings on engineering transfer students' experiences with transitioning to receiving institutions. Because the framework for transfer student capital (TSC) incorporates elements from each of the aforementioned theories, it serves as an organizing guide for my research on engineering transfer students.

2.3.1 TSC Framework Background. Laanan et al. (2010b) designed the TSC theoretical framework to explore relationships between composite variables for academic and social transfer adjustment (their dependent variables) with students’: 1) background information; 2) experiences at the 2-year institution; 3) experiences at the 4-year institution; and 4) transfer student capital. Their framework draws on: 1) Pascarella’s model of student learning and cognitive development (described in greater detail in Manuscript 3), 2) Becker’s human capital theory, and 3) Hagedorn’s notion of transfer as student retention (Laanan et al., 2010b).

Pascarella (1985) identified five factors that influenced student learning and cognitive development in a college environment – “students’ background/pre-college traits, structural/organizational characteristics of institutions, institutional environments, students’ interactions with agents of socialization, and quality of student effort” (Laanan et al., 2010b, p.
Laanan et al. (2010b) used Pascarella’s model to identify variables that should be included to build a hypothesized predictive model for transfer adjustment. Second, Becker’s (1993) theory of human capital influenced Laanan et al. (2010b) to think similarly about the “role and relevance of transfer student capital” (p. 180) and how it could be used to benefit transfer students during the academic and social adjustment period at a receiving university. Third, Hagedorn suggested that community college students who earn good grades are more likely to transfer to a 4-year institution and thus are retained in postsecondary education (Hagedorn & Cepeda, 2004; Hagedorn, Cypers, & Lester, 2008; Hagedorn, Moon, Cypers, Maxwell, & Lester, 2006). Following Hagedorn’s lead, Laanan et al. (2010b) also subscribed to the notion that there is a relationship between grades, transfer, and retention. Using single item variables (e.g., transfer GPA) and composite variables (e.g., perspective from experience at sending institution on learning and study skills, course learning), Hagedorn’s concept is represented in two components for the TSC framework: 1) experiences at the 2-year institution, and 2) transfer student capital.

2.3.2 Operationalizing the TSC Framework. In 2010, transfer student capital was explored in a study using the Laanan Transfer Student Questionnaire (L-TSQ); researchers collected survey responses from over 800 transfer students (Laanan et al., 2010b). Findings demonstrated that 20% of the variance in transfer students’ academic adjustment was explained using students’ background characteristics, experiences at the 2-year institution, transfer capital, and experiences at the 4-year institution (Laanan et al., 2010b). The academic adjustment construct was based on students' responses to 4 survey items about their experiences at the receiving institution (i.e., ease of adjustment; feelings about large classes; dip in GPA; competition between/among peers). Sources of transfer student capital that were statistically significant included academic counseling experiences and learning and study skills gained in the 2-year institution (Laanan et al., 2010b). In a similar analysis focused specifically on STEM transfer students, Laanan and Hernández (2011) explained 38% of the variance in academic adjustment using students’ background characteristics, experiences at the 2-year institution, transfer capital, and experiences at the 4-year institution. Sources of transfer student capital that were statistically significant included academic counseling experiences,
experiences with faculty, and experiences with coursework (Laanan & Hernández, 2011). These findings resonate with the existing literature on critical strategies to help overcome a chilly climate and address retention issues within the fields of science and engineering (Lattuca, Terenzini, & Volkwein, 2006; Lichtenstein et al., 2014; Seymour & Hewitt, 1997).

Based on this research, the authors argued that “transfer student capital can be a significant contributor” to students’ academic adjustments (Laanan & Hernández, 2011, p. 33). In addition, institutions that offer social and academic support programs “help students recognize and activate their unique sources of transfer student capital” (Laanan & Hernández, 2011, p. 35). The researchers also identified multiple opportunities to extend the literature on STEM transfer students. Two of the strategies highlighted involved linking L-TSQ survey responses to longitudinal academic records for transfer students as well as conducting qualitative studies to understand the experiences of STEM transfer students (Laanan et al., 2010b). My study responds directly to this call for action by contributing important foundational work for a larger investigation (NSF EEC - 1428502) that will explore the relationship between transfer student capital and academic achievement and degree attainment for engineering transfer students (Ogilvie et al., 2015, 2016, 2017).

2.3.3 Elements in the Modified TSC Framework. As illustrated in Figure 1, this study’s framework is adapted and modified from Laanan, Starobin, & Eggleston (2010b) and Laanan & Hernández (2011). The original framework was designed to explore academic and social transfer adjustments as outcome variables for transfer students. Instead, the modified framework guiding this study (and the larger investigation) explores relationships between educational outcomes (academic achievement and degree attainment) and engineering transfer students’: 1) background; 2) experiences at the sending institution; 3) transfer student capital; 4) and experiences at the receiving institution.
The modified framework organizes variables into the following five components.

Background. The first subgroup captures student characteristics and background information such as: gender, race/ethnicity, parent/guardian education status, students’ reasons for starting their education at a different institution and factors that influenced their decision to transfer to the receiving institution, and future degree aspirations. Additional variables of interest include: mode of admission at receiving institution (e.g., co-enrolled, concurrently enrolled, vertical transfer, lateral transfer), identification of primary sending institution(s), expected/actual time to degree completion, citizenship, and age.

Experiences at Sending Institution. The second subgroup captures information that characterizes the students’ experiences at the sending institution, such as: transfer GPA, transfer credits, associate degree attainment. Additional variables of interest include: student experiences with faculty, coursework, and time management at the sending institution.

Transfer Student Capital. The third subgroup captures information that is used to measure transfer student capital. Laanan et al. (2010b) operationalized transfer student capital using 4 composite variables that include: 1) academic counseling experiences; 2) perceptions of the transfer process; 3) experiences with faculty at sending institution; and 4) students’ perceptions of learning and study skills acquired at the sending institution. Additional variables of interest include students’ experiences prior to transfer, including experiences with academic
advising at both sending and receiving institutions, use of student resources at the receiving institution, and students’ perceptions on usefulness of information sources on how to transfer.

**Experiences at Receiving Institution.** The fourth subgroup captures information that is used to calculate composite variables for: 1) students’ perspectives on transfer challenges and general perceptions of the receiving institution; and 2) students’ perceptions of the adjustment process and social support available at the receiving institution. Additional variables of interest include students’ experiences with faculty, coursework, and time management at the receiving institution.

**Educational Outcomes.** The final subgroup in the modified framework captures educational outcome data for transfer students, including cumulative university GPA, cumulative major GPA, engineering enrollment status (e.g., retained in engineering, earned degree in engineering).

Using the modified framework as a guide, this multi-manuscript dissertation focuses on two components in the framework: 1) reasons for starting at another institution and factors that influence decisions to transfer; and 2) transitions to receiving institutions. Additionally, the dissertation considers how those components vary across different subgroups of transfer students. Beyond this dissertation, future work will focus on navigating the transfer process and measures of transfer student capital. The analyses within these manuscripts lead to the development of composite variables that will be used in models for the larger study on engineering transfer students. Those models will explore relationships between educational outcomes (academic achievement and degree attainment) and the other components of the Transfer Student Capital framework.
Chapter 3: Manuscript #1

Transfer Students in Engineering: A Synthesis of Recent Literature
Focused on Characteristics, Outcomes, & Experiences

Abstract

**Background** More than a decade after the release of NAE’s (2005) report entitled *Enhancing the Community College Pathway to Engineering Careers*, the body of literature on engineering transfer students is still relatively small, but showing positive signs of growth.

**Purpose** This manuscript explores the current state of literature on transfer students in engineering.

**Design/Method** This review draws on peer reviewed articles, published between 2000 and 2017, focused on transfer students in engineering.

**Results** Four overarching themes emerged from this review of recent literature on engineering transfer students, including: 1) the transfer pathway offers the potential to broaden participation and diversify the engineering workforce; 2) engineering transfer students vary and should not be considered a homogeneous group; 3) for most students, the transfer pathway to an engineering degree is not 2+2; and 4) transfer students in engineering face barriers throughout the pathway. Findings suggest that future research on engineering transfer students and their experiences should disaggregate and analyze data by subgroups to more fully understand this unique student population.

**Conclusions** This synthesis of recent literature on engineering transfer students aids researchers in identifying areas where future scholarship could advance understanding of engineering transfer students and their educational experiences at both sending and receiving institutions.

**Keywords** engineering, transfer students, transfer pathways, transfer student outcomes
Transfer Students in Engineering: A Synthesis of Recent Literature Focused on Characteristics, Outcomes, & Experiences

1.0 Introduction

The purpose of this manuscript is to explore the current state of literature on transfer students in engineering. This review of the literature seeks to answer the following research question: What is known about transfer students in engineering (i.e., characteristics, experiences, academic performance, and educational outcomes)? Outcomes from this investigation can aid researchers in identifying areas where future scholarship can further advance understanding of engineering transfer students and their educational experiences at both sending and receiving institutions.

To locate peer-reviewed articles on transfer students in engineering, a search was performed using Engineering Village, an interface designed to simultaneously search three engineering databases: Compendex, Inspec, and National Technical Information Service (NTIS). Search terms included: engineering and transfer student(s). The search yielded 310 articles relevant to the research topic. Reference lists from journal articles and conference papers on transfer students in STEM or engineering were also reviewed to identify additional articles. To narrow the scope, articles in this literature review met the following criteria: 1.) peer reviewed article; 2.) published between 2000 and 2017; and 3.) addressed experiences and/or educational outcomes of engineering transfer students.

This manuscript begins with an introduction to the current state of literature on transfer students in engineering (section 2.0), followed by a synthesis of recent literature focused on engineering transfer students’ characteristics, performance outcomes, and educational experiences (section 3.0). The manuscript concludes with a summary of overarching themes that emerged from the existing body of literature (Section 4.0).

2.0 Current State of Literature on Transfer Students in Engineering

More than a decade after the release of NAE’s (2005) report entitled Enhancing the Community College Pathway to Engineering Careers, the body of literature on engineering transfer students is still slim and fragmented (Dowd, 2012; Ogilvie, 2014; Olson et al., 2012).
Most of what is known about this student population is based on the community college literature more generally and research focused on transfer students in STEM. Why is research on engineering transfer students still so limited? Existing research suggests that transfer students are an afterthought at many institutions and that they “remain in the shadow of more prominent student populations” such as high-achieving first-time full-time students (Tobolowsky & Cox, 2012, p. 406). Could the dearth of literature on transfer students in engineering be an indication of outright “institutional neglect,” or is there a more significant issue hindering scholarship in this area? Some argue that insufficient data and “inconsistent definitions of who students are” (Tobolowsky & Cox, 2012, p. 400) make it difficult to identify transfer students. Such challenges limit the use of longitudinal databases to track transfer students' progression between institutions. In 2011, the NAE and ASEE encountered this difficulty in an attempt to collect enrollment and demographic data from 17 4-year institutions and 35 2-year institutions for a pilot study on transfer students in engineering and engineering technology programs (Didion, 2015; Gibbons, Cady, Didion, & Fortenberry, 2011a, 2011b). At the time, “lack of readily available data” (Gibbons et al., 2011b, p. 2) and “inconsistent data collection methods” (Didion, 2015, p. 2) proved to be limiting factors for the pilot project.

Since that project, there has been a focused effort to improve research in this area, and multiple studies specific to engineering transfer students have been published using large-scale, multi-institution data sets. These projects include: 1) the California Partnership for Achieving Student Success (Cal-PASS) database (Blash et al., 2012a); 2) the California Postsecondary Education Commission (CPEC) database (Blash et al., 2012a); 3) MIDFIELD, a multi-institution database comprised of 11 universities from the southeastern part of the United States (Ohland, Cosentino, Brawner, Mobley, & Long, 2015); and 4) the Prototype to Production (P2P) project, a survey-based study that included 31 four-year institutions and 15 community colleges (Lattuca et al., 2006; Terenzini et al., 2014).

Table 1 organizes recent literature on engineering transfer students according to broad themes and special topics. Within the last five years, engineering-specific studies have started to characterize transfer students according to sociodemographic profiles, pathway(s) pursued (including reasons and factors in the decision to transfer), persistence from 2-year to 4-year...
institutions, academic performance, course preparation, degree attainment (including time to degree completion and transfer credit), and personal/academic obligations. Employing a mix of quantitative and qualitative approaches, studies are also beginning to explore engineering transfer students’ experiences and perspectives on a variety of special topics, such as reasons for pursuing the transfer pathway and selecting engineering as a major, navigating the transfer process, perceptions of orientation and advising, academic and social adjustments during the transition between institutions, motivations of older transfer students, experiences for first generation transfer students, and success factors for Black transfer students and Hispanic/Latino transfer students. Finally, in the last two years, new publications have introduced an innovative co-enrollment model designed to expand transfer in engineering at Texas A&M University and showcased best practices and transfer-friendly policies that support vertical transfer in engineering.
**Table 1.** Engineering transfer student literature, organized by themes and special topics.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Topic</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterize transfer students in engineering</td>
<td>sociodemographic profiles</td>
<td>(Blash et al., 2012a; Cortez et al., 2015; Didion, 2015; Gibbons et al., 2011b; Knight, Bergom, Burt, &amp; Lattuca, 2014; Ogilvie et al., 2016; Ohland et al., 2014; Sullivan et al., 2012; Terenzini et al., 2014; Yoon, Cortez, Reed, &amp; Imbrie, 2015)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>pathway(s) pursued (including reasons and factors in the decision to transfer)</td>
<td>(Knight et al., 2014; Ogilvie &amp; Knight, in preparation-b; Ogilvie et al., 2016; Shealy et al., 2013; Terenzini et al., 2014)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>persistence from 2-year to 4-year institutions</td>
<td>(Blash et al., 2012a; Cortez et al., 2015)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>academic performance</td>
<td>(Mobley et al., 2014a; Ogilvie et al., 2017; Sullivan et al., 2012; Yoon et al., 2015)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>course preparation</td>
<td>(Knight et al., 2014; Terenzini et al., 2014; Yoon et al., 2015)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>degree attainment (including time to degree completion &amp; transfer credit)</td>
<td>(Blash et al., 2012a; Didion, 2015; Gibbons et al., 2011b; Ogilvie et al., 2017; Sullivan et al., 2012; Yoon et al., 2015)</td>
</tr>
<tr>
<td>Characterize transfer students in engineering</td>
<td>personal/academic obligations</td>
<td>(Knight et al., 2014; Terenzini et al., 2014)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>reasons for pursuing transfer pathway and selecting engineering as a major</td>
<td>(Blash et al., 2012a; Mobley, Brawner, &amp; Long, 2014b; Ogilvie &amp; Knight, in preparation-b)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>navigating the transfer process</td>
<td>(Mobley et al., 2014a)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>perceptions of orientation &amp; advising</td>
<td>(Mobley &amp; Brawner, 2013)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>academic and social adjustments during transition between institutions</td>
<td>(Davis, Ogilvie, &amp; Knight, 2017; Laanan et al., 2010a; Laanan, Jackson, &amp; Rover, 2011; Laungerman, 2012; Mobley et al., 2012; Ogilvie &amp; Knight, 2016, in preparation-a, under review)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>motivations of older transfer students</td>
<td>(Brawner &amp; Mobley, 2014)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>experiences for first generation transfer students</td>
<td>(Mobley et al., 2013)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>success factors for Black transfer students</td>
<td>(Cosentino, Sullivan, Gahlawat, Ohland, &amp; Long, 2014)</td>
</tr>
<tr>
<td>Explore engineering transfer student experiences and perspectives on special topics</td>
<td>success factors for Hispanic/ Latino transfer students</td>
<td>(Froyd et al., 2015; Ogilvie &amp; Knight, 2016, under review; Ogilvie et al., 2015, 2016, 2017)</td>
</tr>
<tr>
<td>Highlight innovative models and best practices</td>
<td>co-enrollment model designed to expand transfer in engineering</td>
<td>(Cortez et al., 2015; Perez et al., 2016)</td>
</tr>
<tr>
<td>Highlight innovative models and best practices</td>
<td>best practices and transfer-friendly policies that support vertical transfer in engineering</td>
<td>(Didion, 2015)</td>
</tr>
</tbody>
</table>
Although much needed and long overdue, the studies highlighted in Table 1 have just scratched the surface when it comes to understanding engineering transfer students and their experiences. There is still a critical need to identify factors that explain why engineering transfer students are successful or not, as research in this area is limited to just a handful of studies (Laanan, Jackson, & Lopez, 2011; Laugerman, 2012; Laugerman & Shelley, 2013; Mickelson & Laugerman, 2011). The following sections explore this existing body of literature in further detail.

### 3.0 Synthesis of Recent Literature on Transfer Students in Engineering

This synthesis of recent literature is focused on engineering transfer students’ characteristics, performance outcomes, and educational experiences. Aligned with these focus areas and further organized by five sub-topics (i.e., sociodemographic characteristics, transfer pathways, educational outcomes, poorly aligned curriculum and time to degree completion, and student experiences at sending/receiving institutions), sections 3.1 through 3.5 summarize findings from relevant research studies and identify opportunities to further advance understanding of transfer students in engineering.

#### 3.1 Sociodemographic Characteristics

Based on current enrollment trends in higher education, the transfer pathway offers the potential to broaden participation and diversify the engineering workforce. According to the American Association of Community Colleges (AACC), an increasing number of students begin their pursuits of higher education at schools other than 4-year public/private colleges for a variety of reasons (AACC, 2015). Multiple studies have analyzed sociodemographic data for transfer students in engineering to increase understanding of this student population (Blash et al., 2012a; Cortez et al., 2015; Didion, 2015; Gibbons et al., 2011b; Knight et al., 2014; Ohland et al., 2014; Sullivan et al., 2012; Terenzini et al., 2014; Yoon et al., 2015). That research indicates that socio-demographic data for students who transfer into 4-year engineering programs is similar to the typical profile of non-transfer students (more commonly referred to as first-time in college (FTIC) students) who direct enroll from high school and are predominately white and male (Blash et al., 2012a; Ohland et al., 2015). However, a small number of studies that were
comprised of different institutional samples have identified disproportionately higher representations of Hispanics (Knight et al., 2014; Terenzini et al., 2014; Yoon et al., 2015), African Americans (Sullivan et al., 2012), and women (Gibbons et al., 2011b) among students who transferred into engineering relative to non-transfer students.

3.1.1 Ethnicity/Race. Using cross sectional survey data from the Prototype to Production (P2P) project (Lattuca et al., 2006), Terenzini et al. (2014) published a report that explored similarities and differences in sociodemographic data (as well as college experiences, both academic and non-academic) across three student groups that were surveyed for the project. The sample included: 1) 1,245 community college students across 15 institutions who planned to transfer to a 4-year institution and major in engineering; 2) 846 former community college students who transferred into engineering at one of 31 four-year institutions included in the study; and 3) 4,085 non-transfer engineering students who started their educations in one of the 31 four-year institutions included in the study. In their analysis, Terenzini et al. (2014) found that students from the community college group and transfer group comprised larger proportions of Hispanic students (23% and 27%, respectively), compared to the non-transfer group (8%). African Americans were also overrepresented on the transfer pathway (7% of the engineering transfer group compared to 4% of non-transfer) but to a lesser extent than Hispanics. An engineering transfer student pilot project conducted by the National Academy of Engineering (NAE) and the American Society of Engineering Education (ASEE) yielded similar findings (Didion, 2015; Gibbons et al., 2011b), as representation of Hispanics and African Americans were higher in the engineering transfer student group than the non-transfer group. In a comparison of engineering transfer students (entry term 2006) and non-transfer students (entry term 2006) at a large southwest, public university, Yoon et al. (2015) revealed that the percentage of Hispanics (16.6% of transfers versus 15.6% of non-transfers) and Asian Americans (6.2% of transfers versus 5.3% of non-transfers) was higher in the transfer group, but the same was not true for African Americans in their sample (2.5% transfers versus 3.6% of non-transfers).

In another multi-institution investigation of demographics and education outcomes for engineering transfer students, Sullivan et al. (2012) analyzed 94,732 domestic engineering
student records from the MIDFIELD database. The sample for the Sullivan et al. (2012) study included academic records for 21,542 transfer and 73,190 non-transfer students in engineering. Similar to the analysis conducted by Terenzini et al. (2014), Sullivan et al. (2012) explored similarities and differences in sociodemographic data (and education outcomes) for transfer students and non-transfer students in the their sample. Their analysis showed an over-representation of African American students in the transfer student group (14.5% of transfers versus 9.2% of non-transfers) and also identified higher representation of Hispanics (4.4% of transfers versus 3.0% of non-transfers), Asian/Pacific Islander (8.0% of transfers versus 7.4% of non-transfers), and American Indian/Alaska Native (0.5% of transfers versus 0.3% of non-transfers) students among the engineering transfer groups, however the differences for these ethnic/racial groups was less pronounced than for African Americans. One explanation for this observation could be a different institutional sample; MIDFIELD is a regional database comprised of institutions primarily located in the southeastern part of the United States. Sullivan et al. (2012) acknowledged that Hispanic, American Indian, and Asian students in the MIDFIELD database were limited to a small portion of the sample.

These studies provide evidence of the potential to broaden participation in engineering for underrepresented minorities by tapping into the transfer pipeline. Increased understanding of engineering transfer students, including focusing on similarities and differences across racial/ethnic groups, can inform future efforts to recruit and support additional students through this pathway.

3.1.2 Gender. Recent demographic data on students enrolled in 2-year public colleges for credit indicate that they are majority female (57%) (AACC, 2015). While that percentage suggests that the 2-year institution pipeline may be worth investigating to expand gender diversity in engineering, existing literature suggests that the representation of women among engineering transfer students is similar to their representation in the non-transfer population, which has hovered around 20% for the last 20 years (Lichtenstein et al., 2014). Using 2009 enrollment data, the NAE-ASEE pilot project reported that women were overrepresented within the transfer pathway (24.4% of transfers versus 19.0% of non-transfers) (Gibbons et al., 2011b). Conversely, the remaining literature on engineering transfer students arrives at the opposite
conclusion—women are slightly underrepresented within the transfer pathway to engineering relative to the non-transfer population (Blash et al., 2012a; Knight et al., 2014; Sullivan et al., 2012; Terenzini et al., 2014; Yoon et al., 2015). In the Prototype to Production (P2P) project, women comprised 14% of the community college pre-engineering group, 13% of the engineering transfer group, and 21% of the non-transfer group (Terenzini et al., 2014). Researchers using the MIDFIELD database reported that 19.3% of engineering transfers were women compared to 21.5% of non-transfers (Sullivan et al., 2012). Female engineering transfer students is a subgroup worthy of future investigation. Findings on their concerns and factors in their decisions to transfer could be used to shape and refine recruitment strategies so that engineering programs can attract more female students from the transfer pathway.

3.1.3 First Generation College Status. A few studies have published findings related to first-generation college status of transfer students in engineering (Knight et al., 2014; Martin et al., 2013; Mobley et al., 2013; Terenzini et al., 2014; Trenor, Yu, Waight, & Zerda, 2008). Using cross sectional survey data from the Prototype to Production (P2P) project, Terenzini et al. (2014) and Knight et al. (2014) reported on parent education status for the three student groups in their sample: 1) community college students who plan to transfer and major in engineering; 2) former community college students who transferred into engineering; and 3) non-transfer engineering students who started their educations in a 4-year institution. Knight et al. (2014) aggregated the parent education data slightly differently than Terenzini et al. (2014), but both found that the highest parent education level for the community college group and transfer group were both lower than for the non-transfer group. The largest difference was between community college students and non-transfer students, as two-thirds of the community college students were first generation college students compared to only one-quarter of the non-transfer students.

Qualitative studies focused on first-generation college students (of which at least half of participants were transfer students in engineering) have illustrated how students' experiences in higher education can vary based parent education status (Martin et al., 2013; Mobley et al., 2013; Trenor, Yu, Waight, & Zerda, 2008). Martin et al. (2013) and Trenor, Yu, Waight, and Zerda (2008) employed social capital theory as a framework to illustrate how the link between
parent education status and students’ social network can shape and influence their “education experience and academic career decisions” (Trenor, Yu, Waight, & Zerda, 2008, p. 1). The researchers found that first-generation college students (of which 75% of participants were transfer students in engineering) had to find ways to overcome the limits of their existing social capital, which led to delays and difficult transitions. Similarly, Mobley et al. (2013) used social capital theory to explain differences in how students described their experiences with advising, navigating the transfer process, and involvement in extra-curricular activities. Mobley et al. (2013) found that students with parents who had some college experience were more likely to “meet with counselors to learn about the transfer process” than students whose parents had no college experience. They also found that students with at least one college educated parent were more likely to describe the transfer process as “smooth” (p. 1).

Evidence from these studies builds a strong argument for taking parent education status into consideration when trying to understand differences across engineering transfer students' experiences. Studies that allow for this level of analysis increase understanding of engineering transfer student experiences in a way that transcends race/ethnicity and gender.

3.1.4 Age. Results from studies specifically on engineering transfer students reconfirm a finding that is common in the broader community college literature. On average, transfer students are older than those who enter college as a non-transfer student (more commonly referred to as a first-time in college (FTIC) student). The Prototype to Production (P2P) project revealed that community college students and engineering transfer students, on average, were two years older than their non-transfer student counterparts when they entered college (20 years old versus 18) (Knight et al., 2014; Terenzini et al., 2014). Researchers also found that community college students and engineering transfer students, on average, expected to be five to seven years older than their non-transfer student counterparts when they graduated (27-28 years old versus 22). After disaggregating the data, Knight et al. (2014) found that engineering transfer students who earned an associate’s degree on their path to an engineering degree expected to be closer to 29 years old at the time of bachelor’s degree completion. Members of the MIDFIELD team, Brawner and Mobley (2014) conducted a qualitative study on the Motivations and Experiences of Older Transfer Student in Engineering. They found that
economics was a critical factor in older students’: 1) decision to return to school; 2) choice of institution to attend; and 3) academic career decisions (i.e., taking time out for a co-op or internship). Older engineering transfer students is a subgroup worthy of future investigation.

3.1.5 Summary. Based on current enrollment trends in higher education and research findings summarized in this section, the transfer pathway offers the potential to broaden participation and diversify the engineering workforce. To more fully leverage the diverse supply of students who start their educations in 2-year institutions, it is important to know who is matriculating from these institutions into 4-year engineering programs. By gaining this knowledge, we can begin to increase our understanding of the more critical issue - who is not matriculating from these institutions into 4-year engineering programs. Considering differences across these sociodemographic characteristics better enables administrators and faculty to recognize when potential talent is being overlooked or excluded from engineering if certain needs that are specific to different subpopulations go unmet.

3.2 Transfer Pathways

In 2015, the National Student Clearinghouse Research Center released its second report on Transfer and Mobility which shed light on the complexity of enrollment patterns and student movement between institutions of higher education (Shapiro, Dundar, Wakhungu, Yuan, & Harrell, 2015). Literature summarizing transfer student movement (Adelman, 2006; Shapiro et al., 2015) has identified multiple pathways, including: vertical (i.e., from a 2-year institution to a 4-year institution) (Dougherty & Kienzl, 2006), lateral (i.e., from one 4-year institution to another) (Goldrick-Rab & Pfeffer, 2009), swirl (i.e., return to original institution) (McCormick, 2003), and double-dipping (i.e., co-enrolled or concurrent enrollment at both a 2-year and 4-year institution) (McCormick, 2003). Using Clearinghouse data for the Fall 2008 student cohort, Shapiro et al. (2015) provided evidence to support claims that student movement across two or more postsecondary institutions is the new normal (Marling, 2013).

New research on pathways and entry points for transfer students in engineering reveal similarly complex enrollment patterns (Ogilvie et al., 2016; Shealy et al., 2013). Equally complex are students’ reasons for starting at a different institution as well as factors in their decision to
transfer into a 4-year engineering degree program at another institution (Knight et al., 2014; Mobley et al., 2014b; Ogilvie & Knight, in preparation-b; Terenzini et al., 2014). Findings from these early studies have already started to reveal that engineering transfer students vary and should not be considered a homogeneous group with respect to their pathways to a 4-year institution. The sections that follow describe the diversity of transfer pathways that are associated with this student population.

3.2.1 Vertical versus Lateral Transfers in Engineering. Shealy et al. (2013) analyzed survey response data from engineering transfer students (n = 126) who volunteered to participate in the qualitative phase of the MIDFIELD transfer student project. Analyses yielded the following findings: 1) 80% of survey respondents indicated that they transferred from an institution within the same state; 2) 34% attended more than one institution prior to transferring to engineering at the 4-year MIDFIELD institution; 3) 46% self-identified as lateral transfer students; 4) 52% of women and 44% of men transferred from a 4-year institution; and 5) Hispanic students were most likely to transfer from a 2-year institution relative to other ethnic groups (Hispanics-71%, Whites-55%; Blacks-33%, Asians-18%). Based on their sample, Shealy et al. (2013) suggested that lateral transfer students in engineering were significant in size and may be worthy of deeper investigation. Preliminary analysis of the data set used by Ogilvie et al. (2016) and related studies (Ogilvie & Knight, in preparation-a, in preparation-b) further demonstrates the need for more in-depth investigations on vertical versus lateral transfers in engineering; nearly one-third of our study’s 1,070 participants self-identified as lateral transfer students (47% vertical transfers, 32% lateral transfers, 17% attended multiple 2-year and 4-year institutions, and 4% entered through a co-enrollment program). Thus, future research should explore similarities and differences between vertical and lateral transfer students.

3.2.2 Reason for Starting Elsewhere. According to the National Center for Education Statistics, 41% of first-time postsecondary students and 46% of all U.S. undergraduates during Fall 2013 were enrolled in 2-year public colleges (AACC, 2015). Although more than 80% of these students intend to earn a bachelor’s degree (Jenkins & Fink, 2015), recent reports on transfer and mobility indicate that only 20–25% actually transfer to a 4-year institution within a
six year timeframe (Hossler et al., 2012; Shapiro et al., 2015). Research has shown that these students begin their postsecondary educations at a 2-year institution for a variety of reasons, including economics, location, flexibility, smaller classes, and emphasis on teaching (Laanan, 2004; Laanan et al., 2010b). Using survey data from the Prototype to Production (P2P) project, Knight et al. (2014) reported similar findings for a sample of 1,245 community college students across 15 institutions who planned to transfer to a 4-year institution and major in engineering. For these students, the primary factor for starting at a community college was cost, followed by “transfer agreement with a 4-year engineering program,” flexible course scheduling, and “being close to home/ family/ friends” (Knight et al., 2014, p. 16). When asked about important factors in their impending decision to transfer, the same sample of students cited “number of credits that will transfer,” “good information on transfer,” and “speaking with an advisor at the 4-year school” (Terenzini et al., 2014, p. 6). Visiting campus and meeting with students and instructors at the 4-year institution also surfaced as important factors in their decision making process.

Researchers from the MIDFIELD transfer student project conducted semi-structured interviews with 86 engineering transfer students across five MIDFIELD institutions to investigate: 1) reasons why these students pursued the transfer pathway; and 2) when and why they selected engineering as a major (Brawner & Mobley, 2014; Mobley et al., 2014b; Ohland et al., 2015). Engineering transfer students over the age of 25 cited cost and proximity to the sending institution as driving forces behind decisions to start their postsecondary educations at another institution (Brawner & Mobley, 2014). Using qualitative data from 47 interviews across three institutions, Mobley et al. (2014b) categorized engineering transfer students of “traditional-age” into groups according to their intentionality or clarity towards selecting engineering as a major and selecting transfer as a pathway. Nearly 60% of participants were intentional and clear about both selecting engineering as a major and selecting transfer as a pathway. However, the remaining 40% were categorized as “accidental” transfers (11%), “accidental engineers” (17%), or both (13%). Mobley et al. (2014b) defined “accidental” transfers as students who started their postsecondary educations without the intention of transferring to another institution and “accidental” engineers as students who eventually stumbled upon the engineering field/degree plan. The authors found “that student decisions
occur within a specific individual, institutional, and political context” (p. 4). For example, the researchers pointed out that five of seven states within the MIDFIELD study have policies in place that “encourage (or discourage) certain types of decisions and pathways” (p. 4). Based on these findings, the MIDFIELD research team concluded that students’ decision making process is “complex and deserves further analysis” (Ohland et al., 2015, p. 4). Future research on why engineering transfer students start their educations at institutions somewhere other than their final receiving institution should explore similarities and differences by sub-populations (e.g., race/ethnicity, first generation college students, vertical transfer students).

3.2.3 Summary. Findings from these early studies have already started to reveal that engineering transfer students vary and should not be considered a homogeneous group with respect to their pathways to a 4-year institution. It is important for researchers to disaggregate and analyze student data by transfer pathway (e.g., vertical transfer, lateral transfer, co-enrolled, concurrently enrolled) in addition to considering their sociodemographic characteristics (e.g., ethnicity/race, parent education status, gender). Only a small number of studies (Mobley et al., 2014a; Ogilvie & Knight, in preparation-a, in preparation-b; Ogilvie et al., 2015; Ohland & Brawner, 2013; Shealy et al., 2013) explore similarities and differences between vertical and lateral transfer students in engineering – those have primarily focused on their reasons for starting elsewhere, factors in their decision to transfer, and their experiences with navigating the transfer process and transitioning to receiving institutions.

3.3 Educational Outcomes

The body of literature on educational outcomes and transitions for students who start their educations at 2-year institutions has evolved over the years to improve understanding of student experiences. One concept that has dominated this literature is transfer shock (Bahr et al., 2013). The term dates back to Hills’ (1965) early work with junior college students and is used to describe the dip in GPA that students experience when they transfer from a 2-year to a 4-year institution (Bahr et al., 2013; Hills, 1965). This concept is also a trending topic in more recent publications focused on the performance of transfer students in engineering (Cosentino
et al., 2014; Mobley et al., 2014a; Ohland & Brawner, 2013; Shealy et al., 2013; Sullivan et al., 2012; Yoon et al., 2015).

In engineering, there is a common assumption that non-transfer students outperform transfer students and that they persist at higher rates. Although these assumptions may hold true for aggregate data analyzed at a macro-level (Sullivan et al., 2012), they are certainly not universal truths, especially when student data are disaggregated for deeper analysis by full-time/part-time enrollment status (Sullivan et al., 2012) or by race/ethnicity (Cosentino et al., 2014; Sullivan et al., 2012; Yoon et al., 2015). Similar to transfer pathways (section 3.2), findings from these early studies on educational outcomes reinforce the notion that engineering transfer students vary and should not be considered a homogeneous group. The sections that follow highlight similarities and differences in academic performance, persistence, and degree attainment that exist within this unique population.

3.3.1 Academic Performance. Findings on academic performance for engineering transfer students are mixed. A handful of studies have focused on investigating the academic performance of engineering transfer students by comparing them to non-transfer students in engineering (Mobley et al., 2014a; Ohland & Brawner, 2013; Sullivan et al., 2012; Yoon et al., 2015). In addition, a small number of studies have specifically focused on select subpopulations of engineering transfer students, such as Black transfer students (Cosentino et al., 2014) or vertical/lateral transfer students (Shealy et al., 2013). Measures used to compare academic performance for these students have included cumulative GPA (Cosentino et al., 2014; Ohland & Brawner, 2013; Sullivan et al., 2012; Yoon et al., 2015), engineering GPA (Cosentino et al., 2014; Sullivan et al., 2012), self-reported categorical GPA (Shealy et al., 2013), and course specific grades (Mobley et al., 2014a). When engineering transfer student data are disaggregated by subgroups, findings on academic performance are mixed and complex.

Cumulative GPA and Engineering GPA: Comparing Transfer Students and Non-transfer Students. Sullivan et al. (2012) found that non-transfer students outperformed transfer students on both cumulative GPA and engineering GPA. Although the differences were statistically significant, Sullivan et al. (2012) concluded that effect sizes for these differences were small for cumulative GPA (.2-.3) and negligible for engineering GPA (less than .2).
Contrastingly, Yoon et al. (2015) did not find statistically significant differences in cumulative GPA (after 18 semesters) when comparing engineering transfer students (entry term 2006) to non-transfer students (FTIC cohort, entry term 2006) at a large, public research institution in the southwest.

After disaggregating their data, Sullivan et al. (2012) reported that non-transfer students outperformed transfer students for three additional subgroupings: 1) non-URM students; 2) Hispanics; and 3) women. Effect sizes of differences in cumulative GPA and engineering GPA for non-URMs and Hispanics were small and negligible, respectively. For women, effect sizes were small for both cumulative GPA and engineering GPA. Yoon et al. (2015) found the opposite effect for Hispanics in their sample; Hispanic transfers earned a higher average cumulative GPA than their Hispanic non-transfer counterparts (note: inferential statistical analyses were not conducted). In addition, Yoon et al. (2015) did not find a statistically significant difference in cumulative GPA for women transfers and non-transfers.

Finally, Sullivan et al. (2012) did not find statistically significant differences between non-transfer and transfer students in academic performance for two subgroupings in the MIDFIELD sample: 1) URM students, and 2) African American students more specifically. However, Yoon et al. (2015) arrived at a different conclusion for African Americans, as African American transfer students earned a higher average cumulative GPA than their African American non-transfer counterparts (note: inferential statistical analyses were not conducted).

**Cumulative GPA and Engineering GPA: Differences within Transfer Students.** To learn more about differences in academic performance within the MIDFIELD sample of engineering transfer students, Sullivan et al. (2012) compared sub-groups using both cumulative GPA and engineering GPA. The researchers found that non-URM transfers outperformed URM transfers; differences were statistically significant, and the effect sizes were classified as medium (.5) for both measures. Likewise, Yoon et al. (2015) identified statistically significant differences in cumulative GPA across race/ethnic groups within the sample of engineering transfer students.

Sullivan et al. (2012) did not find statistically significant differences in engineering GPA between women and men transfers. However, women transfers did outperform men transfers on cumulative GPA (small effect size). The study by Yoon et al. (2015) yielded similar findings;
women transfers outperformed male transfers on cumulative GPA (after 18 semesters). Finally, Sullivan et al. (2012) reported that full-time transfers outperformed part-time transfers, but effect sizes for cumulative GPA and engineering GPA were classified as small.

Shealy et al. (2013) also identified differences in academic performance between lateral and vertical transfer engineering students in the MIDFIELD study. Using self-reported GPA data collected from a small sample (n=126) of engineering transfer students at 5 of 11 MIDFIELD institutions, the researchers found that 45% of the students experienced a drop in GPA ("transfer shock") when they transferred from the sending institution to the receiving institution (only 6% reported an increase in GPA – “transfer ecstasy”). Based on students in the high GPA group (i.e., 3.5-4.0 GPA at sending institution), Shealy et al. (2013) reported that vertical transfers were more likely to experience “transfer shock” than lateral transfers. In the lower GPA group (i.e., 2.5-3.0 at sending institution), grades for both vertical and lateral transfers appeared to be steady – “transfer shock” was not as much of an issue. Although Shealy et al. (2013) acknowledged the limitations of their approach (i.e., used categorical data to make comparisons), findings suggest that research designs should disaggregate vertical and lateral transfer students.

Course Specific Grades: Comparing Transfers Students and Non-transfer Students. A limitation of using cumulative GPA and engineering GPA (at the receiving institution) to compare transfer students to non-transfer students on performance is that transfer students are unable to transfer in letter grades for courses taken at other institutions. Thus, engineering transfer students have expressed the opinion that they may have less of a “buffer” in their GPAs when completing upper division coursework in engineering at the receiving institution (Mobley et al., 2014a). To address this issue, Mobley et al. (2014a) calculated a mean grade differential to compare the academic performance of engineering transfer students and non-transfer students in the same courses (by semester and section) for 11 MIDFIELD institutions. Contrary to findings from an earlier study (Sullivan et al., 2012) using the MIDFIELD database, Mobley et al. (2014a) did not find statistically significant differences in course grades when comparing all engineering transfer students to non-transfer students. When data were disaggregated by institution, statistically significant differences were identified at only two of
the 11 institutions. At the first institution, engineering transfer students outperformed non-transfer students, but the reverse was the case at the second institution. When data were disaggregated by course discipline, 10 of the 11 institutions demonstrated statistically significant differences between groups. At six institutions, non-transfers outperformed transfers, and the reverse was true at two institutions. Performance was mixed across course disciplines at the remaining two institutions, but overall results favored transfers over non-transfers. At the four institutions where engineering transfer students excelled, they outperformed non-transfer students in anywhere from two to four course disciplines (i.e., biological sciences, chemistry, physics, engineering, computer science, and other). Computer science and physics were the two most common course disciplines in which engineering transfer students did not perform as well as non-transfer students; statistically significant differences in grades surfaced at seven of 11 institutions for computer science courses and six of 11 for physics courses.

The studies reviewed in this section illustrate that findings on academic performance for engineering transfer students are mixed and complex, especially when disaggregated by subgroups (e.g., gender, race/ethnicity, part-time/full-time status, vertical/lateral transfers, course disciplines). These results provide further justification for future research to disaggregate analyses by subgroups of transfer students.

3.3.2 Degree Attainment. Similarly, findings on persistence and degree attainment for engineering transfer students also are mixed; some studies have reported that engineering transfer students persist and graduate at higher rates than non-transfer students (Didion, 2015; Gibbons et al., 2011b; Yoon et al., 2015), and others report the opposite (Mobley et al., 2014a; Ohland & Brawner, 2013; Sullivan et al., 2012). When engineering transfer student data are disaggregated by subgroups, findings on persistence and degree attainment become increasingly more complex. Comparing results across studies is quite difficult because measurements used to calculate graduation rates vary across researchers. Approaches have considered graduation within six years post-transfer (Cosentino et al., 2014; Mobley et al., 2014a; Ohland & Brawner, 2013; Sullivan et al., 2012), within eight and a half years post-
transfer (Yoon et al., 2015), and within three years after reaching the junior year (Didion, 2015; Gibbons et al., 2011b).

Persistence and Graduation in Engineering: Comparing Transfer Students and Non-transfer Students. Sullivan et al. (2012) used student records from the MIDFIELD database and a six-year graduation rate to compare engineering transfer students to their non-transfer counterparts. The researchers found that non-transfer students persisted and graduated at higher rates than transfer students in engineering. Although the difference was statistically significant, Sullivan et al. (2012) concluded that the effect size was negligible. In contrast, Yoon et al. (2015) reported that engineering transfer students (entry term 2006) at a large, public research institution in the southwest achieved higher six-year and eight-year graduation rates than non-transfer students in engineering (entry term 2006). Findings from the NAE-ASEE transfer student pilot project yielded a third perspective based on data collected from 17 four-year institutions across the country. Researchers concluded that, on average, graduation rates for vertical transfer students and non-transfer students in engineering were similar (Didion, 2015; Gibbons et al., 2011b).

After disaggregating their data, Sullivan et al. (2012) reported that non-transfer students persisted and graduated at higher rates than transfer students in engineering for two subgroupings: 1) non-URM students, and 2) women. Differences were statistically significant, but effect sizes were negligible. This finding was not applicable to URM transfer students and Black transfer students, however, as transfer students from those populations persisted and graduated at higher rates than non-transfer students (still a negligible effect size). Sullivan et al. (2012) did not find statistically significant differences in persistence and graduation rates between Hispanic transfer and non-transfer students.

Persistence and Graduation in Engineering: Differences within Transfer Students. Sullivan et al. (2012) also compared persistence and graduation data for subgroups within the MIDFIELD sample of engineering transfer students. The researchers found that non-URM transfers persisted and graduated at higher rates than URM transfers; differences were statistically significant, but the effect size was deemed negligible. They also found that full-time transfers persisted and graduated at higher rates than part-time transfers; differences were
statistically significant, and the effect size was categorized as small. Sullivan et al. (2012) did not find statistically significant differences in persistence and graduation rates between women and men transfers.

Based on the Sullivan et al. (2012) finding that Black engineering transfer students persisted and graduated at higher rates than Black engineering non-transfer students, Cosentino et al. (2014) conducted a follow-up study to learn more about academic success factors for these students. Using student records from the MIDFIELD database, Cosentino et al. (2014) identified that Black lateral transfer students graduated in engineering at higher rates than Black vertical transfer students. The lateral transfers also outperformed vertical transfers academically both in terms of cumulative GPA and engineering GPA. The research team acknowledged that this finding may be related to the sizable representation of females among Black lateral transfers (41.4% women) relative to Black vertical transfers (28.4% women). Cosentino et al. (2014) added that in their sample, Black females graduated in engineering at higher rates than Black males, and they were less likely to fail a course or leave the institution.

3.3.3 Summary. The studies reviewed in this section illustrate the complexity of findings on academic performance, persistence, and degree attainment for engineering transfer students, especially when data are disaggregated by subgroups (e.g., gender, race/ethnicity, part-time/full-time status, vertical/lateral transfers, engineering discipline). Because engineering transfer students vary and should not be considered a homogeneous group, it is important for researchers to disaggregate and analyze outcome data by each subgroup.

3.4 Time to Degree Completion

Although national reports draw attention to issues around time to degree completion, (Complete College America, 2011), only a small number of studies explore time to degree completion for transfer students in engineering (Blash et al., 2012a; Yoon et al., 2015). Those studies indicate that for most students, the transfer pathway to an engineering degree is not 2 + 2. A lack of curriculum alignment between 2-year and 4-year institutions can extend transfer student time to degree completion, especially for engineering degree plans that are highly sequential nature (Packard et al., 2012).
In California, a state-wide study was conducted to “understand how students use the state’s community colleges to prepare for transfer into engineering” at 4-year institutions (Blash et al., 2012a). Using the Cal-PASS and CPEC databases, researchers analyzed transfer pathways for more than 4,200 community college transfer students who completed engineering degrees between 1995 and 2009 at one of 17 universities across the state (including nine California State Universities, six Universities of California, and two private institutions). Blash et al. (2012a) found that total time to degree completion in engineering was, on average, 6.5 years for transfer students in their sample. A majority of students were enrolled in the community college for at least 2 years; 46% reported 2-4 years, and 45% reported 4 years or more. The median number of years required to complete the degree (post-transfer) at the 4-year institutions was 2.7 years, which is one year less than findings reported by Yoon et al. (2015), who analyzed longitudinal data for engineering transfer students at a large, public research institution in the southwest. Blash et al. (2012a) also found that California community college students transferring to 4-year institutions with 70 credits or more “were no more likely...to complete their engineering degree in less than two years” than students who transferred in with fewer units (Blash et al., 2012a, p. 8). Similar to findings from other research studies (Laanan & Hernández, 2011), California transfer students who completed the degree in engineering were less likely to earn an associate degree in the transfer process (less than 75 percent earned an associate degree).

In addition to student record data, the California study included interviews with pre-transfer students (n=15) and survey data from post-transfer students (n=225) enrolled in 4-year engineering programs and pre-transfer students (n=245) enrolled in introduction to engineering courses. Blash et al. (2012a) reported that students cited multiple challenges on the transfer path to an engineering degree, including: 1) fulfilling transfer requirements that varied by 4-year institutions in the state; and 2) limited or inefficient offerions of lower-division coursework at community colleges. More than a third of transfer students in the study reported having to take four or more lower-division courses at the 4-year institution post transfer.

In summary, these studies indicate that for most students, the transfer pathway to an engineering degree is not 2 + 2. Findings also suggest that a contributing factor to that
phenomenon is a lack of curriculum alignment between 2-year and 4-year institutions that: 1) dis-incentivizes students to complete their Associate’s degree prior to transferring to a 4-year institution; 2) results in loss of transfer credit; and 3) increases time to degree completion. Co-enrollment programs, such as the Engineering Academies at Texas A&M University, offer an innovative and promising approach to address long-standing issues with curriculum alignment between 2-year and 4-year institutions (Cortez et al., 2015; Perez et al., 2016).

3.5 Experiences at Both the Sending and Receiving Institution(s)

The body of literature on transfer students, more generally, has evolved from Hills’ (1965) early work with junior college students and transfer shock to improving understanding of transfer student experiences (Alexander, Ellis, & Mendoza-Denton, 2008; Gabbard et al., 2006; Hagedorn & Cepeda, 2004; Hagedorn et al., 2008; Hagedorn et al., 2006). A similar trend is occurring within the literature on engineering transfer students. Recent studies specific to the experiences of engineering transfer students (Blash et al., 2012a; Mobley et al., 2012; Ohland et al., 2015; Terenzini et al., 2014) suggest that transfer students in engineering face barriers throughout the pathway. Employing a mix of quantitative and qualitative approaches, studies are beginning to explore engineering transfer students’ experiences and perspectives on a variety of topics, such as parent education status and how it influences the ways students navigate the transfer process (Mobley et al., 2014a; Mobley et al., 2013), make academic career choices (Trenor, Yu, Waight, Zerda, & Sha, 2008), and where they get academic related help, mentorship, and resources (Martin et al., 2013; Mobley et al., 2013).

Other studies focus on differences between pre-engineering community college students, engineering transfer students, and non-transfer engineering students, specifically related to course preparation and personal or academic obligations (Knight et al., 2014; Terenzini et al., 2014). Similarly, Brawner and Mobley (2014) share findings on older transfer students’ experiences with course preparation and balancing personal and academic obligations. A handful of studies focus on engineering transfer students’ academic and social adjustments during the transition between institutions (Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011; Mobley et al., 2012), and one focuses specifically on the transition during
orientation and students’ perceptions of advising and the on-ramping (integration) process (Mobley & Brawner, 2013). Finally, other studies focus more broadly on where engineering transfer students found support after transferring to a 4-year institution (Blash et al., 2012a; Blash, Karandjeff, Purnell, & Schiorr, 2012b). The aforementioned studies have just scratched the surface when it comes to understanding engineering transfer students and their experiences. Scholars whose research is focused on community college students argue that there is still a critical need to identify factors that explain why transfer students are successful or not at attaining their academic goals (e.g., transferring into and adjusting to a 4-year institution, and earning a degree) (Bahr et al., 2013; Laanan et al., 2010b). There is significant room to extend the literature on engineering transfer students beyond the studies described in this manuscript.

4.0 Conclusions

The preceding sections introduce the current state of literature on transfer students in engineering and provide a synthesis of recent literature focused on engineering transfer students’ characteristics, performance outcomes, and educational experiences. Findings are summarized and organized by the following five sub-topics: sociodemographic characteristics, transfer pathways, educational outcomes, time to degree completion, and student experiences at both sending and receiving institutions. This review of the literature produced the following major themes:

1. The transfer pathway offers the potential to broaden participation and diversify the engineering workforce.
2. Engineering transfer students vary and should not be considered a homogeneous group.
3. For most students, the transfer pathway to an engineering degree is not 2+2.
4. Transfer students in engineering face barriers throughout the pathway.

These overarching themes carry multiple implications for future research on transfer students in engineering. In particular, this review demonstrates that to more fully understand this unique student population, it is important to disaggregate and analyze data by subgroups (e.g.,
4.1 Closing Remarks

Transfer students in engineering face barriers throughout the pathway. For many, the transfer pathway to an engineering degree is not 2+2. The postsecondary education system needs to adopt innovative approaches and models that challenge, prepare, and help students move through the transfer path to an engineering degree in a more timely and effective manner. Settling for the status quo (i.e., time to degree completion upwards of 6 to 7 years) is unacceptable, especially considering that an increasing number of students are choosing to start their postsecondary educations at institutions other than 4-year institutions for financial reasons. In Texas, for example, 74% of freshmen and sophomores in the State’s public higher education system were enrolled in 2-year institutions during Fall 2015 (TACC, 2016). To meet the State’s goals for transfer student success, the Texas Commissioner of Higher Education maintains that “two- and four-year institutions must align academic programs in terms of content and rigor, and reduce the number of course credit lost in transfer” (THECB, 2015). The subsequent manuscripts provide new insights for that state system to understand some of those challenges faced by the transfer student population.
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Ogilvie, A. M., & Knight, D. B. (in preparation-b). Pursuing alternate pathways to a 4-year engineering degree: Understanding students’ reasons for starting at another Institution and factors that influence their decisions to transfer.

Ogilvie, A. M., & Knight, D. B. (under review). Transfer students’ recommendations for enhancing success and easing the transition into the middle years of engineering at receiving institutions.


Chapter 4: Manuscript #2

Pursuing Alternate Pathways to a 4 Year Engineering Degree:
Understanding Students' Reasons for Starting at another Institution
and Factors that Influence Their Decisions to Transfer

Abstract

Background  Over seven million students are enrolled in 2-year institutions, representing 45% of all U.S. undergraduates. Based on sheer numbers, leveraging the human capital that resides in 2-year public colleges is one approach to fill the country’s increasing need for innovative, diverse, skilled workers in STEM fields. Bolstering transfer pathways in STEM disciplines expands opportunities for a broader spectrum of students to participate in STEM fields and reap the financial benefits that often are associated with those kinds of careers.

Purpose  This manuscript focuses on increasing understanding of engineering transfer students’ reasons for pursuing alternate pathways to a 4-year engineering degree.

Design/Method  The study draws on survey data from a larger mixed-methods research project on transfer students in engineering. In this paper, we explore why students started their postsecondary educations at another institution and uncover factors that influenced their decisions to transfer to their current 4-year institution. We also investigate differences across subgroups of engineering transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation).

Results  Financial/Affordability, Non-Academic Commitments, and Academic Flexibility surfaced among the top reasons for starting postsecondary educations at a different institution. Top factors in students’ decisions to transfer to their current 4-year institutions included Institutional Prestige, “convenience and location”, Financial/Affordability, and Ease of Transfer. We identified multiple significantly different reasons and factors across subgroups of students.

Conclusions  Reliance on institutional prestige as a primary mechanism to attract prospective transfer students may only resonate with subset of potential recruits. Institutions of higher education must think about marketing and branding that goes beyond promotion of academic rankings to embrace new messaging and practices that address affordability and academic flexibility. Schools of engineering interested in boosting transfer student enrollment can use these findings to better position themselves to appeal to and perhaps capture a larger market of engineering transfer students in the future.

Keywords  transfer pathways in engineering, transfer receptivity, student persistence, broadening participation
Pursuing Alternate Pathways to a 4 Year Engineering Degree: Understanding Students’ Reasons for Starting at another Institution and Factors that Influence Their Decisions to Transfer

1.0 Introduction

Multiple reports from the National Academies have raised awareness of the grand challenges facing society and have voiced concerns about the preparedness of the nation’s STEM workforce to address those challenges (National Academy of Engineering, 2004, 2005, 2008; National Academy of Sciences National Academy of Engineering and Institute of Medicine, 2007, 2010b). A common theme surfacing in each of these national reports is a sense of urgency and critical need to bolster and diversify the STEM workforce. Doing so enhances the likelihood that innovative solutions to increasingly complex challenges can be developed which, the reports argue, will help the United States maintain its economic competitiveness and position as a global leader. To meet these demands, the President’s Council of Advisors on Science Technology estimated the need to prepare over one million additional STEM professionals in the U.S. workforce over the next decade (PCAST, 2012). Multiple reports have ensued with recommendations and similar urgent calls to broaden participation, expand pathways, and increase student retention rates in STEM disciplines (National Academies, 2010a, 2016; National Science Board, 2010).

In recent years, 2-year institutions and the associated transfer pathway have received increased attention and interest for their potential to play significant roles in broadening participation in STEM fields by increasing both the number and diversity of scientists and engineers who enter the U.S. workforce (Dowd, 2012; National Academies of Sciences Engineering and Medicine, 2016; National Research Council, 2005; Olson et al., 2012; Terenzini et al., 2014; Wang, 2013a). In Fall 2014, 7.3 million students were enrolled in credit-bearing programs at 2-year public colleges (AACC, 2016). These students accounted for 41% of first-time postsecondary students and 45% of all U.S. undergraduates. Moreover, students of color enrolled in 2-year public colleges at even higher percentages —62% of American Indian/Alaska Native students, 57% of Hispanic students, 52% of African American students, and 43% of Asian/Pacific Islander students in undergraduate education were enrolled in 2-year public colleges (AACC, 2016). In addition to enrolling the majority of students from underrepresented
racial/ethnic groups in postsecondary education, 2-year public colleges also serve a significant number of first generation college students, single parents, students with disabilities, and veterans. Members of those groups represent 36%, 17%, 12%, and 4% of the student body at 2-year public colleges, respectively (AACC, 2016). These figures demonstrate the high potential for community colleges to play a critical role in preparing the next generation of scientists and engineers. Leveraging the human capital that resides in 2-year public colleges is one approach to fill the country’s increasing need for innovative, diverse, skilled workers in STEM fields. Diversifying the field also has positive implications for equity and social justice (Dowd, 2012; McLoughlin, 2012; Terenzini et al., 2014). Enhancing and bolstering vertical transfer pathways (i.e., from 2-year to 4-year institutions) in STEM disciplines expands opportunities for a broader spectrum of students (i.e., first generation, ethnic/racial minorities, veterans, older students, students with disabilities, etc.) to participate in STEM fields and reap the financial benefits that often are associated with those kinds of careers (Dowd, 2012).

Given this tremendous potential, the NRC and NAE hosted multiple meetings with leaders in higher education to explore opportunities and strategies to enhance transfer pathways to 4-year engineering programs for community college students (National Research Council, 2005; Olson et al., 2012). Participants acknowledged that transfer pathways in engineering do not operate at its full potential; expert panelists re-affirmed that transfer pathways in STEM disciplines were narrow and that the body of literature on STEM transfer students was still too small to substantiate the most effective strategies for bolstering this pathway (Dowd, 2012; National Research Council, 2005; Olson et al., 2012). Despite multiple calls for additional research in this space, the body of literature on engineering transfer students is still slim and fragmented (Ogilvie, 2014; Ogilvie & Knight, in preparation-c). Most of what is known about this student population is based on the community college literature more generally and research focused on transfer students in STEM more broadly (Dowd, 2012).

Moreover, critics of the existing community college literature argue that transfer student input/outcome model research is common and often over emphasized (Bahr, 2013). Instead, these critics call for more research focused on the experiences of transfer students from initial matriculation through graduation from postsecondary education to increase understanding
with respect to the “how and why” of transfer student behavior (Bahr, 2013). Findings from those kinds of studies could then be used to create and improve systems designed to foster transfer and ultimately student success. The present research study responds to those calls and adds to the small body of literature specifically focused on transfer pathways in engineering disciplines.

Using an adapted version of Laanan’s Transfer Student Capital framework as a guide for data collection (Ogilvie et al., 2015, 2016, 2017), our research seeks to increase understanding of engineering transfer students and their experiences at both sending and receiving institutions. Drawing on survey data, in this study we focus attention on engineering transfer students’ backgrounds and their reflective reports of their decision-making processes prior to enrolling in postsecondary education as well as their reflections of their preparations to transfer from a sending institution to a receiving institution. Specifically, this study investigates the following research questions:

1a. What constructs emerge when engineering transfer students are asked to identify reasons for starting their college educations at institutions other than their current 4-year institutions?
1b. What are the differences across subgroups of transfer students? (i.e., open vs. selective enrollment institutions, lateral vs. vertical, Hispanic/Latino vs. non-Hispanic/Latino, first generation vs. non-first generation)

2a. What constructs emerge when engineering transfer students are asked to identify factors that influenced their decisions to transfer to their current 4-year institutions?
2b. What are the differences across subgroups of transfer students? (i.e., open vs. selective enrollment institutions, lateral vs. vertical, Hispanic/Latino vs. non-Hispanic/Latino, first generation vs. non-first generation)

This research not only increases understanding of the important reasons and factors that arise in engineering transfer students’ decision making processes, but it also identifies nuances that exist within “transfer students” in aggregate and delves into differences by institution type, pathway (i.e., vertical versus lateral transfer), Hispanic/Latino status, and first generation college student status. We cannot assume that all engineering transfer students’
decision-making processes are driven by the same reasons or factors. Thus, it is important to disaggregate and explore the data by subgroups to avoid drawing inaccurate conclusions and making generalizations about engineering transfer students as a collective group.

2.0 Literature Review

Focused research on engineering transfer students is limited and still in its early stages of development (Ogilvie, 2014; Ogilvie & Knight, in preparation-c). The body of literature on STEM transfer students more broadly is slightly more developed (Dowd, 2012; D. L. Jackson, Starobin, & Laanan, 2013; National Academies of Sciences Engineering and Medicine, 2016; Wang, 2013a). Most of what we know about transfer students in STEM, however, is drawn from the community college research that focuses on transfer students at an even more general scale (Dowd, 2012). This general community college literature on transfer students has explored a range of topics, including Hill’s concept of GPA shock (Hills, 1965), the effects of enrollment in community college on degree attainment, student remediation and its effect on retention/persistence (Hagedorn & DuBray, 2010; Melguizo, Hagedorn, & Cypers, 2008), and the use of predictive models that link demographic data and pre-college characteristics to student success measures (e.g., Dougherty & Kienzl, 2006). Although research focused on transfer student inputs and outcomes has been crucial to understanding the state of transfer pathways, as previously noted, scholars in the field argue that future research should focus more on: 1) exploring transfer students’ experiences, as well as 2) exploring transfer pathways at the discipline level (Bahr, 2013; Bahr, McNaughtan, Jackson, Gross, & Oster, 2015; Bahr et al., 2013; Laanan et al., 2010b).

Prior studies have explored transfer students’ reasoning and/or decision making processes from multiple perspectives. For example, some research has explored or cited reasons why students begin their postsecondary educations at a community college or at another 4-year institution (Bahr, 2009; Bensimon & Dowd, 2009; Brawner & Mobley, 2014; D. L. Jackson et al., 2013; Knight et al., 2014; Laanan, 2004; Laanan et al., 2010b; Mobley et al., 2014b; Pérez & Ceja, 2010; Reyes, 2011; Shealy et al., 2013). Common reasons that emerge across these studies include cost, affordability, convenient location, proximity to home, family,
and friends, open admission, existing articulation agreements, flexibility of course scheduling, small class sizes, access to professors, emphasis on teaching, and child care. Other research related to our study identified factors that influence students’ decisions to transfer to a particular 4-year institution or reasons for students’ delays in transferring to those institutions (Bensimon & Dowd, 2009; Brawner & Mobley, 2014; Crisp & Nora, 2010; Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011; Mobley et al., 2014b; Packard, Gagnon, LaBelle, Jeffers, & Lynn, 2011; Packard et al., 2012; Terenzini et al., 2014). Common factors encompassed across these studies include cost, affordability, location, proximity to home, family, and friends, academic reputation of the institution, transferability of credits, and information and input from family, institution agents (e.g., advisors), and peers. Finally, a handful of studies shed light on factors that influence transfer students’ decisions to major in STEM (Wang, 2013b) or more specifically major in engineering (Blash et al., 2012a; Brawner & Mobley, 2014), and one study explored the sequence, timing, and interaction of students’ decisions to major in engineering and pursue the transfer pathway (Mobley et al., 2014b).

These researchers have commonly drawn on Bourdieu’s theories of cultural capital and social capital (Bourdieu, 1986) to guide investigations (Bensimon & Dowd, 2009; Packard et al., 2011). A handful of quantitative studies have incorporated broader, systems approaches to explore factors that influence students’ decisions (Crisp & Nora, 2010; Knight et al., 2014; Terenzini et al., 2014; Wang, 2013b). These broader conceptual frameworks include a combination of Tinto’s Model of Student Integration and Nora’s Student/Institution Engagement Model (Crisp & Nora, 2010), which is an adaption of Lent’s Social Cognitive Career Theory (Wang, 2013b), and Terenzini and Reason’s college-impacts framework (Knight et al., 2014; Terenzini et al., 2014). The following sections highlight salient findings related to the previously listed reasons and factors that influence postsecondary pathways for transfer students in general, in STEM, and in engineering.

2.1 Transfer Students - Reasons and Factors Influencing Postsecondary Pathways

Using a social and cultural capital lens, Bensimon and Dowd (2009) conducted an ethnographic study of Hispanic/Latino students to explore causes for transfer choice gap – a
phenomenon where students who are eligible to transfer to selective institutions instead choose to transfer to less selective, open enrollment institutions. The researchers found that a lack of access to institutional agents who had “specialized funds of knowledge on transfer” greatly impacted students’ decisions related to their postsecondary pathway. Participants who had higher amounts of cultural capital (e.g., those with older siblings in college) and social capital (e.g., those with frequent contact with institutional agents such as faculty, staff, and advisors) described having access to “insider information” that helped them transfer to a selective institution of their choice. Participants with limited cultural and social capital described feelings of uncertainty and did not know what questions to ask, received limited advising, and had less frequent contact with institutional agents. These participants wanted more structure and guidance with thinking through and exploring their options. The authors posited that transfer information systems (e.g., course equivalency website, advising sheets) are insufficient without individuals to serve as institutional agents who specialize in transfer. Bensimon and Dowd (2009) drew connections between their findings and prior work by Tierney and Venegas (2006) on family and “fictive kin” and the influence they have on student choices in educational settings as well as Stanton-Salazar’s work on institutional agents and the ways in which they can provide support to youth and low-SES students (Stanton-Salazar, 1997, 2001, 2009).

In another study of Hispanic/Latino community college students, Crisp and Nora (2010) used a quantitative approach to identify factors influencing persistence and transfer decisions, drawing on multiple theories such as Bourdieu’s theories of cultural and social capital. Their predictive modeling approach included variables such as demographic data, pre-college characteristics, socio-cultural capital, academic experiences, environmental pull (i.e., factors that detract students from staying focused on their academic goals, such as the need to work while attending school), and student outcomes (i.e., persistence or transfer in years 2 and 3). The authors found that parent education, full-time enrollment, financial support, and academic preparation positively related to student persistence and transfer; delayed enrollment and students’ need to work had the opposite effect. Based on their findings, Crisp and Nora (2010) posited that Hispanic/Latino students’ decisions to persist or transfer could be further abetted
with increased financial support; such resources would help students overcome environmental pull factors driven by their need to work.

In the literature focused on transfer students in STEM, similar reasons and factors surfaced as influences on postsecondary pathway decisions, such as access to insider knowledge through institutional agents, financial pressures, and environmental pull factors. Guided by theories of social and cultural capital, Packard et al. (2011) explored the experiences of 30 women on the transfer pathway in STEM. Interviewed pre- and post-transfer to 4-year institutions, participants identified effective transfer advising and supportive community college faculty as facilitators in making the decision to transfer. Financial barriers and the need to work were concerns for all participants. Additionally, financial reasons and family responsibilities impacted some students’ decisions to delay transfer altogether. In a different study focused on women of color in the STEM transfer pathway, the need for or reliance on a familial support system influenced some participants’ decisions to transfer to less selective institutions so that they could remain closer to home (Reyes, 2011).

These studies demonstrate how vertical transfer students’ postsecondary pathway decisions are influenced by environmental pull (e.g., the need to work, family responsibilities) as well as concerns centered on cost/affordability. Prior research described herein also highlights relationships between access to capital (social and cultural) and postsecondary pathway decisions for vertical transfer students, which includes high percentages of students who also identify as members of underrepresented communities in higher education (i.e., Hispanic/Latino students, first generation college students, women in STEM, and women of color in STEM). Within a more specific disciplinary context, the present study further explores the role of capital (both cultural and social), environmental pull, affordability, and access to institutional agents in the postsecondary pathway decisions of engineering transfer students; moreover, this research explores differences between a variety of sub-groups within this student population.
2.2 Transfer Students in Engineering - Reasons and Factors Influencing Postsecondary Pathways

A small number of studies have begun to unveil the factors that influenced engineering transfer students’ decisions to transfer to a different institution (Brawner & Mobley, 2014; Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011; Terenzini et al., 2014). Employing a qualitative approach, researchers from the MIDFIELD transfer student project have conducted semi-structured interviews with 86 engineering transfer students across five MIDFIELD institutions (Brawner & Mobley, 2014; Mobley et al., 2014b; Ohland et al., 2015). Focused on interview data from engineering transfer students over the age of 25, Brawner and Mobley (2014) reported that these students cited cost and proximity to the sending institution as driving forces (i.e., “environmental pull factors”) behind their decisions to start their postsecondary educations at another institution. Mobley et al. (2014b) were motivated to understand reasons why these students pursued the transfer pathway, and when and why they selected engineering as a major. Using a subset of the MIDFIELD interview data, they categorized engineering transfer students of “traditional-age” into groups according to their intentionality or clarity of selecting engineering as a major and selecting transfer as a pathway to a degree. They found that 60% of participants were intentional and clear about both selecting engineering as a major and selecting transfer as a pathway. The remaining 40% included a mix of participants who were intentional and clear about one or the other or were not intentional about either decision. In addition to commonly cited reasons for starting elsewhere (i.e., cost, proximity, emphasis on teaching), new reasons surfaced through these analyses, including: existing transfer bridge programs (i.e., 2+2 or 3+2 program), access to better or easier classes, and dissatisfaction with the original or previous institution. Some participants identified the transfer pathway as a “back-door” to their current institution, and others explained that their decision to pursue the transfer pathway was in response to an adverse family or personal situation. The authors asserted that “student decisions occur within a specific individual, institutional, and political context” (Mobley et al., 2014b, p. 4). As an example, they pointed out that five of seven states within the MIDFIELD study have policies in place that “encourage (or discourage) certain types of decisions and pathways” (Mobley et al.,
The MIDFIELD research team concluded that students’ decision making process is “complex and deserves further analysis” (Ohland et al., 2015, p. 4).

Informed by findings from prior qualitative research, a few studies followed a survey research design (Knight et al., 2014; Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011; Terenzini et al., 2014). Drawing on data from the Prototype to Production (P2P) project, Knight et al. (2014) reported findings for a sample of 1,245 community college students across 15 institutions who planned to transfer to a 4-year institution and major in engineering. For these students, the primary factor for starting at a community college was cost, followed by “transfer agreement with a 4-year engineering program,” flexible course scheduling, and “being close to home/ family/ friends” (Knight et al., 2014, p. 16). When asked about important factors in their impending decision to transfer, the same sample of students cited “number of credits that will transfer,” “good information on transfer,” and “speaking with an advisor at the 4-year school” (Terenzini et al., 2014, p. 6). Visiting campus and meeting with students and instructors at the 4-year institution also surfaced as important factors in their decision making process. Further adding to this conversation, Laanan, Jackson, and Rover (2011) and Laanan et al. (2010a) reported that a majority (65-90%) of engineering transfer students in their studies rated “academic reputation,” “affordable tuition,” and “convenience and location” as important or very important factors in their decisions to transfer to their current institutions. A smaller portion (7-35%) of their student sample rated outside influencers (i.e., institutional agents, family, and friends) as important or very important factors.

Although findings from these quantitative studies have contributed to our understanding of engineering transfer students, they are limited because they did not investigate differences across students and institutions and instead reported on engineering transfer students in aggregate. The current study includes that finer-grained analysis.

2.3 Summary and Future Work

In summary, findings from prior studies on transfer students’ postsecondary pathway decisions have centered on themes of affordability, environmental pull, academic reputation, transfer systems and state policies, institutional agents, and other forms of social and cultural
capital. Prior research points to the importance of disaggregating data to further our understanding of differences across groups, especially in studies where findings have the potential to vary for participants from groups historically underrepresented in STEM disciplines (Lichtenstein et al., 2014; Riley, Slaton, & Pawley, 2014; Ro & Knight, 2016; Ro et al., 2016). In the literature specific to transfer students in STEM, multiple studies describe the critical need for careful attention and data disaggregation across institutional type (Dowd, 2012; Dowd et al., 2006; Dowd & Cheslock, 2006), type of pathway (Ogilvie et al., 2016; Shealy et al., 2013), race/ethnicity (Dowd, 2012; D. L. Jackson et al., 2013; National Academies of Sciences Engineering and Medicine, 2016; Reyes, 2011; Sullivan et al., 2012; Wang, 2013a), and first generation college status (Mobley & Brawner, 2013; Mobley et al., 2014b; Mobley et al., 2013).

The current study responds to that critical need and contributes to the existing literature in multiple ways. First, we bring new data to contribute to the body of knowledge on engineering transfer students’ reasons for starting their postsecondary educations at another institution and the factors that influence their decisions to transfer their current institutions. Informed by this prior research, we anticipated that certain constructs (i.e., affordability, environmental pull, academic reputation, institutional agents) would emerge from the data collected for our study, but it was important to test that assumption for a different institutional sample. Second, we explore and identify differences within subgroups of engineering transfer students based on type of institution, type of transfer pathway, student status as Hispanic/Latino, and student status as first generation. As prior research in this area has not explored differences between subgroups of engineering transfer students, we posited that differences would surface in our study’s sample.
3.0 Methods

3.1 Data Source and Sample

Data for this study were drawn from a mixed methods investigation focused on increasing understanding of transfer pathways to engineering degrees (NSF EEC - 1428502) (Ogilvie et al., 2015, 2016). Study sites included four large, public institutions (20,000-50,000 students on each campus) in Texas that are all recognized as top producers of U.S. Hispanic engineers. The four institutions represented a balanced mix of Predominantly White Institutions (PWIs) and Hispanic Serving Institutions (HSIs), as well as institutions with open enrollment admissions policies and others with more selective admissions policies. Three of the sites were universities with very high research activity (RU/VH), and the fourth was classified as a large Master’s College/University.

In summer and fall 2015, a cross-sectional survey collected data from a usable sample of 1,070 engineering students who transferred into one of the four 4-year institutions as new engineering students between 2007 and 2014. The population for the study included 7,608 transfer students, and e-mail addresses were secured for 97% of the eligible participants. Responses were received from 1,102 individuals, representing an overall response rate of 15% across all four institutions (i.e., the percent of respondents from the potential participants who had a working email address on file). To address systematic bias in nonresponse, we weighted survey response data by institution response rate, gender, and ethnicity/race so that the sample data set would be representative of the transfer student population at each of the four study sites (Krathwohl, 2009). Table 1 displays a summary of sample demographics.

Following social science research norms, we addressed the issue of missing data using multiple imputation; all variables were included in the analysis (Cox, McIntosh, Reason, & Terenzini, 2014; Graham, 2009; Rubin, 1996; Schafer, 1999). Data were missing at random, primarily due to item non-response, and the total amount of missing data for the full data set was 16%. Under the traditional listwise deletion method, 82% of the 1,070 participants in the sample would have been available for analysis. Weights for institution response rate, gender, and ethnicity/race were included in the imputation process. IBM SPSS Statistics 24 multiple imputation command generated 5 imputed datasets, and with the exception of the
subsequently described exploratory factor analysis and the 2-way ANOVAs, Rubin’s rules (Rubin, 2004) were used to pool analyses run on each dataset. The following notation is used to report an overall summary of results from the 2-way ANOVAs: [1 of 5] indicates that we identified statistically significant interaction effects in 1 of the 5 imputed datasets, [2 of 5] indicates that we identified statistically significant interaction effects in 2 of the 5 imputed datasets, and so on up to [5 of 5].

<table>
<thead>
<tr>
<th>Table 1. Demographics of engineering transfer student sample.</th>
<th>Total (N=1070)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Status</strong></td>
<td></td>
</tr>
<tr>
<td>Current Student</td>
<td>54%</td>
</tr>
<tr>
<td>Alumni</td>
<td>42%</td>
</tr>
<tr>
<td>No Longer Enrolled</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Institution Type</strong></td>
<td></td>
</tr>
<tr>
<td>Attended Institution with Selective Enrollment Policies</td>
<td>71%</td>
</tr>
<tr>
<td>Attended Institution with Open Enrollment Policies</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Type of Transfer</strong></td>
<td></td>
</tr>
<tr>
<td>Vertical Transfer</td>
<td>56%</td>
</tr>
<tr>
<td>Lateral Transfer</td>
<td>40%</td>
</tr>
<tr>
<td>Co-enrollment Program</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>80%</td>
</tr>
<tr>
<td>Female</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0.3%</td>
</tr>
<tr>
<td>Asian</td>
<td>11%</td>
</tr>
<tr>
<td>Black or African American</td>
<td>3%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>40%</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>0.3%</td>
</tr>
<tr>
<td>White</td>
<td>41%</td>
</tr>
<tr>
<td>2 or more races</td>
<td>2%</td>
</tr>
<tr>
<td>Foreign or International</td>
<td>3%</td>
</tr>
<tr>
<td>Prefer not to answer/Not applicable/Unknown</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Parent Education Status</strong></td>
<td></td>
</tr>
<tr>
<td>Earned Bachelors Degree or Higher</td>
<td>53%</td>
</tr>
<tr>
<td>Some College</td>
<td>14%</td>
</tr>
<tr>
<td>High School Graduate or Below</td>
<td>14%</td>
</tr>
<tr>
<td>Not reported</td>
<td>18%</td>
</tr>
</tbody>
</table>
3.2 Measures

3.2.1 Instrument. Cross-sectional survey data were collected using the Engineering Transfer Student Survey. This instrument includes a combination of multiple choice and open-ended items to capture student information in six primary areas: 1) personal background data; 2) enrollment status and transfer pathway; 3) experience with the transfer process; 4) experience at sending institution; 5) experience at receiving institution; and 6) comparison of experiences at each institution (see Ogilvie et al. (2015) for a fuller description of the instrument). The 45-item survey requires 15 to 25 minutes to complete, as multiple survey items are embedded within 16 of the 45 items.

Developed for the NSF project, the Engineering Transfer Student Survey is an adaptation of the Laanan Transfer Students’ Questionnaire (L-TSQ) (Laanan, 2004, 2007; Moser, 2012) with the addition of survey items extracted from the following multi-institutional research studies that investigated transfer students’ experiences in engineering and STEM more broadly: Prototype to Production: P2P (Terenzini et al., 2014) and Measuring Constructs of STEM Student Success Literacy: Community College Students’ Self-Efficacy, Social Capital, and Transfer Knowledge (Johnson et al., 2012; Myers et al., 2012). These instruments were identified in a literature review of surveys that have been vetted in peer-reviewed literature and are pertinent to transfer students in STEM.

To address construct validity (Shadish, Cook, & Campbell, 2002), the Engineering Transfer Student Survey was developed using input and feedback from content experts on the project advisory board as well as representatives from the participating 4-year institutions and their local partner 2-year institutions. Representatives from institutions included a combination of administrators, faculty members, and staff from eight institutions with working knowledge of policies and practices in Texas that impact students who transfer to 4-year institutions as new engineering students. During survey development, the full project team provided feedback on drafts of the survey instrument via conference calls and written comments. Through this initial round of feedback, the project team identified survey items that were areas of high priority or interest locally and highlighted the need for local customization because of varying terminology and practices across institutions (Ogilvie et al., 2015). To increase clarity for study participants
and stakeholders, the project team defined key terms and dedicated careful attention to appropriate use of terminology. Based on this round of feedback, the Engineering Transfer Student survey was revised, customized for each institution, and thoroughly vetted with representatives from each institution in another round of revisions.

3.2.2 Variables. Dependent variables for this study were drawn from participants’ responses to two survey items from the “Personal Background” section of the Engineering Transfer Student Survey; each item included multiple sub-items. Using a 5-point Likert-type scale to capture level of importance, the first survey item asked participants to rate the level of importance of 15 reasons for starting their postsecondary educations at another institution. Using the same scale for level of importance, the second item asked participants to rate 18 factors that influenced their decisions to transfer to their current institutions. Specific sub-items are shown in Table 2.

Independent variables included the following, which were captured by the survey and supplemented with institutional records as needed: 1) type of institution - selective versus open enrollment; 2) type of transfer pathway - lateral versus vertical; 3) student status as Hispanic/Latino; and 4) student status as first generation. The first generation variable was derived from students’ reports of their parents'/guardians’ education levels—when neither parent/guardian earned a Bachelor’s degree (or higher), the student was categorized as first generation.
**Table 2.** Survey Items from Engineering Transfer Student Survey

<table>
<thead>
<tr>
<th>Survey Items</th>
</tr>
</thead>
</table>
| **Reasons for starting at another Institution:** How important were the following reasons in your decision to start your education at an institution other than [RI]?
| a. Cost |
| b. Received financial aid (includes grants & scholarships) |
| c. Close to home/family/friends |
| d. Family/work obligations |
| e. I applied but wasn't accepted to my school of choice |
| f. I applied but wasn't accepted to a four-year school |
| g. I knew I would get accepted |
| h. Uncertainty about area of study/future career field |
| i. Good place to find out if I was ready for college-level courses |
| j. Type of course offerings (online vs. in-person) |
| k. Flexible course scheduling (evenings, weekends) |
| l. On-campus childcare |
| m. English as a Second Language program |
| n. Transfer agreement with a four-year engineering program |
| o. Diverse student population |
| p. Other (please specify; ____) - Text response. |

*Scale: 1-Not at all Important, 2-Slightly Important, 3- Moderately Important, 4 - Very Important, 5 - Extremely Important, N/A-Not Applicable*

<table>
<thead>
<tr>
<th>Survey Items</th>
</tr>
</thead>
</table>
| **Factors in decision to transfer to [RI]:** Listed below are some factors that might have influenced your decision to attend [RI]. How important was each in your decision to attend [RI]?
| a. Academic reputation of [RI] (i.e., graduates obtain good employment and gain admission to top graduate/professional schools) |
| b. [RI]'s ranking in national magazines |
| c. My campus visit to [RI] |
| d. Meeting with instructors or sitting in on classes at [RI] |
| e. Speaking with an academic advisor at [RI] |
| f. Talking with students at [RI] |
| g. Academic advisor/counselor(s) at my previous college advised me to attend |
| h. A [RI] representative recruited me |
| i. A friend suggested that I attend |
| j. Family recommended that I attend |
| k. My family attended [RI] |
| l. Number of credits that would transfer |
| m. Access to clear and useful information on transferring |
| n. Convenience and location |
| o. Size of [RI] |
| p. Cost of living in (site for [RI]) |
| q. Cost of tuition at [RI] |
| r. Amount of financial aid (includes grants & scholarships) that I received at [RI] |
| s. Other (please specify; ____) - Text response. |

*Scale: 1-Not at all Important, 2-Slightly Important, 3- Moderately Important, 4 - Very Important, 5 - Extremely Important, N/A-Not Applicable*
3.3 Analytical Procedures

To address the research questions, our analyses included a multi-step procedure. First, we calculated means and standard error of the means for each sub-item (in place of standard deviation because we were working with an imputed data set (Wayman, 2003)).

Next, we identified emergent constructs for each survey item using exploratory factor analysis (EFA). Because the Engineering Transfer Student Survey is a compilation of three existing surveys and was administered in a new context, we ran EFA on survey response data in this study. We conducted a maximum likelihood EFA to identify emergent constructs from participants’ responses to both survey items (each with multiple sub-items) (Thurstone, 1947; Yong & Pearce, 2013). The method of extraction for factor analysis was principal axis factoring using Direct Oblimin - an oblique rotation technique (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Yong & Pearce, 2013). We employed an iterative approach as well as professional judgement to determine the number of constructs to extract (Kaiser, 1970). In the first iteration, the number of constructs extracted was determined based on eigenvalues greater than one. Output data from this iteration (i.e., scree plot and the “Total Variance Explained”) served as a guide for subsequent analyses, which extracted a number of constructs based on user input.

As the number of constructs was explored, we calculated Cronbach’s coefficient alpha to measure internal consistency and establish reliability for the emergent constructs (Allen, Reed-Rhoads, Terry, Murphy, & Stone, 2008; Cortina, 1993; Nunnally & Bernstein, 1994; Streiner, 2003). Given that our factor analysis was exploratory and not confirmatory, we adopted 0.60 as the minimum threshold to establish reliability (Costello & Osborne, 2005; Tabachnick & Fidell, 2013). Upon settling on a final number of constructs that met our requirements analytically and conceptually (i.e., there needed to be a reasonable rationale for sub-items to be considered in combination), scales for emergent constructs were calculated by summing participants’ responses to sub-items that loaded together divided by the number of sub-items included in that scale (Armor, 1973).

To address the second part of each research question, we used multiple methods to explore differences between sub-groups of engineering transfer students. First, we compiled
frequency data to explore the tails of the data distribution for the dependent variables. Reviewing frequency data enabled us to understand whether there were systematic patterns across subgroups of transfer students in terms of respondents who flagged higher levels of importance on certain sub-items that may have been masked by analyses of mean values. Second, we employed independent samples t-tests to identify statistically significant differences in the mean of the construct between each subgroup of transfer students. For each construct and for single sub-items that failed to load on a construct, we ran four separate independent samples t-tests to compare means for the following subgroups of engineering transfer students: 1) type of institution - selective versus open enrollment; 2) type of transfer pathway - lateral versus vertical; 3) student status as Hispanic; and 4) student status as first generation. We also ran 2-way ANOVAs for constructs and sub-items where we identified statistically significant differences in mean participant ratings across two or more of the subgroup comparisons (i.e., type of institution, transfer pathway, student status as Hispanic/Latino, and student status as first generation). This analysis enabled us to explore interaction effects between the independent variables.

3.4 Limitations of the Study
Our study includes multiple limitations. First, data were collected using a web-based survey instrument. Even though web-based surveys are a fast and economical way to collect survey data, we had to rely on participants to: 1) interpret survey items similarly, and 2) recall activities that may have taken place multiple years ago. Other common weaknesses of survey research include coverage error and nonresponse error (Singleton & Straits, 2010). To minimize coverage error, we partnered with study sites to access institutional records and secure updated contact information for prospective study participants. We also accessed population data from institutional records so that we could address non-response error by applying weights to participant responses to reflect the sample population.

Second, the web-based survey for this particular study included closed-ended survey items for reasons and factors for participants to draw from. While these lists of items were informed by the literature, vetted by university administrators and staff with first-hand working
knowledge of engineering transfer students, and used in prior studies of transfer students, it is possible that participants could identify additional reasons or factors not included within the set of items. An additional open-ended item was included on the survey where participants could write in additional reasons or factors. Analysis of these open-ended responses is outside the scope of this particular article.

In addition, the population under investigation in this study includes students who enrolled as new transfer students in engineering between 2007 and 2014 at four Texas 4-year institutions. It was a conscious decision to collect data from students who completed the transfer process into a 4-year institution because the broader NSF study from which these data were drawn sought to understand how transfer students navigated this pathway to a 4-year engineering degree. The study does not include perspectives, however, from students who initially wanted to transfer into engineering but were unsuccessful in their efforts. It is possible that our study’s participants who successfully navigated the transfer process have different perspectives and experiences than pre-transfer students, especially those who stalled out or delayed transfer. Research on these pre-transfer students is worthy of future investigation and will require strong partnerships with 2-year institutions who would play a central role in identifying those students.
4.0 Results and Discussion – Part I

Participants’ Reasons for Starting Their College Educations at another Institution

4.1 Results for Addressing Research Question 1a

Study participants were asked to respond to 15 sub-items addressing “reasons for starting their college educations at another institution” using a 5-point Likert-type scale. Response means and standard errors of the means for each of the 15 sub-items are shown in Table 3.

Five constructs emerged following an exploratory factor analysis of those 15 sub-items: 1) Financial/Affordability (α = .63); 2) Non-Academic Commitments (α = .70); 3) Academic Flexibility (α = .73); 4) Driven by Admission Outcomes (α = .67); and 5) Specialized Support Services (α = .63) (see Table 4). The Financial/Affordability construct focuses on cost of education and participants’ accessibility to financial aid, such as grants and scholarships. The Non-Academic Commitments construct is comprised of sub-items that create environmental pull, such as family obligations, work obligations, and the need to be close home, family, and/or friends. The construct Academic Flexibility highlights educational experiences where students’ personal goals and academic needs are being met. The construct Driven by Admission Outcomes indicates that students’ final postsecondary institution decision was the result of not being accepted to a 4-year institution or their initial school of choice. Last, the construct Specialized Support Services represents unique offerings such as on-campus childcare and English as a Second Language programs. One sub-item from the set of 15 did not load on any of the five constructs.

For this sample, students’ reasons for starting their college educations at institutions other than their current 4-year institutions tended not to be Driven by Admission Outcomes or Specialized Support Services. Rather, students cited Financial/Affordability reasons as the primary driver for why they started their college educations at institutions other than their current 4-year institutions. Students ranked Non-Academic Commitments and Academic Flexibility as the second and third, respectively, most important reasons for starting their
college educations at a different institution. Response means for emergent constructs did not exceed 3.28 on this five-point scale.

Table 3. Reasons for Starting at another Institution

<table>
<thead>
<tr>
<th>Sub-items</th>
<th>Mean (N = 1024)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost</td>
<td>3.47</td>
<td>1.45</td>
</tr>
<tr>
<td>2. Received financial aid (includes grants &amp; scholarships)</td>
<td>3.10</td>
<td>1.62</td>
</tr>
<tr>
<td>3. Close to home/family/friends</td>
<td>2.72</td>
<td>1.43</td>
</tr>
<tr>
<td>4. I knew I would get accepted</td>
<td>2.49</td>
<td>1.50</td>
</tr>
<tr>
<td>5. Family/work obligations</td>
<td>2.48</td>
<td>1.45</td>
</tr>
<tr>
<td>6. Transfer agreement with a four-year engineering program</td>
<td>2.42</td>
<td>1.63</td>
</tr>
<tr>
<td>7. Good place to find out if I was ready for college-level courses</td>
<td>2.25</td>
<td>1.42</td>
</tr>
<tr>
<td>8. Uncertainty about area of study/future career field</td>
<td>2.23</td>
<td>1.41</td>
</tr>
<tr>
<td>9. Flexible course scheduling (evenings, weekends)</td>
<td>2.23</td>
<td>1.43</td>
</tr>
<tr>
<td>10. Type of course offerings (online vs. in-person)</td>
<td>2.09</td>
<td>1.41</td>
</tr>
<tr>
<td>11. Diverse student population</td>
<td>1.89</td>
<td>1.28</td>
</tr>
<tr>
<td>12. I applied but wasn’t accepted to my school of choice</td>
<td>1.75</td>
<td>1.35</td>
</tr>
<tr>
<td>13. I applied but wasn’t accepted to a four-year school</td>
<td>1.38</td>
<td>0.98</td>
</tr>
<tr>
<td>14. English as a Second Language program</td>
<td>1.30</td>
<td>0.84</td>
</tr>
<tr>
<td>15. On-campus childcare</td>
<td>1.16</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Scale: 1-Not at all Important, 2-Slightly Important, 3-Moderately Important, 4-Very Important, 5-Extremely Important; Means are of weighted data.

1 Participants in co-enrollment program(s) were exempt from this survey item.
Table 4. Reasons for Starting at another Institution

<table>
<thead>
<tr>
<th>Construct</th>
<th>Sub-items</th>
<th>Mean (N = 1024)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial/Affordability</td>
<td>Cost</td>
<td>3.28</td>
<td>1.31</td>
</tr>
<tr>
<td></td>
<td>Received financial aid (includes grants &amp; scholarships)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Academic Commitments</td>
<td>Close to home/family/friends</td>
<td>2.60</td>
<td>1.26</td>
</tr>
<tr>
<td></td>
<td>Family/work obligations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Flexibility</td>
<td>I knew I would get accepted</td>
<td>2.28</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Transfer agreement with a four-year engineering program</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good place to find out if I was ready for college-level courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uncertainty about area of study/future career field</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexible course scheduling (evenings, weekends)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type of course offerings (online vs. in-person)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driven by Admission Outcomes</td>
<td>Diverse student population</td>
<td>1.89</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialized Support Services</td>
<td>English as a Second Language program</td>
<td>1.23</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>On-campus childcare</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1-Not at all Important, 2-Slightly Important, 3-Moderately Important, 4-Very Important, 5-Extremely Important; Means are of weighted data.

1 Participants in co-enrollment program(s) were exempt from this survey item.

4.2. Results for Addressing Research Question 1b - Comparing Groups

On average, participants did not rate any sub-items or constructs as “very or extremely important” reasons for starting their college educations at institutions other than their current 4-year institutions. To avoid making inaccurate generalizations from this aggregate measure, we employed a three step process to explore differences between groups within the sample (e.g., students at selective vs. open enrollment institutions, lateral vs. vertical transfer students, non-Hispanic/Latino vs. Hispanic/Latino students, non-first generation vs. first generation college students). First, we explored frequency counts for participants’ responses that fell in the right tail of the data distribution (i.e., reasons identified as 4 - very important or 5 - extremely important). Second, we used independent samples t-tests to compare means and identify statistically significant differences between groupings. Finally, in cases where we
identified statistically significant differences, we used 2-way ANOVAs to investigate interaction effects between subgroups of engineering transfer students (e.g., Hispanic/Latino students who were also first generation students).

4.2.1 Exploring the Right Tail of Data Distributions. Table 5 summarizes the percentage of study participants who responded at the higher end of the scale with 4 or 5 ratings on reasons for starting college educations at another institution.

Relative to their comparison groups, a higher percentage of students at open enrollment institutions (53%), Hispanic/Latino students (52%), first generation college students (50%), and vertical transfer students (48%) rated the Financial/Affordability construct as a very important to extremely important reason for starting college educations at another institution. As a point of reference, 42% of all study participants responded with ratings of 4 and 5 for the Financial/Affordability construct.

We observed a similar pattern for Non-Academic Commitments. Relative to their comparison groups, a higher percentage of students from open enrollment institutions (31%), Hispanic/Latino students (29%), first generation college students (25%), and vertical transfer students (26%) rated Non-Academic Commitments as a very important to extremely important reason for starting college educations at another institution. Again, as a point of reference, 21% of all study participants responded with ratings of 4 and 5 for the Non-Academic Commitments construct.

High end ratings from all study participants for Academic Flexibility, Driven by Admission Outcomes, Specialized Support Services, and the sub-item “diverse student population” were fairly representative of high end ratings from respective subgroups of transfer students (i.e., less than 5% difference).
**Table 5. Reasons for Starting at Another Institution** – Student responses equal to 4 - *Very Important* or 5 - *Extremely Important*; reported as a percentage of respective groupings.

<table>
<thead>
<tr>
<th>Reason for Starting</th>
<th>Total N</th>
<th>Selective</th>
<th>Open</th>
<th>Lateral</th>
<th>Vertical</th>
<th>HIS = N</th>
<th>HIS = Y</th>
<th>1st Gen = N</th>
<th>1st Gen = Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial/Affordability 2 items)</td>
<td>1024</td>
<td>672</td>
<td>352</td>
<td>404</td>
<td>619</td>
<td>576</td>
<td>448</td>
<td>606</td>
<td>397</td>
</tr>
<tr>
<td>Financial/Affordability</td>
<td>42%</td>
<td>36%</td>
<td>53%</td>
<td>32%</td>
<td>48%</td>
<td>34%</td>
<td>52%</td>
<td>37%</td>
<td>50%</td>
</tr>
<tr>
<td>Non-Academic Commitments (2 items)</td>
<td>672</td>
<td>42%</td>
<td>36%</td>
<td>53%</td>
<td>32%</td>
<td>48%</td>
<td>34%</td>
<td>52%</td>
<td>37%</td>
</tr>
<tr>
<td>Academic Flexibility (6 items)</td>
<td>352</td>
<td>21%</td>
<td>16%</td>
<td>31%</td>
<td>14%</td>
<td>26%</td>
<td>15%</td>
<td>29%</td>
<td>19%</td>
</tr>
<tr>
<td>Diverse student population</td>
<td>404</td>
<td>7%</td>
<td>5%</td>
<td>10%</td>
<td>4%</td>
<td>8%</td>
<td>5%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Driven by Admission Outcomes (2 items)</td>
<td>619</td>
<td>14%</td>
<td>13%</td>
<td>16%</td>
<td>13%</td>
<td>13%</td>
<td>16%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Specialized Support Services (2 items)</td>
<td>576</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

**Table 6. Comparing means for subgroups: Reasons for Starting at Another Institution**

<table>
<thead>
<tr>
<th>Reason for Starting</th>
<th>SEL 672</th>
<th>OPN 352</th>
<th>LAT 404</th>
<th>VERT 619</th>
<th>Not 576</th>
<th>HIS 448</th>
<th>Not 606</th>
<th>1st Gen N 397</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial/Affordability (2 items)</td>
<td>3.12</td>
<td>3.60</td>
<td>2.98</td>
<td>3.48</td>
<td>** 0.39</td>
<td>M</td>
<td>3.05</td>
<td>3.59</td>
<td>** -0.42</td>
</tr>
<tr>
<td>Non-Academic Commitments (2 items)</td>
<td>2.42</td>
<td>2.95</td>
<td>2.34</td>
<td>2.77</td>
<td>** 0.35</td>
<td>M</td>
<td>2.38</td>
<td>2.89</td>
<td>** -0.41</td>
</tr>
<tr>
<td>Academic Flexibility (6 items)</td>
<td>2.16</td>
<td>2.53</td>
<td>2.04</td>
<td>2.44</td>
<td>** 0.42</td>
<td>M</td>
<td>2.18</td>
<td>2.42</td>
<td>** -0.25</td>
</tr>
<tr>
<td>Diverse student population</td>
<td>1.84</td>
<td>1.97</td>
<td>1.99</td>
<td>1.82</td>
<td>* -0.14</td>
<td>S</td>
<td>1.83</td>
<td>1.96</td>
<td></td>
</tr>
<tr>
<td>Driven by Admission Outcomes (2 items)</td>
<td>1.66</td>
<td>1.38</td>
<td>1.63</td>
<td>1.51</td>
<td>** -0.28</td>
<td>M</td>
<td>1.64</td>
<td>1.45</td>
<td>** 0.19</td>
</tr>
<tr>
<td>Specialized Support Services (2 items)</td>
<td>1.18</td>
<td>1.31</td>
<td>1.18</td>
<td>1.26</td>
<td>* 0.13</td>
<td>S</td>
<td>1.20</td>
<td>1.26</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1 - Not at all Important, 2 - Slightly Important, 3 - Moderately Important, 4 - Very Important, 5 - Extremely Important
Means are of weighted data.

** p-value < .01, * p-value < .05

Effect size (Hedges' g): large ≥ .8; .8 > mid-range > .2; small ≤ .2
4.2.2 Independent Samples t-Tests. We found statistically significant differences between varying subgroups for multiple constructs and sub-items. Table 6 summarizes results from the independents samples t-tests.

In comparing response means from participants at open enrollment institutions to those at more selective institutions, we found statistically significant differences for all five constructs (Financial/Affordability, Non-Academic Commitments, Academic Flexibility, Driven by Admission Outcomes, and Specialized Support Services). Each of the effect sizes were mid-range in magnitude. Much like the patterns observed in the analyses of the right tail of the distribution, means for students from open enrollment institutions were higher than means for students attending selective institutions for each construct with the exception of Driven by Admission Outcomes, which was significantly different in the opposite direction.

For the vertical versus lateral transfer student comparison, we found statistically significant differences for four constructs (Financial/Affordability, Non-Academic Commitments, Academic Flexibility, and Specialized Support Services) and one sub-item (“diverse student population”). The effect sizes were small to mid-range. Significantly different mean responses from vertical transfer students tended to be higher than responses from lateral transfer students, with the exception of the “diverse student population” sub-item.

In comparing response means from Hispanic/Latino students to non-Hispanic/Latino students, we found statistically significant differences for four constructs (Financial/Affordability, Non-Academic Commitments, Academic Flexibility, and Driven by Admission Outcomes). The effect sizes for differences were small to mid-range. The patterns for Hispanic/Latino versus non-Hispanic/Latino students (Table 6) were similar to findings for the selective versus open enrollment students, with the mean for Hispanic/Latino students higher than the mean for non-Hispanic/Latino students for all constructs with the exception of Driven by Admission Outcome (opposite direction). One difference for this grouping, however, was the lack of a significant difference in “Specialized Support Services” as an important reason for starting elsewhere.

For the comparison of first generation college students to non-first generation college students, we found statistically significant differences in response means for four constructs
(Financial/Affordability, Non-Academic Commitments, Academic Flexibility, and Specialized Support Services), with small to mid-range effect sizes. Mean responses from first generation college students were significantly greater than mean responses from non-first generation students for each comparison.

**4.2.3 2-way ANOVA Testing Interaction Effects.** Looking across subgroups (see Table 6), we identified a total of five constructs with statistically significant differences between two or more subgroups of engineering transfer students: 1) Financial/Affordability; 2) Non-Academic Commitments; 3) Academic Flexibility; 4) Driven by Admission Outcomes; and 5) Specialized Support Services. We ran 2-way ANOVAs to explore interaction effects between these subgroups.

Statistically significant interaction effects for the Financial/Affordability construct were identified for the following subgroups: 1) institution type and students’ status as Hispanic/Latino [4 of 5 imputations]; 2) type of transfer pathway and students’ status as Hispanic/Latino [3 of 5 imputations]; and 3) type of transfer pathway and students’ status as first generation in college [2 of 5 imputations]. These interactions are displayed in Figures 1, 2, and 3.

The interaction between type of institution and student status as Hispanic/Latino (Figure 1) demonstrates that the difference in reported levels of importance for Financial/Affordability reasons between Hispanic/Latino and non-Hispanic/Latino students was greater at institutions with open enrollment admission policies than at institutions with more selective admissions policies. For Hispanic/Latino students, those enrolled in open enrollment institutions reported higher levels of importance (on Financial/Affordability reasons) than Hispanic/Latino students enrolled in selective enrollment institutions. The case was reversed for non-Hispanic/Latino students, as those enrolled in open enrollment institutions reported lower levels of importance (on Financial/Affordability reasons) than non-Hispanic/Latino students enrolled in more selective institutions. Thus, our results indicate that Financial/Affordability reasons for starting their college educations at another institution was especially important for Hispanic/Latino students at open enrollment institutions. Moreover, this finding also suggests that Financial/Affordability reasons may not be the primary reason...
why non-Hispanic/Latino students at open enrollment institutions in our sample started their postsecondary educations at another institution.

The difference between Hispanic/Latino and non-Hispanic/Latino students on the vertical transfer pathway is of lesser magnitude than the difference between Hispanic/Latino and non-Hispanic/Latino students on the lateral transfer pathway (Figure 2). Thus, Hispanic/Latino and non-Hispanic/Latino students who embarked on the vertical transfer pathway were more similar in their perspectives on the Financial/Affordability construct as a reason for starting elsewhere relative to students on the lateral transfer pathway. A similar pattern is evident in the interaction of first generation status and type of transfer pathway (Figure 3). Students on the vertical transfer pathway were more similar in their perspectives on Financial/Affordability, regardless of student status as first generation. As shown by both of these interaction effects, Financial/Affordability reasons were not as important for non-Hispanic/Latino and non-first generation students—relative to students who were in those groups—on the lateral track as opposed to the vertical track.

For the Non-Academic Commitments construct, we identified a statistically significant interaction effect between students’ Hispanic/Latino status and type of transfer pathway [1 of 5 imputations]. As shown in Figure 4, this interaction effect demonstrated that Hispanic/Latino and non-Hispanic/Latino students who embarked on the vertical transfer pathway were more similar in their perspectives on Non-Academic Commitments as reasons for starting elsewhere, as compared to a larger gap in perspectives for Hispanic/Latino and non-Hispanic/Latino students on the lateral transfer pathway. We found that Hispanic/Latino students on the vertical transfer path reported the highest levels of importance of Non-Academic Commitments as their reasons for starting elsewhere; contrastingly, non-Hispanic/Latino students on the lateral transfer pathway reported lowest levels of importance on Non-Academic Commitments as a reason for starting elsewhere. There is a limitation associated with this finding, however. Because of unequal variance and unequal sample size for these particular groups for this variable, the data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.
We did not find statistically significant interaction effects between subgroups for the following constructs: Academic Flexibility, Driven by Admission Outcomes, and Specialized Support Services.

Figure 1. **Reasons for Starting at Another Institution – Financial/Affordability.** Interaction between Hispanic/Latino status and type of institution. Pattern observed in 4 of the 5 imputed datasets.
Figure 2. **Reasons for Starting at Another Institution – Financial/Affordability.** Interaction between Hispanic/Latino status and type of transfer pathway. Pattern observed in 3 of the 5 imputed datasets.

Figure 3. **Reasons for Starting at Another Institution – Financial/Affordability.** Interaction between first generation college student status and type of transfer pathway. Pattern observed in 2 of the 5 imputed datasets.
Figure 4. **Reasons for Starting at Another Institution – Non-Academic Commitments.** Interaction between Hispanic/Latino status and type of transfer pathway. Pattern observed in 1 of the 5 imputed datasets. Note: Data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.

### 4.3 Discussion

We identified five emergent constructs with respect to reasons for students starting their postsecondary educations at institutions other than their current 4-year institutions. Ranked from most to least important (according to response means), emergent constructs included the following: 1) Financial/Affordability; 2) Non-Academic Commitments; 3) Academic Flexibility; 4) Driven by Admissions Outcomes; and 5) Specialized Support Services. The sub-item “diverse student population” did not load onto any of the five emergent constructs, and participants only rated it as a slightly important reason for starting their educations elsewhere. For the collective group of participants in our study, the top three rated reasons for starting their postsecondary educations at another institution affirm—and begin to rank–emergent themes from prior qualitative studies that identify reasons why transfer students started at another institution (Bensimon & Dowd, 2009; Packard et al., 2011; Reyes, 2011). These findings also align with studies focused more specifically on transfer students in engineering that have
identified cost, affordability, convenience, proximity to family, and flexible schedule as commonly cited reasons why these students start their postsecondary educations at institutions other than their current 4-year institutions (Brawner & Mobley, 2014; Knight et al., 2014; Mobley et al., 2014b).

Motivated by prior calls for deeper investigations of transfer students using disaggregated data (Bahr et al., 2013; Mobley et al., 2013; Shealy et al., 2013), our analyses increase understanding and awareness of areas where subgroups of engineering transfer students respond similarly and where they respond differently with respect to their reasons for starting their postsecondary educations at another institution. We discuss these findings by theme (i.e., constructs and sub-items) in the paragraphs below.

Although the Financial/Affordability construct emerged as a primary driver for initial postsecondary pathway decisions for all participants in our study, we found that transfer students at open enrollment institutions, Hispanic/Latino students, first generation students, and vertical transfer students reported significantly higher response means than their respective counterparts. While these findings may seem intuitive, to our knowledge, no other study has made this direct comparison between subgroups of transfer students. By investigating specific groups of students, prior studies have identified cost and affordability as important reasons for engineering transfer students in general (Brawner & Mobley, 2014; Knight et al., 2014; Mobley et al., 2014b), for vertical transfer students in STEM who were women (Packard et al., 2011), and for vertical transfer students who were Hispanic/Latino (Bensimon & Dowd, 2009; Ornelas & Solorzano, 2004; Reyes, 2011). With the exception of Knight et al. (2014), all of these prior studies have employed qualitative research approaches to collect data from smaller samples of students. Our research, which draws on a large and diverse data set to compare subgroups of engineering transfer students, builds on and extends findings from prior studies – both qualitative and quantitative - by ranking reasons and adding additional layers of granularity that identify differences between transfer students based on type of institution, type of pathway, student status as Hispanic/Latino, and student status as first generation college student.
For example, we found that Hispanic/Latino transfer students at open enrollment institutions and those on the vertical transfer pathway reported the highest levels of importance to Financial/Affordability as a reason for starting at another institution. This finding, for Hispanic/Latino transfer students at open enrollment institutions in particular, corroborated results from a qualitative study by Bensimon and Dowd (2009) which revealed that Hispanic/Latino transfer students’ increased levels of concern around cost and a lack of information about financial aid options resulted in transfer choice gap. Although less extreme, first generation students on the vertical transfer pathway also reported higher levels of importance to Financial/Affordability as a reason for starting at another institution. Overall, these findings increase our understanding and awareness of which subgroups of engineering transfer students (i.e., transfer students at open enrollment institutions, Hispanic/Latino students, first generation college students, and vertical transfer students) make postsecondary pathway decisions under increased levels of financial pressure.

In this study, Non-Academic Commitments were rated as the second most important reason for students starting their postsecondary educations at institutions other than their current institutions. We also found higher mean response ratings from students at open enrollment institutions, and from vertical transfer students, Hispanic/Latino students, and first generation college students. Moreover, the interaction effect between transfer pathway and student status as Hispanic/Latino demonstrated that Hispanic/Latino students on the vertical transfer path reported the highest levels of importance on Non-Academic Commitments as their reason for starting elsewhere. Again, to our knowledge, no other study has made this direct comparison between subgroups of transfer students. However, these results are consistent with findings from prior qualitative studies which identify environmental pull factors (e.g., family obligations, work obligations) that influence postsecondary pathway decisions for specific groups of students on the transfer pathway (Bensimon & Dowd, 2009; Brawner & Mobley, 2014; Crisp & Nora, 2010; Packard et al., 2011; Reyes, 2011). As an example, for women of color in the STEM transfer pathway, Reyes (2011) found that the need for or reliance on a familial support system influenced some participants’ decisions to transfer to less selective institutions to stay closer to home. In a separate study on women in the STEM transfer
pathway, Packard et al. (2011) found that family responsibilities impacted some students’ decisions to delay transfer altogether.

The construct Academic Flexibility also emerged as one of the top three reasons why our participants decided to begin their postsecondary educations at institutions other than their current institutions. This finding aligns with prior studies citing academic flexibility, flexible course scheduling, and existing articulation agreements as several reasons why some students chose to enroll in 2-year institutions (D. L. Jackson et al., 2013; Knight et al., 2014; Laanan et al., 2010b). The mean response ratings for Academic Flexibility from students enrolled at institutions with open admission policies, vertical transfer students, Hispanic/Latino students, and first generation college students were statically significantly higher than their respective counterparts. This finding suggests that students from these subgroups may be operating within a context that steers them to place a higher premium on Academic Flexibility when it comes to postsecondary pathway decisions. This need for academic flexibility could potentially be a response to existing environmental pull factors that influence postsecondary pathway decisions for some groups of transfer students more than others. Prior research documents the impact of environmental pull on postsecondary pathway decisions for vertical transfer students, Hispanic/Latino transfer students, older transfer students, women in STEM, and women of color in STEM (Bensimon & Dowd, 2009; Brawner & Mobley, 2014; Crisp & Nora, 2010; Packard et al., 2011; Reyes, 2011). Our results confirm findings from this prior research and provide additional evidence to illustrate the influence of environmental pull on postsecondary pathway decisions for transfer students who are first generation college students.

Participants rated the sub-item “diverse student population” on the lower end of importance in their decisions to start their educations at institutions other than their current institution. In our comparison of subgroups, we found lateral transfer students’ responses higher than vertical transfer students’ responses. Based on findings from prior literature (Ornelas & Solorzano, 2004; Packard et al., 2011; Reyes, 2011) and our results for Financial/Affordability, we posit that vertical transfer students are making decisions under increased levels of financial constraint. Following that rationale, we hypothesize that
postsecondary pathway decisions driven by the importance of “diverse student population” would feasibly be lower on the list of essential needs and priorities for vertical transfer students than for lateral transfer students. Thus, lateral transfer students may have the luxury of taking a variety of non-financial elements under consideration when making postsecondary pathway decisions, which potentially explains why their rating for “diverse student population” was higher than vertical transfer students.

The construct Driven by Admissions Outcomes also emerged on the lower end of important reasons for why participants in our study started their postsecondary educations at institutions other than their current institutions. However, we did find that students enrolled in institutions with more selective admission policies and non-Hispanic/Latino students reported significantly higher response means than their respective comparison groups. This finding, particularly with respect to transfer students at more selective institutions, corroborates prior work by Mobley et al. (2014b). Participants in their study described the transfer pathway as a “back-door” to their current institution. For transfer students at more selective institutions, our data suggest that Admissions Based Outcomes carried a level of importance that shaped these students’ decisions to enroll in different institutions before transferring to their current selective institution. For example, students may have initially applied to their school of choice for freshman admission, were denied admission (and/or offered a system admissions alternative), enrolled at another institution, and later re-applied to their school of choice to gain admission as a transfer student.

There is nothing wrong with using a “back-door” (as described above) to gain admission to more selective institutions. However, what is concerning is the future livelihood of this “back-door” approach for prospective transfer students who hope to gain future admission to selective institutions. Dowd and colleagues argue that “opportunity to transfer to elite institutions is shrinking” and support this claim with evidence illustrating that the transfer pathway into selective institutions is increasingly narrow (Dowd et al., 2006; Dowd & Cheslock, 2006; Melguizo & Dowd, 2006). While growth in student enrollment at 2-year institutions has outpaced the growth at 4-year institutions, Dowd and Cheslock (2006) found that from 1994 to 2002 “the share of transfer students among the entering student class declined from 11% to 6%
at highly selective private institutions, and from 22% to 19% at public selective institutions” (Dowd et al., 2006, p. 3). Dowd (2012) further explained that loss of transfer access to selective institutions is a result of increased demand for elite education in the United States that emerged during the 1980s and 1990s. Since then, open enrollment institutions have stepped in to fill this gap by accommodating a growing number of transfer students who seek to earn baccalaureate degrees. Findings from our study suggest that outcomes from the admissions process drive some engineering students (i.e., students at more selective institutions and non-Hispanic/Latino students) to start their postsecondary educations at institutions other than their current institutions. If that pathway continues to be constricted for elite institutions, communication to students about negative admissions decisions from elite institutions should be transparent about the viability of future transfer so that students may make appropriately informed decisions about their postsecondary matriculation.

Finally, participants in our study rated Specialized Support Services lowest on their list of reasons for starting their educations at institutions other than their current institutions. This construct captured participants’ perspectives on levels of importance for an English as a second language program and on-campus childcare. The mean response ratings for Specialized Support Services from students enrolled at institutions with open admission policies, vertical transfer students, and first generation college students were significantly higher than their respective counterparts. Prior research has shown that environment pull factors, such as family responsibilities, can delay transfer and even avert transfer altogether (Packard et al., 2011; Reyes, 2011). Therefore, it would not be entirely accurate to conclude that specialized support services are superfluous or unnecessary based on low levels of importance as reported by participants in our study. In fact, our results suggest that taking away these services could have a higher impact on certain subsets of the population, which could further exacerbate their participation in the engineering field. Moreover, a limitation of this study is that we made a conscious decision to collect data from students who successfully transferred into a 4-year institution. It is possible that our participants experienced environmental pull differently than students who are still in or never made it out of the pre-transfer status. These differing experiences, especially for pre-engineering students who stalled out or delayed transfer, could
influence reported levels of importance for Specialized Support Services. Implications for policy, practice and research are summarized in section 6.0.
5.0 Results and Discussion – Part II

Factors Influencing Participants’ Decisions to Transfer to Their Current Institutions

5.1 Results for Addressing Research Question 2a

Study participants responded to 18 sub-items related to “factors that influenced their decisions to transfer to their current 4-year institution.” Response means and standard errors of the means for each of the sub-items are shown in Table 7.

Four constructs emerged from the exploratory factor analysis: 1) Institutional Prestige ($\alpha = .71$); 2) Financial/Affordability ($\alpha = .79$); 3) Ease of Transfer ($\alpha = .70$); and 4) Formal & Informal Interactions on Campus ($\alpha = .79$) (see Table 8). The construct Institutional Prestige includes sub-items that emphasize institutions’ national rankings and academic reputation. The Financial/Affordability construct includes sub-items that focus on cost, measures of affordability, and financial support. Ease of Transfer is composed of sub-items that key in on transferable credit and access to clear and useful information on transferring. Finally, the construct for Formal & Informal Interactions on Campus includes sub-items that describe students visiting the receiving institutions’ campus, connecting with faculty members and students at the receiving institution, and meeting with academic advisor/counselors at both the sending and receiving institutions. Five sub-items from the original list of 18 did not load on any of the four constructs.

Based on response means from our study’s sample, Institutional Prestige emerged as a leading factor that influenced students’ decisions to transfer to their current 4-year institution followed by the “convenience and location” sub-item. Tied for third and fourth, students rated Financial/Affordability and Ease of Transfer equally on the scale of important factors that influenced their decisions to transfer to their current institutions.

In aggregate, response means for constructs did not exceed 3.71 on the five-point scale. As a collective group, participants did not identify any items or constructs as “very or extremely important” factors that influenced their decisions to transfer to their current 4-year institutions.
Table 7. **Factors in decision to transfer to receiving institution [RI]**

<table>
<thead>
<tr>
<th>Sub-items</th>
<th>Mean (N = 1024)(^1)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.  Cost of tuition at [RI]</td>
<td>3.54</td>
<td>1.37</td>
</tr>
<tr>
<td>3.  Convenience and location</td>
<td>3.49</td>
<td>1.39</td>
</tr>
<tr>
<td>4.  [RI]'s ranking in national magazines</td>
<td>3.30</td>
<td>1.43</td>
</tr>
<tr>
<td>5.  Number of credits that would transfer</td>
<td>3.26</td>
<td>1.53</td>
</tr>
<tr>
<td>6.  Access to clear and useful information on transferring</td>
<td>3.26</td>
<td>1.43</td>
</tr>
<tr>
<td>7.  Cost of living in [RI]'s city/town</td>
<td>3.15</td>
<td>1.43</td>
</tr>
<tr>
<td>8.  Amount of financial aid (includes grants &amp; scholarships) that I received at [RI]</td>
<td>3.09</td>
<td>1.61</td>
</tr>
<tr>
<td>9.  Talking with students at [RI]</td>
<td>2.82</td>
<td>1.46</td>
</tr>
<tr>
<td>10. Family recommended that I attend</td>
<td>2.68</td>
<td>1.50</td>
</tr>
<tr>
<td>11. My campus visit to [RI]</td>
<td>2.66</td>
<td>1.46</td>
</tr>
<tr>
<td>12. Speaking with an academic advisor/counselor at [RI]</td>
<td>2.56</td>
<td>1.49</td>
</tr>
<tr>
<td>13. Size of [RI]</td>
<td>2.43</td>
<td>1.33</td>
</tr>
<tr>
<td>14. A friend suggested that I attend</td>
<td>2.35</td>
<td>1.42</td>
</tr>
<tr>
<td>15. Meeting with instructors or sitting in on classes at [RI]</td>
<td>2.10</td>
<td>1.38</td>
</tr>
<tr>
<td>16. Academic advisor/counselor(s) at my previous college advised me to attend</td>
<td>2.09</td>
<td>1.41</td>
</tr>
<tr>
<td>17. My family attended [RI]</td>
<td>1.88</td>
<td>1.37</td>
</tr>
<tr>
<td>18. A [RI] representative recruited me</td>
<td>1.39</td>
<td>0.92</td>
</tr>
</tbody>
</table>

*Scale: 1-Not at all Important, 2-Slightly Important, 3- Moderately Important, 4 - Very Important, 5 - Extremely Important; Means are of weighted data.*

\(^1\) Participants in co-enrollment program(s) were exempt from this survey item.
Table 8. Factors in decision to transfer to receiving institution [RI]

<table>
<thead>
<tr>
<th>Construct</th>
<th>Sub-items</th>
<th>Mean (N = 1024)¹</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Prestige (α = .71)</td>
<td>▪ Academic reputation of [RI]</td>
<td>3.71</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>▪ [RI]’s ranking in national magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Convenience and location</td>
<td>3.49</td>
<td>1.39</td>
</tr>
<tr>
<td>Financial/Affordability (α = .79)</td>
<td>▪ Cost of tuition at [RI]</td>
<td>3.26</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>▪ Cost of living in [RI]’s city/town</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Amount of financial aid (includes grants &amp; scholarships) that I received at [RI]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ease of Transfer (α = .70)</td>
<td>▪ Number of credits that would transfer</td>
<td>3.26</td>
<td>1.30</td>
</tr>
<tr>
<td></td>
<td>▪ Access to clear and useful information on transferring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Family recommended that I attend</td>
<td>2.68</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>▪ Size of [RI]</td>
<td>2.43</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>▪ A friend suggested that I attend</td>
<td>2.35</td>
<td>1.42</td>
</tr>
<tr>
<td>Formal &amp; Informal Interactions on Campus</td>
<td>▪ Talking with students at [RI]</td>
<td>2.27</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>▪ My campus visit to [RI]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Speaking with an academic advisor/counselor at [RI]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Meeting with instructors or sitting in on classes at [RI]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Academic advisor/counselor(s) at my previous college advised me to attend</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ A [RI] representative recruited me</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ My family attended [RI]</td>
<td>1.88</td>
<td>1.37</td>
</tr>
</tbody>
</table>

Scale: 1-Not at all Important, 2-Slightly Important, 3- Moderately Important, 4 - Very Important, 5 - Extremely Important; Means are of weighted data.

¹ Participants in co-enrollment program(s) were exempt from this survey item.

5.2. Results for Addressing Research Question 2b - Comparing Groups

To explore differences between subgroups in the sample and avoid making inaccurate generalizations about the collective population, we followed a similar approach as in research question 1b. Results from right tail frequency count data, independent samples t-tests, and 2-ways ANOVAs are reported in 5.2.1 through 5.2.3.

5.2.1 Exploring the Right Tail of Data Distributions. Table 9 summarizes the percentage of study participants who responded at the higher end of the scale with 4 or 5 ratings on factors that influenced their decisions to transfer to their current 4-year institution.

Higher percentages of students at open enrollment institutions identified “convenience and location” as a very important to extremely important factor, with 69% of this group...
providing a 4 or 5 response rating. High percentages of Hispanic/Latino (61%), vertical (59%), and first generation college students (58%) also rated “convenience and location” as a very important to extremely important factor that influenced their decisions to transfer to their current 4-year institutions. Similarly, a higher percentage of students at open enrollment institutions, Hispanic/Latino students, first generation college students, and vertical transfer students rated Financial/Affordability and Ease of Transfer as very important to extremely important factors relative to their counterpart groups. Lower percentages of students from these groups rated Institutional Prestige as very important to extremely important factors in their decisions to transfer to their current 4-year institutions relative to their counterpart groups.
### Table 9. Factors in decision to transfer to [RI] – Student responses equal to 4 - Very Important or 5 - Extremely Important; reported as a percentage of respective groupings.

<table>
<thead>
<tr>
<th></th>
<th>Total of N=1024</th>
<th>Selective % of N=672</th>
<th>Open % of N=352</th>
<th>Lateral % of N=404</th>
<th>Vertical % of N=619</th>
<th>HIS = N % of N=576</th>
<th>HIS = Y % of N=448</th>
<th>1st Gen = N % of N=606</th>
<th>1st Gen = Y % of N=397</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Prestige (2 items)</td>
<td>54%</td>
<td>66%</td>
<td>32%</td>
<td>58%</td>
<td>53%</td>
<td>61%</td>
<td>46%</td>
<td>58%</td>
<td>49%</td>
</tr>
<tr>
<td>Convenience and location</td>
<td>55%</td>
<td>48%</td>
<td>69%</td>
<td>49%</td>
<td>59%</td>
<td>50%</td>
<td>61%</td>
<td>53%</td>
<td>58%</td>
</tr>
<tr>
<td>Financial/Affordability (3 items)</td>
<td>34%</td>
<td>27%</td>
<td>47%</td>
<td>26%</td>
<td>39%</td>
<td>25%</td>
<td>47%</td>
<td>27%</td>
<td>45%</td>
</tr>
<tr>
<td>Ease of Transfer (2 items)</td>
<td>42%</td>
<td>40%</td>
<td>46%</td>
<td>34%</td>
<td>47%</td>
<td>40%</td>
<td>44%</td>
<td>41%</td>
<td>44%</td>
</tr>
<tr>
<td>Family recommended that I attend</td>
<td>33%</td>
<td>35%</td>
<td>31%</td>
<td>32%</td>
<td>34%</td>
<td>34%</td>
<td>33%</td>
<td>37%</td>
<td>28%</td>
</tr>
<tr>
<td>Size of [RI]</td>
<td>22%</td>
<td>23%</td>
<td>19%</td>
<td>21%</td>
<td>23%</td>
<td>24%</td>
<td>20%</td>
<td>24%</td>
<td>20%</td>
</tr>
<tr>
<td>A friend suggested that I attend</td>
<td>25%</td>
<td>29%</td>
<td>18%</td>
<td>25%</td>
<td>25%</td>
<td>26%</td>
<td>23%</td>
<td>24%</td>
<td>25%</td>
</tr>
<tr>
<td>Formal &amp; Informal Interactions on Campus (6 items)</td>
<td>6%</td>
<td>5%</td>
<td>7%</td>
<td>4%</td>
<td>7%</td>
<td>4%</td>
<td>8%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>My family attended [RI]</td>
<td>16%</td>
<td>16%</td>
<td>16%</td>
<td>14%</td>
<td>18%</td>
<td>17%</td>
<td>15%</td>
<td>17%</td>
<td>14%</td>
</tr>
</tbody>
</table>

### Table 10. Comparing means for subgroups: Factors in decision to transfer to [RI]

<table>
<thead>
<tr>
<th></th>
<th>SEL</th>
<th>OPN</th>
<th>effect size</th>
<th>LAT</th>
<th>VERT</th>
<th>effect size</th>
<th>Not</th>
<th>HIS</th>
<th>effect size</th>
<th>Not</th>
<th>1st Gen</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>N= 672</td>
<td>4.07</td>
<td>3.03</td>
<td>** -1.02 L</td>
<td>3.77</td>
<td>3.68</td>
<td></td>
<td>3.92</td>
<td>3.44</td>
<td>** 0.44 M</td>
<td>3.80</td>
<td>3.58</td>
<td>* 0.20 S</td>
</tr>
<tr>
<td>Institutional Prestige (2 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience and location</td>
<td>3.27</td>
<td>3.90</td>
<td>** 0.46 M</td>
<td>3.32</td>
<td>3.60</td>
<td>** 0.21 M</td>
<td>3.34</td>
<td>3.69</td>
<td>** -0.25 M</td>
<td>3.40</td>
<td>3.64</td>
<td>* -0.17 S</td>
</tr>
<tr>
<td>Financial/Affordability (3 items)</td>
<td>3.06</td>
<td>3.65</td>
<td>** 0.49 M</td>
<td>3.06</td>
<td>3.39</td>
<td>** 0.27 M</td>
<td>2.99</td>
<td>3.61</td>
<td>** -0.52 M</td>
<td>3.09</td>
<td>3.53</td>
<td>** -0.36 M</td>
</tr>
<tr>
<td>Ease of Transfer (2 items)</td>
<td>3.22</td>
<td>3.33</td>
<td></td>
<td>3.02</td>
<td>3.41</td>
<td>** 0.31 M</td>
<td>3.21</td>
<td>3.32</td>
<td></td>
<td>3.23</td>
<td>3.31</td>
<td></td>
</tr>
<tr>
<td>Family recommended that I attend</td>
<td>2.71</td>
<td>2.62</td>
<td></td>
<td>2.60</td>
<td>2.73</td>
<td></td>
<td>2.70</td>
<td>2.67</td>
<td></td>
<td>2.79</td>
<td>2.50</td>
<td>* 0.19 S</td>
</tr>
<tr>
<td>Size of [RI]</td>
<td>2.50</td>
<td>2.31</td>
<td>* -0.14 S</td>
<td>2.43</td>
<td>2.43</td>
<td></td>
<td>2.47</td>
<td>2.39</td>
<td></td>
<td>2.44</td>
<td>2.42</td>
<td></td>
</tr>
<tr>
<td>A friend suggested that I attend</td>
<td>2.49</td>
<td>2.08</td>
<td>** -0.29 M</td>
<td>2.33</td>
<td>2.36</td>
<td></td>
<td>2.41</td>
<td>2.27</td>
<td></td>
<td>2.34</td>
<td>2.36</td>
<td></td>
</tr>
<tr>
<td>Formal &amp; Informal Interactions on Campus (6 items)</td>
<td>2.23</td>
<td>2.35</td>
<td></td>
<td>2.20</td>
<td>2.32</td>
<td>* 0.13 S</td>
<td>2.18</td>
<td>2.38</td>
<td>** -0.21 M</td>
<td>2.25</td>
<td>2.30</td>
<td></td>
</tr>
<tr>
<td>My family attended [RI]</td>
<td>1.86</td>
<td>1.90</td>
<td></td>
<td>1.87</td>
<td>1.88</td>
<td></td>
<td>1.92</td>
<td>1.82</td>
<td></td>
<td>1.95</td>
<td>1.74</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1-Not at all Important, 2-Slightly Important, 3-Moderately Important, 4 - Very Important, 5 - Extremely Important
Means are of weighted data. ** p-value < .01, * p-value < .05
Effect size (Hedges’ g): large ≥ .8; .8 > mid-range > .2; small ≤ .2

Andrea M. Ogilvie, P.E.
5.2.2 Independent Samples t-Tests. In comparing response means, we found statistically significant differences between varying subgroups for multiple constructs and sub-items. Table 10 summarizes results from the independents samples t-tests.

In comparing response means of participants from open enrollment institutions to those from more selective institutions, we found statistically significant differences for a total of five constructs and sub-items; the effect size for each significant difference was small to mid-range, with the exception of Institutional Prestige, which exhibited a large effect size. Students at more selective institutions reported higher response means for Institutional Prestige, “size of the receiving institution, and “a friend suggested that I attend.” Students at open enrollment institutions reported higher response means for “convenience and location” and Financial/Affordability.

For the vertical versus lateral transfer student comparison, we found statistically significant differences in response means for a total of four constructs and sub-items. Effect sizes for all were considered mid-range, with the exception of Formal and Informal Interactions on Campus, which was small in magnitude. Vertical transfer students had significantly higher response means in all four areas: “convenience and location”, Financial/Affordability, Ease of Transfer, and Formal and Informal Interactions on Campus.

In comparing response means between Hispanic/Latino students and non-Hispanic/Latino students, we found statistically significant differences for a total of four constructs and sub-items; effect sizes for all were considered mid-range. Hispanic/Latino students reported statistically significant higher means for “convenience and location”, Financial/Affordability, and Formal and Informal Interactions on Campus. Conversely, non-Hispanic/Latino students reported statistically significant higher means for Institutional Prestige.

Finally, for the comparison of first generation college students to non-first generation college students, we found statistically significant differences in response means for a total of four constructs and sub-items. Effect sizes for all were small, with the exception of Financial/Affordability which was considered mid-range in size. First generation college students had significantly higher response means for “convenience and location” and
Financial/Affordability. Conversely, non-first generation college students had significantly higher response means for Institutional Prestige and “family recommended that I attend.”

5.2.3 2-way ANOVA Testing Interaction Effects. We identified statistically significant differences across all four comparison groups for Financial/Affordability and the sub-item “convenience and location.” We identified significant differences across three comparison groups for Institutional Prestige and across two comparison groups for Formal and Informal Interactions on Campus. This section explores interaction effects for constructs and sub-items with two or more statistically significant different comparison groups.

For Institutional Prestige, there was a significant interaction effect between type of institution and student status as first generation college student [2 of 5 imputations]. As shown in Figure 5, the difference between students at selective institutions versus open enrollment institutions is greater for non-first generation college students than for first generation college students. However, because of unequal variance and unequal sample size for this construct for these groups, we caution readers to consider that the data did not meet all assumptions of ANOVA.

For the independent item “convenience and location”, there was a significant interaction effect between students’ status as Hispanic/Latino and their status as a first generation college student [4 of 5 imputations]. Figure 6 shows that the difference between Hispanic/Latino and non-Hispanic/Latino students who are first generation college students is greater than the difference between Hispanic/Latino and non-Hispanic/Latino students who are not first generation college students for this sub-item. “Convenience and location” was most important for Hispanic/Latino students who also identified as first generation college students when they were deciding to transfer to their current institutions (relative to other comparison groups for this interaction).

For the construct representing Financial/Affordability factors, we identified a statistically significant interaction effect between institution type and students’ status as Hispanic/Latino [5 of 5 imputations]. The difference between Hispanic/Latino and non-Hispanic/Latino students at open enrollment institutions is greater than the difference between Hispanic/Latino and non-Hispanic/Latino students at selective enrollment institutions (see Figure 7).
Financial/Affordability was most important for Hispanic/Latino students at open enrollment institutions when they were deciding to transfer to their current institutions.

Finally, we did not find statistically significant interaction effects between subgroups for Formal and Informal Interactions on Campus.

![Diagram showing interaction between type of institution and first generation college student status.](image)

**Figure 5.** **Factors in decision to transfer to [RI] – Institutional Prestige.** Interaction between type of institution and first generation college student status. Pattern observed in 2 of the 5 imputed datasets. Note: Data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.
Figure 6. **Factors in decision to transfer to [RI] – Convenience and location.** Interaction between Hispanic/Latino status and first generation college student status. Pattern observed in 4 of the 5 imputed datasets.

Figure 7. **Factors in decision to transfer to [RI] – Financial/Affordability.** Interaction between Hispanic/Latino status and type of institution. Pattern observed in 5 of the 5 imputed datasets.
5.3 Discussion

Four constructs emerged from analyses of participants’ responses with respect to factors that influenced their decisions to transfer to their current 4-year institutions. Ranked from most to least important factors according to response means, constructs included the following: 1) Institutional Prestige; 2) Financial/Affordability; 3) Ease of Transfer; and 4) Formal and Informal Interactions on Campus. Although the sub-item “convenience and location” failed to load onto one of those constructs, participants rated it as the second most important factor that influenced their decisions. One objective of our analyses is to increase understanding and awareness of areas where subgroups of engineering transfer students respond similarly and where they respond differently with respect to factors that influence their decisions to transfer to their current institutions. We discuss these findings by theme (i.e., constructs and sub-items) in the following paragraphs.

For the collective group of participants in our study, Institutional Prestige emerged as the top factor that influenced participants’ decisions to transfer to their current 4-year institutions. This finding corroborates results from qualitative studies (Brawner & Mobley, 2014; Mobley et al., 2014b) and other quantitative studies (Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011) that have identified academic or institutional reputation as a factor considered by engineering transfer students when they were deciding where to transfer. Further extending this prior research, we found that levels of importance assigned to Institutional Prestige varied by subgroups of engineering transfer students, as students at open enrollment institutions, Hispanic/Latino students, and first generation college students rated Institutional Prestige lower than their respective counterparts. Results presented in section 4.3 of this manuscript and findings from prior qualitative research (Bensimon & Dowd, 2009; Packard et al., 2011; Reyes, 2011) indicate that cost and affordability tend to be important factors that drive postsecondary pathway decisions for Hispanic/Latino students, first generation college-students, and students at open enrollment institutions. Thus, our finding that Institutional Prestige is of lesser importance to these engineering transfer student subgroups aligns with results from prior qualitative research. Moreover, drawing on

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quantitative data, we contribute the following additional insights: 1) students at open enrollment institutions ranked Institutional Prestige fourth - behind “convenience and location”, Financial/Affordability, and Ease of Transfer; 2) Hispanic/Latino students ranked Institutional Prestige third, behind “convenience and location” and Financial/Affordability; and 3) first generation college students ranked Institutional Prestige second, behind “convenience and location.” These findings suggest that other factors beyond Institutional Prestige may be more important for certain groups of students when deciding where to transfer.

Convenience and location also surfaced high on the list of important factors, which is consistent with prior quantitative studies (Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011) as well as qualitative studies that describe environmental pull and its influence on postsecondary pathway decisions for students on the transfer pathway (Brawner & Mobley, 2014; Packard et al., 2011; Reyes, 2011). Moreover, we found statistically significant differences in response means across all four subgroups of engineering transfer students. Our data reveal that students at open enrollment institutions, Hispanic/Latino students, first generation college students, and vertical transfer students reported higher response means than their respective counterparts. This result affirms qualitative findings from prior research on Hispanic/Latino students. In those studies, some participants were first generation college students and/or students who opted to enroll in less selective institutions (Bensimon & Dowd, 2009; Reyes, 2011).

We also found differences in response means for Hispanic/Latino students based on their status as a first generation college student. Hispanic/Latino students who were first generation college students reported the highest levels of importance for “convenience and location,” whereas Hispanic/Latino students who were not first generation college students responded more similarly to non-Hispanic/Latino students (regardless of first generation college student status). These findings suggest that, for Hispanic/Latino students who are the first in their families to go to college, “convenience and location” is a significant factor that influences their decisions regarding to which institution to transfer. Moreover, this finding is an example of how cultural capital can influence students’ postsecondary pathway decisions. Bensimon and Dowd (2009) made a similar observation in their qualitative research on...
Hispanic/Latino transfers students and found that participants who had higher amounts of cultural capital (e.g., older siblings in college) and social capital (e.g., frequent contact with institutional agents) described having access to “insider information” that helped them transfer to a selective institution of their choice. Similarly, in a study women of color in the STEM transfer pathway, the need for or reliance on a familial support system influenced some participants’ decisions to transfer to less selective institutions to stay closer to home (Reyes, 2011). Thus, varying levels (and types) of cultural capital could explain why some participants in our study assigned higher levels of importance to “convenience and location” than other students. Without access to cultural capital, it is possible that these students were unaware of other options and instead selected institutions closer to home that were more known. Alternately, these students may have: 1) had different environmental pull factors that restricted their options for the institution to which they could transfer; or 2) had access to a different type of cultural capital (i.e., a culture that places high value on maintaining close familial ties) which ultimately drives individual preferences for “convenience and location” over other factors such as Institutional Prestige.

The Financial/Affordability construct also emerged as one of the three most important factors that influenced participants’ decision to transfer to their current institutions. This finding corroborates results from prior qualitative studies (Bensimon & Dowd, 2009; Brawner & Mobley, 2014; Mobley et al., 2014b; Packard et al., 2011; Reyes, 2011) and quantitative studies (Crisp & Nora, 2010; Knight et al., 2014; Laanan et al., 2010a; Laanan, Jackson, & Rover, 2011) that identified cost and affordability as important factors that drive postsecondary pathway decisions. Further extending prior findings on Financial/Affordability, we found statistically significant differences in response means across all four subgroups of engineering transfer students. Students enrolled at institutions with open admission policies, vertical transfer students, Hispanic/Latino students, and first generation college students reported higher levels of importance for Financial/Affordability than their respective counterparts. Finding from our research provide further evidence to suggest that students from these subgroups may be operating within and making postsecondary pathway decisions under increased levels of financial constraint and concerns of college affordability. These results are consistent with
findings documented in section 4.3, where the same four subgroups of engineering transfer students reported statistically significant higher response means for Financial/Affordability as their most important reason for starting their postsecondary educations at an institution other than their current institution. Moreover, these results also align with findings from prior research that highlight concerns around affordability for vertical transfer students (Packard et al., 2011) and Hispanic/Latino students, of which some were first generation colleges students and/or students who opted to enroll in less selective institutions (Bensimon & Dowd, 2009; Reyes, 2011). Based on this prior research, we anticipated that response means from Hispanic/Latino students for the construct Financial/Affordability would be higher than their respective counterparts, which proved to be accurate. However, our analyses yielded new information on differences between Hispanic/Latino students based on the type of institution in which they enrolled. Hispanic/Latino students at open enrollment institutions reported higher levels of importance of Financial/Affordability in comparison to their counterparts at more selective institutions. Our research extends prior findings and provides more specific evidence suggesting that Hispanic/Latino students at open enrollment institutions, in particular, may be operating within and making postsecondary pathway decisions under increased levels of financial constraint and concerns about college affordability.

Our analyses also demonstrated that participants rated the Ease of Transfer just as important as financial considerations in their decisions to transfer to their current 4-year institutions. The mean response rating from vertical transfer students was significantly higher than mean ratings from lateral transfer students. This result was not unusual, especially given that vertical transfer students in our study also placed high levels of importance on “convenience and location” as a factor in their decision to transfer to their current institution. Our finding corroborates results from the Prototype to Production (P2P) project, which surveyed a sample of 1,245 community college students across 15 institutions who planned to transfer to a 4-year institution and major in engineering. When asked about important factors in their impending decision to transfer, students rated “number of credits that will transfer” and “good information on transfer” as the top two most important factors (Terenzini et al.,
2014, p. 6); other important factors included “speaking with an advisor at the 4-year school” and “visiting the 4-year school.”

Participants rated the sub-item “family recommended that I attend” of intermediate importance on the list of factors for consideration in their decisions’ to transfer to their current 4-year institutions. More importantly, we found that first generation college students reported lower response means than their counterparts. This finding seems to align with results from prior research on first generation engineering transfer students. Mobley et al. (2013) found that students with parents who had achieved high levels of education (i.e., Bachelor degree or higher) reported getting “practical and logistical help from parents with applying to school and negotiating the transfer process”; they also found that students with parents who completed lower levels of education (i.e., less than a Baccalaureate degree) indicated that “their parents could not relate to the logistical and practical challenges of transfer process” (Ohland et al., 2014, p. 6). Thus, we see how students’ family and their levels of involvement in the transfer process can change based on variations in social and cultural capital. In our study, for first generation college students, lower levels of importance placed on “my family recommended that I attend” could be an indication of lower levels of family involvement because of more limited social and cultural capital.

Similar to the previous sub-item, participants rated “size of receiving institution” of intermediate importance on the list of factors for consideration in their decisions’ to transfer to their current 4-year institutions. Given that the selective institutions include in this study each enroll more than 50,000 students, it was not unusual to find that students who enrolled in these institutions reported higher levels of importance to “size of receiving institution” as a factor in their decisions to transfer to their current institutions. This finding raises the following question: Was it the large size of the receiving institution that attracted the student to that particular campus? And, for the students at open enrollment institutions (both still on the large side, with 20,000-35,000 students each): Why was size of receiving institution not as important? Perhaps the size of the smaller campuses felt more manageable to students and so they were less concerned about it being an issue. Given that our study employed closed ended
questions, however, we are unable to provide answers to these additional questions without further investigation.

Finally, survey respondents rated the Formal and Informal Interactions on Campus construct of lesser importance for participants’ decisions to transfer to their current 4-year institutions. However, mean response ratings from Hispanic/Latino students and vertical transfer students were higher than their corresponding counterparts. Although this result aligns with findings from prior qualitative studies that have acknowledged the roles of institutional agents who serve as funds of knowledge on transfer for students with limited access to social and/or capital (Bensimon & Dowd, 2009; Packard et al., 2011; Reyes, 2011; Stanton-Salazar, Macias, Bensimon, & Dowd, 2010), the overall low level of importance placed on Formal and Informal Interactions on Campus by participants in our study is an area of concern. Bensimon and Dowd (2009) found that institutional agents can play a significant role mitigating transfer gap choice, especially for students with limited access to social and/or cultural capital. Thus, findings from our data raise more questions than answers. For example, is it that Formal and Informal Interactions on Campus were not very important to engineering transfer students in their decision-making processes relative to the other factors in the list? Or, is it that Formal and Informal Interactions on Campus, in particular with institutional agents, happened too infrequently to be an important factor in participants’ decisions to transfer to their current 4-year institution? Given that some students may need to rely more heavily on institutional agents to help them navigate the transfer process (e.g., Hispanic/Latino students, first generation students and vertical transfer students) (Mobley et al., 2013), this finding is a critical area that warrants further investigation.
6.0 Implications

6.1 Implications for Research

Results from this study offer a number of implications for future research. First, our findings on engineering transfer students’ reasons for starting their educations at other institutions and factors that influenced decisions to transfer to their current institutions extend prior community college research on STEM transfer students as well as transfer students more generally by investigating differences across subgroups of students and types of institutions. This study also adds new information to the body of literature specific to engineering transfer students. For example, we show that institutional prestige (i.e., academic reputation, rankings) is an important factor influencing certain subpopulations of engineering transfer students’ decisions on where to transfer. Future research on postsecondary pathway decisions for transfer students in engineering should account for institutional prestige and college rankings as potential influencers of decisions.

Contrary to prior qualitative studies that report on the important role of institutional agents in helping students with limited social or cultural capital navigate transfer processes and more fully exercise postsecondary pathway options (Bensimon & Dowd, 2009; Packard et al., 2011; Reyes, 2011; Stanton-Salazar et al., 2010), our quantitative study suggests lesser influence of such institutional agents relative to other factors. As we noted in Section 5.3, we are unable to make a strong claim about whether those individuals are simply not important or effective or whether students had infrequent interactions with such agents. Additional research is needed before we can fully answer these questions.

Finally, our findings demonstrate the nuances that exist between subgroups of engineering transfer students (i.e., transfer students at open enrollment institutions versus more selective institutions, vertical versus lateral transfer students, Hispanic/Latino versus non-Hispanic/Latino students, first generation versus non-first generation students). We provide evidence to illustrate the importance of disaggregating data during research analyses, especially if we hope to further our understanding of similarities and differences for groups historically underrepresented in STEM disciplines (Lichtenstein et al., 2014; Ro & Knight, 2016; Ro et al., 2016). Based on our findings, future research on engineering transfer students should
seek to account for such differences, at a minimum, as opposed to considering “transfer students” as a single block of students who share similar experiences.

6.2 Implications for Policy and Practice

Our study also has multiple implications for policy and practice, especially for higher education leaders who seek to leverage the human capital that resides in 2-year public colleges to meet our nation’s increasing need for innovative, skilled workers in STEM disciplines. First, reliance on institutional prestige as the primary mechanism to attract prospective transfer students may resonate with only a subset of potential recruits. In our study, non-Hispanic/Latino students, non-first generation college students, and students enrolled at more selective institutions reported higher levels of importance on institutional prestige than their counterparts. This finding suggests that factors beyond institutional prestige may be more important when deciding where to transfer for Hispanic/Latino students, first generation college students, and students at open enrollment institutions. To tap into the broader base of human talent, institutions of higher education must think about marketing and branding that goes beyond promotion of academic rankings. Based on findings from this study, new messaging should speak to affordability and academic flexibility. Increased institutional funding to support need-based scholarships earmarked for engineering transfer students would be invaluable and critical to leveraging talent from 2-year public institutions.

For Hispanic/Latino students and first generation college students, both of which are over-represented in 2-year institutions, Financial/Affordability reasons surfaced as a primary driver for postsecondary pathway decisions. To better meet the needs of prospective engineering transfer students, the 2-year to 4-year pathway must be cost effective, and prior research indicates that this is not the case. Students are losing time because of inadequate advising, poorly aligned curriculum, and limited course offerings (Packard et al., 2012); losing time is costly (Dowd, 2012), especially for students who are already concerned about affordability (Packard et al., 2011). Moreover, students entering the 2-year college pathway en route to a bachelor’s degree severely underestimate their time to degree (Knight et al., 2014). Blash et al. (2012a) found that total time to degree completion in engineering was on average 6.5 years for transfer students in their sample, and Cataldi et al. (2011) found that bachelor’s
degree recipients who started their postsecondary educations in public 2-year institutions borrowed more money to pay for college than those who started at public 4-year institutions. Improved advising, better aligned curriculum, and access to institutional agents who serve as funds of knowledge on transfer hold great potential to curb cost and improve time to degree completion for transfer students in engineering.

In addition to Financial/Affordability reasons, participants in our study cited “convenience and location,” Non-Academic Commitments, and Academic Flexibility as additional reasons and factors that influenced their postsecondary pathway decisions. Given the shift in demographics for students enrolling in postsecondary education, administrators, faculty, and staff can expect to see an increasing number of students seeking, demanding, and demonstrating a need for Academic Flexibility. Institutions of higher education must be creative and find ways to meet these needs by offering work-arounds, especially for engineering transfer students with Non-Academic Commitments or other environmental pull factors that require them to select a 4-year institution based on Academic Flexibility, convenience and/or location. Directly addressing each of the aforementioned areas of student concern (e.g., “convenience and location,” Non-Academic Commitments, Academic Flexibility), the Engineering Academy at Texas A&M University is a promising model that is breaking down location barriers to attract and meet the needs of prospective engineering students (Cortez et al., 2015; Perez et al., 2016). The Engineering Academy model allows students to co-enroll in the College of Engineering at Texas A&M University and a partner 2-year institution located in one of five different regions across the State; students remain co-enrolled for one to two years before relocating to the main campus in College Station to complete their baccalaureate degree in engineering. Academy students take their “math, science and core curriculum courses through the 2-year institution, while taking engineering courses from Texas A&M faculty on the 2-year campus” (Texas A&M College of Engineering, 2017). This innovative approach opens and clears the transfer pathway to an engineering degree at a highly ranked, selective, flagship institution in the state, which holds important equity implications especially for students from groups historically underrepresented in higher education and in engineering disciplines.
7.0 Conclusions

In this study on engineering transfer students, we identified: 1) five emergent constructs for reasons why participants started at another institution, and 2) four emergent constructs for factors that influenced participants’ decisions to transfer to their current 4-year institutions. Financial/Affordability, Non-Academic Commitments, and Academic Flexibility surfaced among the top reasons for starting postsecondary education at a different institution. Top factors in students’ decisions to transfer to their current 4-year institutions, included: Institutional Prestige, “convenience and location”, Financial/Affordability, and Ease of Transfer.

In our comparison of subgroups of engineering transfer students, we identified multiple cases where mean responses were different. Among those most notable, we found that students from open enrollment institutions, vertical transfer students, Hispanic/Latino students, and first generation college students all reported statistically significantly higher levels of importance than their counterparts for the following: 1) reasons - Financial/Affordability, Non-Academic Commitments, Academic Flexibility; and 2) factors – “convenience and location,” Financial/Affordability.

We also identified multiple interaction effects between subgroups of transfer students. These findings suggest that both Hispanic/Latino students and first generation college students on the vertical transfer pathway in particular are making postsecondary pathway decisions with increased levels of concern around affordability and financial limitations; this finding was even more acute for Hispanic/Latino students who transferred to the open enrollment institutions in our study. To tap into the broader base of human capital that resides in 2-year public colleges as a means to bolster STEM talent in the U.S. workforce, institutions of higher education must think about marketing and branding that that goes beyond promotion of academic rankings to embrace new messaging and practices that address affordability and academic flexibility.

Findings on why engineering transfer students begin their postsecondary educations elsewhere can be used to inform policy and align practice so that our systems of higher education can better meet the needs of a growing and increasingly diverse body of students. In addition, schools of engineering interested in boosting enrollment can use our findings related to factors that influenced engineering transfer students’ decisions to transfer to their current
institution to better position themselves to appeal to and capture a larger and more diverse market of engineering transfer students in the future.
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DIS未成年人革教育研究


Chapter 5: Manuscript #3

Problems, Perceptions, and Adjustments: Understanding the Transition Experience for Engineering Transfer Students at 4-Year Institutions

Abstract

Background Amidst national rhetoric of state disinvestment in public higher education, performance based funding models, institutional productivity, and amassing student loan debt, leveraging transfer pathways between institutions of higher education is a topic that continues to garner increased interest from multiple stakeholders of higher education.

Purpose This manuscript increases understanding of the transition experience for engineering transfer students at 4-year institutions.

Design/Method This study draws on survey data from a larger mixed-methods research project on transfer students in engineering. In this paper, we explore student responses to questions about their post-transfer transition processes - specifically problems, perceptions, and support during their adjustment to the receiving institution. We identify emergent constructs and explore differences across subgroups of transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation).

Results Cost of attendance, the transfer credit process, and high academic expectation surfaced as the top three problems for engineering transfer students during their transitions to their receiving institutions. While perceptions of their receiving institution were generally positive, engineering transfer students experienced a variety of challenges during the adjustment period.

Conclusions There are opportunities to further enhance transfer receptivity on campuses of 4-yr institutions. Receiving institutions should consider: 1) seeking solutions that jointly address engineering transfer students’ perceived challenges with the transfer credit process and cost of attendance; 2) employing strategic partnerships and focused efforts to address engineering transfer students’ perceived challenges with meeting high academic expectations and navigating academic transition; and 3) placing more emphasis on programs, services, and networks that fast-track academic integration.

Keywords transfer pathways in engineering, integration, transfer receptivity, post-transfer transition processes
Problems, Perceptions, and Adjustments: Understanding the Transition Experience for Engineering Transfer Students at 4-Year Institutions

1.0 Introduction

The rising costs of higher education, increased student enrollments in postsecondary education institutions, and frequency of student movement across two or more postsecondary institutions all surface in national conversations around the critical need to bolster transfer pathways in higher education. In 2015, the National Student Clearinghouse Research Center released its second report on Transfer and Mobility, which shed light on the complexity of enrollment patterns and student movement between institutions of higher education. The report provided evidence to support claims that student movement across two or more postsecondary institutions is the new normal (Marling, 2013; Shapiro et al., 2015).

Amidst national rhetoric of state disinvestment in public higher education, performance based funding models, institutional productivity, and amassing student loan debt, leveraging transfer pathways for higher education continues to garner increased interest from multiple stakeholders of higher education – students, policy makers, administrators, and citizens whose taxes help subsidize public higher education. Elected officials seek to maximize output and outcomes from state and federal investments in public higher education; and, since the turn of the twenty-first century, state and federal governments have placed increasing emphasis on the need to improve productivity in the higher education (Branch, 2013). In 2010, the National Governors Association launched the Complete to Compete campaign, which called for: 1) a revamp of higher education accountability systems across the nation; 2) state leaders to focus on broad questions related to increasing attainment, productivity, and meeting workforce needs; and 3) campus leaders to focus on increasing success rates, course completion, and reducing time to degree (Reindl & Reyna, 2011). Streamlined pathways to the workforce, institutional productivity, and student success continue to be top policy issues in higher education in 2017 (Harnisch & Opalich, 2017).

Our study on engineering transfer students is timely and relevant to this national dialogue for institutions of higher education. Over the last two to three decades, recruitment and retention efforts to meet workforce demands and broaden participation in colleges of
engineering across the country have focused primarily on catering to the needs of first-year, traditional age college students who matriculate directly from high school into 4-year institutions (Lichtenstein et al., 2014; Lord & Chen, 2014; Riley et al., 2014). While these efforts have moved the needle on enrollment and retention for undergraduate students in engineering, growth and improvement measures have started to taper in recent years (Lichtenstein et al., 2014). To meet current and future workforce demands for more STEM professionals, we must be creative about how to move beyond this ceiling effect; and, great potential exists among the growing population of students who begin their pursuit of a higher education within the community college system (Dowd, 2012; Terenzini et al., 2014; Wang, 2013a) and move between institutions of higher education.

This study is part of a larger investigation focused on transfer pathways to engineering degrees. Using an adapted version of Laanan’s Transfer Student Capital framework as a guide for data collection (Ogilvie et al., 2015, 2016, 2017), our research seeks to increase understanding of engineering transfer students and their experiences at both sending and receiving institutions. In this particular paper, we focus attention on engineering transfer students’ reflective reports of problems encountered during the post-transfer transition process and their perceptions of the adjustment process at their receiving 4-year institutions. More specifically, we explore the following research questions:

1. What constructs emerge when engineering transfer students are asked about their transitions to engineering programs at 4-year institutions?
2. What are the differences across subgroups of engineering transfer students (i.e., open enrollment vs. more selective admission requirements, vertical vs. lateral pathway, student status as Hispanic/Latino, student status as first generation college students)?

This study brings to light engineering transfer students’ perspectives on problems encountered during the post-transfer transition process. Research findings enable administrators, faculty members, and staff at sending and receiving institutions to key in on aspects of transfer that may require additional attention. Furthermore, findings from this study can help stakeholders at receiving institutions design or customize programs and services to address pressing needs.
and further enhance engineering transfer students’ success by advancing them toward timely degree completion at their new institutions.

2.0 Literature Review and Theoretical Underpinnings

Investigators have used a range of research designs to study transfer students’ transitions to 4-year institutions and their outcomes over the past 50 years (Bahr et al., 2013). Moreover, they have explored the topic from multiple perspectives, including: student characteristics (Melguizo & Dowd, 2006), institutional characteristics (Dowd & Cheslock, 2006), academic performance (Cejda, 1997; Diaz, 1992; Hills, 1965), degree attainment (Adelman, 2006; Cabrera, Burkum, LaNasa, & Bibo, 2012; Cejda, Rewey, & Kaylor, 1998), and time to degree completion (Adelman, 2005). However, there is widespread consensus that Hill’s (1965) concept of transfer shock tends to dominate the literature (Bahr et al., 2013; Berger & Malaney, 2003; Laanan et al., 2010b; Reyes, 2011; Townsend & Wilson, 2006).

Many of these studies on transfer shock find that vertical transfer students (i.e., students who transfer from 2-year to 4-year institutions) experience a drop in grade point average (GPA) after transfer – a phenomenon commonly referenced in the literature as “transfer shock”. However, a meta-analysis by Diaz (1992) revealed that these decreases in GPAs for transfer students were on the magnitude of .50 or less, and a majority of vertical transfer students “recovered from transfer shock, usually within one year after transfer” (p. 279). Hence, researchers have attempted to move the conversation beyond transfer shock. For example, Berger and Malaney (2003) explored transfer student adjustment and persistence at 4-year institutions using measures of student satisfaction and academic performance. Striving for a more holistic assessment, Laanan and colleagues have focused on developing new measures to assess transfer student adjustment in three critical areas – academic, social, and psychological (Jackson, 2010; Laanan, 2007; Laanan et al., 2010b).

Also aimed at moving the conversation beyond transfer shock, scholars have called for a shift in research focus from an agenda primarily focused on investigating transfer student outcomes to one that also includes studies designed to increase understanding of post-transfer processes – answering the how and why questions that are relevant to transfer student
persistence and degree attainment (Bahr, 2013). Other recent studies have explored transfer students’ experiences with transfer stigma (Alexander et al., 2008) and with transitioning to new institutions in general (Flaga, 2006; Owens, 2010), to research institutions (Townsend, 2008; Townsend & Wilson, 2006, 2009), and to highly elite institutions (Wolf-Wendel et al., 2004). However, researchers describe this existing body of literature that is focused on student experiences’ with post-transfer transition processes as “sporadic and unsystematic” (Bahr et al., 2013, p. 461). To help organize prior research, Bahr et al. (2013) identified, defined, operationalized, and synthesized findings around five concepts that most frequently emerge in the literature, including integration, involvement, capital, transfer receptivity, and environmental pull.

The importance of each of those concepts is well-articulated in different theoretical frameworks used within the higher education literature. To understand transfer students’ experiences with transition processes at their receiving institutions and to explain why some students persist and others do not, researchers often draw on theories of student integration (Tinto, 1993) and student involvement (Astin, 1984) for guidance (Berger & Malaney, 2003; Owens, 2010; Townsend, 2008; Townsend & Wilson, 2006, 2009). Theories of capital (Bourdieu, 1986; Coleman, 1988; Laanan et al., 2010b; Lin, 2001) have also proven to be useful for understanding and explaining differences in how transfer students navigate and experience the adjustment process at receiving institutions (Laanan et al., 2010b; Packard et al., 2011; Reyes, 2011; Wolf-Wendel et al., 2004). In the following sections, we: 1) highlight salient findings from studies that have applied these conceptual frameworks to explore transfer students’ experiences, and 2) describe calls for research that can push the field beyond this existing literature base.

2.1 Integration

Tinto’s (1993) theory of integration draws attention to the relationship between students’ perception of fit – academically and socially – within the institution and their subsequent persistence. Moreover, his theory added academic and social integration to a list of other factors that have the potential to influence student retention, such as student
characteristics, goals, and commitments. Guided by Tinto’s theory of integration, multiple studies have been designed to explore and identify factors that contribute to or hinder transfer students’ academic and social integration at large, public universities (Owens, 2010; Townsend & Wilson, 2006, 2009). Townsend and Wilson (2006) found that certain institutional characteristics (e.g., size of institution, research focused mission, classes held in large lecture halls, student body primarily full-time traditional age college students) can serve as hindrances to transfer student integration in terms of their perception of fit academically and socially. They also found that the integration needs of transfer students were slightly different than the needs of traditional college students who reside on campus and matriculate directly from high school to 4-year institutions. Although traditional students desired both social and academic integration, transfer students tend to prioritize academic integration over social integration. Finally, both Owens (2010) and Townsend (2008) advocated that future research on the integration of transfer students should explore differences for minority groups and the type of pathway (i.e., lateral transfer students compared to vertical transfer students). This paper directly addresses those calls for additional research on this student population.

2.2 Involvement

Astin’s (1984) student involvement theory keys in on student effort and links the quantity and quality of these efforts to students’ outcomes and learning. Student involvement can take on many forms including time and energy dedicated to studying, time on campus, interaction with faculty and peers, and involvement in student organizations. Pascarella and Terenzini (2005) concurred with Astin (1984) and highlighted the important roles that institutions play in establishing campus climates that foster student involvement. Studies informed by Astin’s theory of involvement have focused on measuring and comparing the quantity and quality of transfer students’ actions dedicated to studying, participating in student organizations and other extra-curricular activities, as well as interacting with faculty, academic advising staff, and peers at both the sending and receiving institutions (Berger & Malaney, 2003; Laanan, 2007). Berger and Malaney (2003) explored relationships between measures of transfer student involvement at both the community college and university with academic
performance and satisfaction with the university. In their regression analysis, they found that transfer students who reported higher levels of engagement with their university peers were more likely to report higher levels of satisfaction with the university but less likely to have a higher university GPA. Relationships between performance and satisfaction with other measures of student involvement (e.g., studying and homework, clubs and activities) were not statistically significant. Given the relationship between involvement and student persistence, this study explores engineering transfer students’ post-transfer adjustment processes with questions designed to capture participants’ perceived levels of involvement at the receiving institutions.

2.3 Capital

Informed by Bourdieu’s (1986) theories of cultural capital and social capital, some researchers have designed studies to explore how transfer students’ socioeconomic status (e.g., first generation college student) relates to differences in their educational experiences and outcomes (Mobley et al., 2013; Packard et al., 2011; Reyes, 2011; Wolf-Wendel et al., 2004). Prior research indicates that transfer students draw on multiple forms of capital to navigate post-transfer transition processes; this reality could disadvantage some students more than others because of variations in the accumulation of cultural, social, and transfer student capital (Mobley et al., 2013). Moreover, institutional agents (e.g., faculty members, academic advisors, peer mentors) with access to information and resources that facilitate student integration and involvement can play a significant role in easing the transition process for transfer students with limited or varying levels of capital (Packard et al., 2011; Reyes, 2011).

Inspired by these early forms of capital, Laanan et al. (2010b) developed and advanced the idea of a much more specific type of “transfer student capital”—defined as an accumulation of knowledge about higher education that develops in a student as he or she interacts with faculty, receives academic advising and counseling, studies in courses, navigates through university transfer policies to fulfill academic requirements, and proceeds through the transfer process from a 2-year institution to a 4-year institution. Laanan et al. (2010b) posited that transfer student capital (TSC) could be harnessed to influence transfer students’ adjustments to
their receiving institutions. Students with higher levels of TSC help transfer students navigate post-transfer transition processes with greater ease and more success. This study explores the role of social capital in engineering transfer students’ perceptions of the adjustment process at their receiving institutions.

2.4 Transfer Receptivity

The concept of transfer receptivity describes the culture at four-year institutions with respect to the institutions’ commitment to fostering a campus climate and designing policies and programs that facilitate transfer student integration and involvement. Studies focused on transfer receptivity have explored transfer students’ perceptions of and experiences with transfer stigma at their receiving institutions (Alexander et al., 2008; Reyes, 2011; Townsend, 2008). Other studies have explored transfer students’ perceptions of and experiences with programs and services offered at their receiving institutions to assist them with the post-transfer transition process (Mobley & Brawner, 2013; Ogilvie & Knight, 2016; Owens, 2010; Packard et al., 2011; Townsend & Wilson, 2006). Townsend and Wilson (2006) found that transfer students often wanted more help from receiving institutions than was offered, especially during the early weeks of the transition period. In this study, we explore engineering transfer students’ perceptions of transfer receptivity at their new receiving institutions during their post-transfer transition processes.

2.5 Environmental Pull

The concept of environmental pull is a term used to describe external factors and competing demands that detract students from pursuing their academic related goals or commitments. Multiple studies have explored and identified pull factors that affect transfer students (Owens, 2010; Reyes, 2011; Townsend & Wilson, 2006, 2009; Wolf-Wendel et al., 2004). Findings from these studies indicate that environmental pull (e.g., financial concerns, need to work while going to school, living/working off-campus, family responsibilities) can impede transfer students’ integration (their perceptions of fit) and involvement (their quality and quantity of effort). In this study, we explore how environmental pull impacts subgroups of
engineering transfer students during their post-transfer transition processes at receiving institutions.

2.6 Summary of How to Extend the Literature Base

In the *Higher Education: Handbook of Theory and Research*, Bahr et al. (2013) provided an in-depth summary and critique of prior research that focuses on post-transfer transition processes for community college students who transfer to four-year institutions. To advance understanding of transfer students’ experiences with post-transfer transition processes, these scholars contend that future studies should include research designs that: 1) are multi-institutional; 2) longitudinal; 3) discipline specific; and 4) disaggregate and explore data by sub-populations (e.g., socioeconomic status, race/ethnicity, transfer pathway) (Bahr et al., 2013).

Our multi-institutional study on engineering transfer students and their experiences with post-transfer transition processes responds directly to three of these four recommendations for future work. Informed by theories and findings presented in this review of the literature, we further explore the relevance of integration, involvement, capital, transfer receptivity, and environmental pull to transfer students in an engineering specific context. Based on site selection and available sample size, findings from our study expand the existing body of literature by contributing new knowledge on similarities and differences between subgroups of transfer students.
3.0 Methods

3.1 Data Source and Sample

Data for this study were drawn from a mixed methods research project focused on increasing understanding of transfer pathways to baccalaureate degrees in engineering (NSF EEC - 1428502) (Ogilvie et al., 2015, 2016, 2017). Study sites include four large, public research universities (20,000-50,000 students on each campus) in Texas; these institutions are nationally recognized for each ranking among the top 10 producers of Hispanic engineers. The institutional sample represents a balanced mix of Hispanic Serving Institutions (HSIs) and Predominantly White Institutions (PWIs), as well as institutions with open enrollment policies and those with more selective admissions requirements.

Data were collected using a cross-sectional survey that was administered across the four study sites during the summer and fall of 2015. The population for the study included 7,608 current and former students (includes alumni and students no longer enrolled) who transferred to one of the four 4-year institutions as new engineering students between 2007 and 2014. Research partners from each institution who had access to institutional records for students and alumni retrieved valid email addresses for 97% of the population; these individuals were invited by email to participate and complete the web-based survey for the study. We received 1,102 responses to our call for participants (with 1,070 useable responses), which equates to a 15% response rate, consistent with other web-based research surveys. To address systematic bias that may have been introduced by nonresponses, survey response data were weighted by institutional response rate, gender, and race/ethnicity to ensure that the sample data set would be representative of the engineering transfer student population at each of the four study sites (Krathwohl, 2009). Table 1 provides a summary of demographic data for participants in the study.

To address the issue of missing data from respondents, we followed social science research norms and used multiple imputation methods (Cox et al., 2014; Graham, 2009; Rubin, 1996; Schafer, 1999). The total amount of missing data values for the full data set was 16%; data were missing at random, primarily due to item non-response. Under the traditional listwise deletion method, 82% of the 1070 participants in the sample would have been available
for analysis. Weights for institution response rate, gender, and race/ethnicity were applied during the imputation process and all variables were included in the analysis. The multiple imputation command in IBM SPSS Statistics 24 was used to generate five imputed datasets. With the exception of the subsequently described exploratory factor analysis and the 2-way ANOVAs, Rubin’s rules (Rubin, 2004) were used to pool analyses run on each dataset. The following notation is used to report an overall summary of results from the 2-way ANOVAs: [1 of 5] indicates that we identified statistically significant interaction effects in 1 of the 5 imputed datasets, [2 of 5] indicates that we identified statistically significant interaction effects in 2 of the 5 imputed datasets, and so on up to [5 of 5].
Table 1. Demographic data for participants - engineering transfer student sample.

<table>
<thead>
<tr>
<th></th>
<th>Total (N=1070)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Status</strong></td>
<td></td>
</tr>
<tr>
<td>Current Student</td>
<td>54%</td>
</tr>
<tr>
<td>Alumni</td>
<td>42%</td>
</tr>
<tr>
<td>No Longer Enrolled</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Institution Type</strong></td>
<td></td>
</tr>
<tr>
<td>Attended Institution with Selective Enrollment Policies</td>
<td>71%</td>
</tr>
<tr>
<td>Attended Institution with Open Enrollment Policies</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Type of Transfer</strong></td>
<td></td>
</tr>
<tr>
<td>Vertical Transfer</td>
<td>56%</td>
</tr>
<tr>
<td>Lateral Transfer</td>
<td>40%</td>
</tr>
<tr>
<td>Co-enrollment Program</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>80%</td>
</tr>
<tr>
<td>Female</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0.3%</td>
</tr>
<tr>
<td>Asian</td>
<td>11%</td>
</tr>
<tr>
<td>Black or African American</td>
<td>3%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>40%</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>0.3%</td>
</tr>
<tr>
<td>White</td>
<td>41%</td>
</tr>
<tr>
<td>2 or more races</td>
<td>2%</td>
</tr>
<tr>
<td>Foreign or International</td>
<td>3%</td>
</tr>
<tr>
<td>Prefer not to answer/Not applicable/Unknown</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Parent Education Status</strong></td>
<td></td>
</tr>
<tr>
<td>Earned Bachelors Degree or Higher</td>
<td>53%</td>
</tr>
<tr>
<td>Some College</td>
<td>14%</td>
</tr>
<tr>
<td>High School Graduate or Below</td>
<td>14%</td>
</tr>
<tr>
<td>Not reported</td>
<td>18%</td>
</tr>
</tbody>
</table>

3.2 Measures

3.2.1 Instrument. Data were collected using the Engineering Transfer Student Survey, an instrument developed for the research project funded by NSF (NSF EEC - 1428502) (Ogilvie et al., 2015, 2016, 2017). The survey is an adaptation of the Laanan Transfer Students’ Questionnaire (L-TSQ) (Laanan, 2004, 2007; Moser, 2012) with the addition of survey items extracted from the following multi-institutional research studies that investigated transfer students’ experiences in engineering or STEM more broadly: Prototype to Production: P2P
(Terenzini et al., 2014) and Measuring Constructs of STEM Student Success Literacy: Community College Students’ Self-Efficacy, Social Capital, and Transfer Knowledge (Johnson et al., 2012; Myers et al., 2012). These instruments were identified during our review of the literature for surveys, vetted in peer-reviewed literature, and pertinent to transfer students in STEM.

The Engineering Transfer Student Survey includes a combination of multiple choice and open-ended questions that capture information from students and alumni in six primary areas: 1) personal background data; 2) enrollment status and transfer pathway; 3) experience with the transfer process; 4) experience at sending institution; 5) experience at receiving institution; and 6) comparison of experiences at each institution (see Ogilvie et al. (2015) for a fuller description of the instrument). The 45-question survey requires 15 to 25 minutes to complete, as multiple survey items are embedded within 16 of the 45 questions.

To address construct validity (Shadish et al., 2002), the Engineering Transfer Student Survey was developed using input and feedback from content experts on the project advisory board as well as administrators, faculty members, and staff from the participating 4-year institutions and their local partner 2-year institutions. During survey development, the full project team provided feedback on a draft of the survey instrument via conference calls and written comments. Based on this initial round of feedback, the Engineering Transfer Student survey was revised, customized for each institution, and thoroughly vetted with representatives from each institution in another round of revisions. Prior to launching the study, we pilot tested the survey instrument with several individuals who were similar to the target population.

**3.2.2 Variables.** Dependent variables for this study were drawn from participants’ responses to three survey items from the “experience at receiving institution” section of the survey; each item included multiple sub-items (see Table 2). Using a 4-point scale to capture level of problem, the first survey item asked participants to rate the extent to which they experienced problems with 11 experiences that participants may have encountered during post-transfer transition processes at receiving institutions. Using a 5-point Likert-type scale to capture level of agreement, the second survey item asked participants to rate 16 statements related to their perceptions of the receiving institutions. Using the same scale for level of agreement, the third item asked participants to rate 18 statements on their perceptions of the
adjustment process and social support at the receiving institution. Captured on the survey, independent variables included the following: 1) type of institution attended (selective versus open enrollment); 2) type of transfer pathway (lateral versus vertical); 3) student status as Hispanic/Latino; and 4) student status as first generation. The first generation variable was derived from students’ reports of their parents’/guardians’ education levels—when neither parent/guardian earned a Bachelor’s degree (or higher), the student was categorized as first generation. In cases where students did not report their parents’/guardians’ education levels (18% of cases), we used multiple imputation to fill in missing values.
Table 2. Survey Items from Engineering Transfer Student Survey

<table>
<thead>
<tr>
<th>Survey Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much of a problem were the following in your transfer to [RI]?</td>
</tr>
<tr>
<td>a. Long commute or need to relocate</td>
</tr>
<tr>
<td>b. Need to quit job or reduce hours at work</td>
</tr>
<tr>
<td>c. Family obligations</td>
</tr>
<tr>
<td>d. Meeting demands of student life (i.e., study time) while living at home with family or other relatives</td>
</tr>
<tr>
<td>e. My English language skills</td>
</tr>
<tr>
<td>f. Cost of attendance</td>
</tr>
<tr>
<td>g. High academic expectations</td>
</tr>
<tr>
<td>h. The transfer credit process</td>
</tr>
<tr>
<td>i. Large size of engineering school</td>
</tr>
<tr>
<td>j. Unsure if the faculty, staff, or students will make me feel welcome</td>
</tr>
<tr>
<td>k. Students compete rather than help one another</td>
</tr>
</tbody>
</table>

**Scale:** 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem

**General Perceptions of [RI]:** Please indicate the extent to which you agree or disagree.        |
| a. When I started, it was difficult learning how things work on campus.                                 |
| b. Because I am a “transfer student”, most students tend to underestimate my abilities.                   |
| c. Because I am a “transfer student”, most faculty tend to underestimate my abilities.                   |
| d. Because I am a “transfer student”, most teaching assistants tend to underestimate my abilities.       |
| e. There is a stigma on campus against students who start at another institution or community college.   |
| f. Generally, students are more concerned about “getting the grade” instead of learning the material.   |
| g. Most students are treated like a "number."                                                            |
| h. Student services are responsive to student needs.                                                      |
| i. If students expect to benefit from what [RI] has to offer, they have to take the initiative.         |
| j. Once at [RI], I had access to scholarships to assist me in paying for my college education.          |
| k. Once at [RI], I had access to grants and loans to assist me in paying for my college education.      |
| l. The amount of financial aid that I receive at [RI] is adequate.                                       |
| m. The courses I have taken at [RI] are interesting and worthwhile.                                      |
| n. [RI] is an intellectually stimulating place to be.                                                     |
| o. I would recommend to other transfer students to go to [RI].                                           |
| p. If I could start over again, I still would go to [RI].                                               |

**Scale:** 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree

**Adjustment process & social support at [RI]:** Please indicate the extent to which you agree or disagree. |
| a. Adjusting to the academic standards or expectations at [RI] has been easy.                           |
| b. I experienced a drop in grades (GPA) during my first semester at [RI].                              |
| c. Adjusting to the social environment at [RI] has been easy.                                           |
| d. Upon transferring I felt alienated at [RI].                                                         |
| e. I have a lot in common with the other students in my classes at [RI].                               |
| f. I feel more comfortable spending time with friends that I made at the previous college I attended. |
| g. I feel more comfortable making friends with transfer students than non-transfer students.           |
| h. It is easy to make friends at [RI].                                                                |
| i. I am meeting as many people and making as many friends as I want at [RI].                           |
3.3 Analytical Procedures

We employed multiple steps to analyze survey response data. First, we explored participants’ responses using descriptive statistics (note: standard error of the mean is reported in place of standard deviation because we were working across a collection of five imputed datasets (Wayman, 2003)).

Since the Engineering Transfer Student Survey is a revised adaption and compilation of three existing surveys, we ran exploratory factor analysis (EFA) on survey response data and calculated Cronbach’s coefficient alpha to measure internal consistency and establish reliability for emergent constructs (Allen et al., 2008; Cortina, 1993; Nunnally & Bernstein, 1994; Streiner, 2003). To address research question one (what constructs emerge), we conducted separate EFA’s for each of the three survey items. This decision was made for two reasons. First, the scales were different across survey items (one used a 4-point scale, and two used a 5-point scale). Second, despite all focusing on students’ post-transfer transition processes, each survey item focused on a different aspect of those experiences. One item focused on students’ perceptions of problems, another focused on students’ perceptions of the receiving institution, and the third focused on students’ perceptions of adjustment processes and social supports offered at their receiving institutions. Thus, we preferred to run separate exploratory factor analyses on each item to determine if constructs emerged within these overarching experiences.

We used maximum likelihood EFA (Thurstone, 1947; Yong & Pearce, 2013); the method of extraction was principle axis factoring using Direct Oblimin – an oblique rotation technique (Fabrigar et al., 1999; Yong & Pearce, 2013). We used an iterative approach which also included
professional judgement to determine the number of factors to extract (Kaiser, 1970). In the first iteration, the number of factors extracted was based on the criterion that the minimum eigenvalue would be equal to one. Output from the first iteration (i.e., taking into account the scree plot and total variance explained) served as a guide for subsequent iterations, where the number of factors extracted was based on a pre-set number defined by the researcher.

As we explored the number of factors to extract, we calculated Cronbach’s coefficient alpha (α) to measure internal consistency of the emerging constructs (Allen et al., 2008; Cortina, 1993; Nunnally & Bernstein, 1994; Streiner, 2003). Since we were conducting exploratory factor analysis and not confirmatory factor analysis, we adopted α = 0.60 as a minimum threshold to establish reliability (Costello & Osborne, 2005; Tabachnick & Fidell, 2013). Once we arrived at a number of factors that met our analytical and conceptual requirements (i.e., α > .60 for emergent constructs; groupings of sub-items that were conceptually logical), we calculated new scales for each construct by summing participants’ responses to sub-items that loaded together and then dividing that sum by the number of sub-items comprising the construct (Armor, 1973).

To address the second research question (differences across subgroups), we used multiple methods to explore differences between subgroups of engineering transfer students. Given that a single measure of central tendency can mask underlying activity in a dataset, we first present frequency data to explore the tails of the data distribution for each dependent variable and disaggregated the data by the four subgroups within the sample: 1) type of institution (open enrollment versus more selective); 2) type of pathway (vertical versus lateral); 3) student status as Hispanic/Latino; and 4) student status as first generation college student. This approach allowed us to explore sub-items and identify trends where particular subgroups of transfer students reported disproportionally higher levels of concern that potentially could have been masked by analyses of mean values. Second, for each construct and independent sub-item that did not load onto a construct, we ran separate independent samples t-tests to explore differences in mean responses across each of the subgroup comparisons. For each construct and/or independent sub-item where we identified statistically significant differences in means for two or more subgroups (i.e., type of institution, type of pathway, student status as...
Hispanic/Latino, student status as first generation college student), we ran 2-way ANOVAs to explore interaction effects between the independent variables.

### 3.4 Limitations of the Study

Although web-based surveys are a fast and economical approach to collect large amounts of data from sizeable target populations that reside in geographically diverse locations, they also present limitations to this study. Multiple limitations of this study stem from the decision to use a web-based survey to collect data from participants. For example, we relied on participants’ individual interpretations of each survey question and their ability to recall information, accurately report on their lived experiences, and resist social desirability bias. To minimize issues in this area, we employed practices and recommendations cited in the literature on survey research (Singleton & Straits, 2010) including the following: 1) we employed closed-ended survey items to aid memory recall; 2) we used proxy IDs so that participants could respond to the survey and remain anonymous; 3) we invited content experts to vet the survey instrument for construct validity; and 4) we pilot tested the survey instrument with several individuals similar to the target population prior to launching the study.

Additional limitations emerge from the quantitative nature of this study and the use of closed-ended survey items to explore engineering transfer students’ perceptions of and experiences with post-transfer transition processes at receiving institutions. While these items were informed by the literature, vetted by university administrators and staff with first-hand working knowledge of engineering transfer students, and used in prior studies of transfer students, it is possible that participants could identify additional factors or experiences that impacted their post-transfer transitions at receiving institutions not included within the set of items. To minimize issues in this area, we added several open-ended survey items that invited participants to reflect on their post-transfer experiences and identify factors that facilitated their adjustments to the receiving institutions. Analysis of these open-ended responses is outside the scope of this particular article.

The low percentage of responses (4%) received from students no longer enrolled at one of the study sites (i.e., students who withdrew or stopped out before earning a baccalaureate
degree) could be viewed as another limitation, especially given that the focus of this study is to increase understanding of engineering transfer students’ experiences with post-transfer transition processes, including both successful and unsuccessful transfers. Thus, these results should be interpreted as reports of the experiences from students who, by and large, either had previously (i.e., alumni) or were experiencing success (i.e., current students) at the time of the survey administration.

Additionally, without careful attention and consideration, coverage error and nonresponse error can introduce bias to survey research (Singleton & Straits, 2010). To minimize coverage error, we retrieved the most up to date email addresses available for 97% of the sample population. To minimize nonresponse error, the survey data collection period remained open from four to six weeks at each site, and multiple reminders were sent by email to prospective participants. Finally, also focused on minimizing systematic errors introduced by nonresponses, we weighted survey response data by institutional response rate, gender, and race/ethnicity to ensure that the sample data set would be representative of the engineering transfer student population at each of the four study sites (Krathwohl, 2009).
4.0 Results and Discussion – Part I

Participants’ Perceptions of Problems during Post-Transfer Transition Processes

4.1 Results for Addressing Research Question 1

Study participants responded to 11 sub-items focused on various aspects of the transfer process and asked to rate how problematic each item was for them as they transitioned to their new receiving institutions. Response means and standard errors of the means for each of the 11 sub-items are shown in Table 3.

Following an exploratory factor analysis of those 11 sub-items, two constructs emerged: 1) Competing Personal Demands ($\alpha = .77$); and 2) Integration into Community ($\alpha = .73$) (see Table 4). The construct Competing Personal Demands is comprised of sub-items that represent environmental pull – factors that detract students from pursuing their academic plans and goals. The construct Integration into Community is comprised of sub-items focused on institutional characteristics (e.g., size, culture, faculty-staff-student attitudes) that influence students’ perception of fit. Four sub-items from the original list of 11 did not load onto a construct.

Based on means from this sample, aspects of the transfer process that surfaced as most problematic for transfer students as they transitioned to their new receiving institutions included “cost of attendance” followed by “the transfer credit process” and “high academic expectations.” Participants (in aggregate) did not perceive that any of these issues were serious problems; instead, the top three issues were rated somewhere between minor to moderate problems. The constructs for Competing Personal Demands and Integration into Community were not deemed as problematic for participants in aggregate, emerging just below the rating for minor problem. “My English language skills” surfaced as least problematic for study participants as they transitioned to their new receiving institutions.
Table 3. Problems in transfer to [RI]

<table>
<thead>
<tr>
<th>Sub-items</th>
<th>Mean (N = 1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost of attendance</td>
<td>2.28</td>
<td>1.06</td>
</tr>
<tr>
<td>2. The transfer credit process</td>
<td>2.19</td>
<td>1.01</td>
</tr>
<tr>
<td>3. High academic expectations</td>
<td>2.13</td>
<td>1.00</td>
</tr>
<tr>
<td>4. Long commute or need to relocate</td>
<td>1.95</td>
<td>0.98</td>
</tr>
<tr>
<td>5. Meeting demands of student life (i.e. study time) while living at home with family or other relatives</td>
<td>1.82</td>
<td>0.98</td>
</tr>
<tr>
<td>6. Students compete rather than help one another</td>
<td>1.81</td>
<td>0.98</td>
</tr>
<tr>
<td>7. Unsure if the faculty, staff, or students will make me feel welcome</td>
<td>1.78</td>
<td>0.94</td>
</tr>
<tr>
<td>8. Need to quit job or reduce hours at work</td>
<td>1.76</td>
<td>1.00</td>
</tr>
<tr>
<td>9. Large size of engineering school</td>
<td>1.72</td>
<td>0.91</td>
</tr>
<tr>
<td>10. Family obligations</td>
<td>1.68</td>
<td>0.89</td>
</tr>
<tr>
<td>11. My English language skills</td>
<td>1.33</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem
Means are of weighted data.

Table 4. Problems in transfer to [RI]

<table>
<thead>
<tr>
<th>Construct</th>
<th>Sub-items</th>
<th>Mean (N = 1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Cost of attendance</td>
<td>2.28</td>
<td>1.06</td>
</tr>
<tr>
<td>-</td>
<td>The transfer credit process</td>
<td>2.19</td>
<td>1.01</td>
</tr>
<tr>
<td>-</td>
<td>High academic expectations</td>
<td>2.13</td>
<td>1.00</td>
</tr>
<tr>
<td>Competing Personal Demands (α = .77)</td>
<td>Long commute or need to relocate</td>
<td>1.80</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Meeting demands of student life (i.e. study time) while living at home with family or other relatives</td>
<td>1.80</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Need to quit job or reduce hours at work</td>
<td>1.80</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Family obligations</td>
<td>1.80</td>
<td>0.72</td>
</tr>
<tr>
<td>Integration into Community (α = .73)</td>
<td>Students compete rather than help one another</td>
<td>1.77</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>Unsure if the faculty, staff, or students will make me feel welcome</td>
<td>1.77</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>Large size of engineering school</td>
<td>1.77</td>
<td>0.78</td>
</tr>
<tr>
<td>-</td>
<td>My English language skills</td>
<td>1.33</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem
Means are of weighted data.

4.2. Results for Addressing Research Question 2 - Comparing Groups

On average, participants did not rate any of the sub-items or constructs as moderate to serious problems in their transfer to receiving institutions. However, drawing conclusions based solely on aggregate measures can lead to inaccurate generalizations. To avoid this, we employed a three step process to further explore the data and identify differences between
subgroups of engineering transfers (i.e., transfer students at open enrollment institutions versus transfer students at more selective institutions; vertical transfer students versus lateral transfer students; Hispanic/Latino students versus non-Hispanic/Latino students; first generation college students versus non-first generation college students).

First, we explored frequency count data for participants’ responses that fell in the right tail of the data distribution (i.e., sub-items and constructs rated as 3 - moderate problem or 4 - serious problem). Second, we ran independent samples t-tests to compare means and identify statistically significant differences between subgroups of engineering transfer students. Third, in cases where we did find statistically significant differences, we ran 2-way ANOVAs to explore interaction effects across subgroups (e.g., vertical transfer students who were also first generation college students, Hispanic/Latino students at more selective institutions).

4.2.1 Exploring the Right Tail of Data Distributions. Table 5 summarizes percentages of study participants who responded to constructs and individual sub-items with ratings of a 3 or 4 (i.e., moderate or serious problem). High end ratings from all study participants for the construct Integration into Community and the individual sub-item “my English language skills” were fairly representative of high end ratings from subgroups of transfer students (i.e., less than 5% difference). However, this did not hold true for other aspects of the transfer process; we highlight those differences for subgroups of transfer students who were overrepresented or underrepresented in the high end ratings by margins of 5% or more relative to the proportions of all transfer students.

At 48%, a higher percentage of vertical transfer students rated “cost of attendance” as a moderate to serious problem, relative to 41% of all study participants. A lower percentage of lateral transfer students rated “cost of attendance” as a moderate to serious problem (31%); instead, more lateral students expressed concern about “the transfer credit process” (42% compared to 34% for all transfer students combined). A smaller percentage of transfer students at open enrollment institutions (27%) rated “high academic expectations” as a moderate to serious problem, relative to 34% of all study participants. However, a higher percentage of those open enrollment students (13%) rated Competing Personal Demands as a moderate to serious problem, relative to 8% of all study participants.
**DISSENIATION: Transfer Student Pathways to Engineering Degrees**

Table 5. **Problems in transfer to [RI]** – Student responses equal to 3-**Moderate Problem**, 4-**Serious Problem**; reported as a percentage of respective groupings.

<table>
<thead>
<tr>
<th></th>
<th>N=</th>
<th>Total</th>
<th>Selective</th>
<th>Open</th>
<th>Lateral</th>
<th>Vertical</th>
<th>HIS = N</th>
<th>HIS = Y</th>
<th>1st Gen = N</th>
<th>1st Gen = Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
<td>% of</td>
</tr>
<tr>
<td>Cost of attendance</td>
<td>1067</td>
<td>41%</td>
<td>43%</td>
<td>38%</td>
<td>31%</td>
<td>48%</td>
<td>39%</td>
<td>45%</td>
<td>39%</td>
<td>45%</td>
</tr>
<tr>
<td>The transfer credit process</td>
<td></td>
<td>34%</td>
<td>36%</td>
<td>30%</td>
<td>42%</td>
<td>30%</td>
<td>34%</td>
<td>35%</td>
<td>34%</td>
<td>34%</td>
</tr>
<tr>
<td>High academic expectations</td>
<td></td>
<td>34%</td>
<td>38%</td>
<td>27%</td>
<td>32%</td>
<td>35%</td>
<td>36%</td>
<td>32%</td>
<td>33%</td>
<td>37%</td>
</tr>
<tr>
<td>Competing Personal Demands (4 items)</td>
<td></td>
<td>8%</td>
<td>6%</td>
<td>13%</td>
<td>5%</td>
<td>10%</td>
<td>6%</td>
<td>12%</td>
<td>6%</td>
<td>12%</td>
</tr>
<tr>
<td>Integration into Community (3 items)</td>
<td></td>
<td>12%</td>
<td>14%</td>
<td>8%</td>
<td>11%</td>
<td>12%</td>
<td>13%</td>
<td>10%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>My English language skills</td>
<td></td>
<td>6%</td>
<td>6%</td>
<td>7%</td>
<td>7%</td>
<td>6%</td>
<td>5%</td>
<td>8%</td>
<td>6%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Table 6. Comparing means for subgroups: **Problems in transfer to [RI]**

<table>
<thead>
<tr>
<th></th>
<th>SEL</th>
<th>OPN</th>
<th>effect size</th>
<th>LAT</th>
<th>VERT</th>
<th>effect size</th>
<th>Not</th>
<th>HIS</th>
<th>effect size</th>
<th>Not</th>
<th>1st Gen</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of attendance</td>
<td>715</td>
<td>352</td>
<td></td>
<td>403</td>
<td>662</td>
<td></td>
<td>613</td>
<td>454</td>
<td></td>
<td>642</td>
<td>402</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>effect size</td>
<td></td>
<td></td>
<td>effect size</td>
<td></td>
<td></td>
<td>effect size</td>
<td></td>
<td></td>
<td>effect size</td>
</tr>
<tr>
<td>The transfer credit process</td>
<td>2.29</td>
<td>2.26</td>
<td></td>
<td>2.05</td>
<td>2.41</td>
<td>** M 0.34</td>
<td>2.19</td>
<td>2.39</td>
<td>** S -0.18</td>
<td>2.20</td>
<td>2.39</td>
<td>* S -0.18</td>
</tr>
<tr>
<td>High academic expectations</td>
<td>2.24</td>
<td>2.08</td>
<td>* S -0.17</td>
<td>2.39</td>
<td>2.07</td>
<td>** M -0.32</td>
<td>2.22</td>
<td>2.15</td>
<td></td>
<td>2.19</td>
<td>2.17</td>
<td></td>
</tr>
<tr>
<td>Competing Personal Demands (4 items)</td>
<td>2.22</td>
<td>1.97</td>
<td>** M -0.25</td>
<td>2.08</td>
<td>2.17</td>
<td></td>
<td>2.17</td>
<td>2.08</td>
<td></td>
<td>2.10</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td>Integration into Community (3 items)</td>
<td>1.71</td>
<td>1.99</td>
<td>** M 0.39</td>
<td>1.70</td>
<td>1.87</td>
<td>** M 0.23</td>
<td>1.72</td>
<td>1.92</td>
<td>** M -0.28</td>
<td>1.68</td>
<td>2.00</td>
<td>** M -0.47</td>
</tr>
<tr>
<td>My English language skills</td>
<td>1.85</td>
<td>1.60</td>
<td>** M -0.32</td>
<td>1.77</td>
<td>1.77</td>
<td></td>
<td>1.81</td>
<td>1.71</td>
<td>* S 0.13</td>
<td>1.76</td>
<td>1.78</td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem.
Means are of weighted data. ** p-value < .01, * p-value < .05
Effect size (Hedges' g): large ≥ .8; .8 > mid-range > .2; small ≤ .2
4.2.2 Independent Samples t-Tests. In comparing response means, we found statistically significant differences between subgroups for multiple constructs and sub-items. Table 6 summarizes results from the independents samples t-tests.

In comparing response means from participants at open enrollment institutions to those at more selective institutions, we found statistically significant differences for a total of four constructs and sub-items: 1) “the transfer credit process”; 2) “high academic expectations”; 3) Competing Personal Demands; 4) Integration into Community. Effect sizes for these differences were all mid-range, with the exception of the small effect size of differences for “the transfer credit process.” Transfer students at more selective institutions reported statistically significant higher response means (i.e., higher level of problem) for: 1) “the transfer credit process”; 2) “high academic expectations”; and 3) Integration into Community. Transfer students at open enrollment institutions reported significantly higher response means for the construct Competing Personal Demands.

For the vertical versus lateral transfer student comparison, we found statistically significant differences (mid-range effect sizes) in response means for a total of three constructs and sub-items: 1) “cost of attendance”; 2) “the transfer credit process”; and 3) Competing Personal Demands. Vertical transfer students had statistically significant higher means (i.e., higher level of problem) for “cost of attendance” and Competing Personal Demands; lateral transfer students had a higher mean to “the transfer credit process” sub-item.

In comparing response means between Hispanic/Latino students and non-Hispanic/Latino students, we found statistically significant differences for a total of three constructs and sub-items: 1) “cost of attendance”; 2) Competing Personal Demands; and 3) Integration into Community. The effect size for Competing Personal Demands was considered mid-range, and the effect sizes for the other two differences were small. Hispanic/Latino students reported statistically significant higher means (i.e., higher level of problem) for “cost of attendance” and Competing Personal Demands; non-Hispanic/Latino students had higher means for the construct Integration into Community.

Finally, for the comparison of first generation college students to non-first generation college students, we found statistically significant differences in response means for: 1) “cost of...
attendance”; and 2) Competing Personal Demands. Effect sizes were considered small and mid-range, respectively. First generation college students had statistically significant higher means (i.e., higher level of problem) for both “cost of attendance” and Competing Personal Demands.

In summary, we identified statistically significant different response means between subgroups of engineering transfer students for a total of five constructs and sub-items: 1) “cost of attendance”; 2) “the transfer credit process”; 3) “high academic expectations”; 4) Competing Personal Demands; 5) Integration into Community. We did not find any statistically significant differences in response means between subgroups for the sub-item “my English language skills.”

4.2.3 2-way ANOVA Testing Interaction Effects. Looking across multiple subgroups (see Table 6), we identified a total of 4 constructs and sub-items with statistically significant differences for two or more subgroups of engineering transfer students: 1) “cost of attendance”; 2) “transfer credit process”; 3) Competing Personal Demands; 4) Integration into Community. We ran 2-way ANOVAs to explore interaction effects between subgroups for each of these constructs and sub-items. The following paragraphs summarize statistically significant findings from our analyses.

Statistically significant interaction effects for “cost of attendance” were identified for the following subgroups: 1) type of transfer pathway and students’ status as Hispanic/Latino [1 of 5 imputations]; and 2) type of transfer pathway and students’ status as first generation in college [1 of 5 imputations]. These interactions are displayed in Figures 1 and 2. Cost of attendance was less of an issue for non-Hispanic/Latino students on the lateral transfer pathway (see Figure 1). A similar pattern was observed for non-first generation college students on the lateral transfer pathway (see Figure 2). There are limitations associated with both of these findings, however. First, results were not consistent across imputations. Second, data did not meet all assumptions for an ANOVA because of unequal variance and unequal sample size for these particular groups for this variable. Therefore, caution should be taken when interpreting both of these findings.
Figure 1. **Problems in transfer to [RI] — Cost of attendance.** Interaction between student status as Hispanic/Latino and type of pathway. Pattern observed in 1 of the 5 imputed datasets. Note: Data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding. Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem
For the “transfer credit process”, we identified a statistically significant interaction effect between type of institution and type of pathway [4 of 5 imputations]. Figure 3 illustrates that the “transfer credit process” was more of an issue for lateral transfer students at more selective institutions. However, because of unequal variance and unequal sample size for these particular groups for this variable, the data did not meet all assumptions for an ANOVA, and caution should be taken in interpreting this finding.

For Competing Personal Demands, we identified a statistically significant interaction effect between type of institution and students’ status as Hispanic/Latino [5 of 5 imputations]. The construct Competing Personal Demands was more of an issue for Hispanic/Latino students at open enrollment institutions (see Figure 4). Similar to “the transfer credit process,” caution should be taken in interpreting this finding because of violations in some assumptions for ANOVA.
Figure 3. **Problems in transfer to [RI] – The transfer credit process.** Interaction between type of institution and type of pathway. Pattern observed in 4 of the 5 imputed datasets. Note: Data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.

Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem
Figure 4. **Problems in transfer to [RI] – Competing Personal Demands.** Interaction between type of institution and student status as Hispanic/Latino. Pattern observed in 5 of the 5 imputed datasets. Note: Data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.

Scale: 1-Not at all a problem, 2-Minor problem, 3-Moderate problem, 4-Serious problem
4.3 Discussion

Based on results from the aggregated data set, participants in our study identified “cost of attendance,” “the transfer credit process,” and “high academic expectations” as the most problematic aspects of their transfer to their receiving institutions; these results affirm—and begin to rank—emergent themes from prior qualitative studies that identify barriers for transfer students in STEM (Packard et al., 2011; Reyes, 2011) and engineering (Blash et al., 2012a). Through exploratory factor analysis, we identified constructs of Competing Personal Demands and Integration into Community, which participants (in aggregate) rated as minor problems. These constructs are similar to the concepts of environmental pull and perception of fit that frequently emerge in prior studies as challenges for transfer students during post-transfer transition processes (Packard et al., 2011; Reyes, 2011; Townsend & Wilson, 2009).

Informed and motivated by multiple calls for deeper investigations on transfer students using disaggregated data (Bahr et al., 2013; Mobley et al., 2013; Owens, 2010; Shealy et al., 2013; Townsend, 2008), we explored and identified multiple differences between subgroups of engineering transfer students. Based on participants’ mean responses to constructs and items related to aspects of the transfer process than can be problematic, we identified the largest number (n=4) of statistically significant differences between transfer students at open enrollment institutions and transfer students at more selective institutions. Comparison of participants’ means based on student status as first generation yielded the fewest number (n=2) of statistically significant differences. The objective of this analysis is to increase understanding and awareness of areas where subgroups respond similarly and where they might respond differently. We explore each theme (i.e., constructs and sub-items) in the paragraphs that follow.

While “cost of attendance” was high on the list of problems for all participants, vertical transfer students, Hispanic/Latino students, and first generation college students reported this issue as being more problematic relative to their peer comparison groups. This result extends related findings from qualitative (Reyes, 2011) and quantitative studies (Ogilvie & Knight, in preparation-a) that highlight transfer students’ concerns about financial pressures and the
importance of college affordability, especially for vertical transfers students who are Hispanic/Latino and/or a first generation college student.

The transfer credit process emerged second on the list for all participants. However, lateral transfer students and transfer students at more selective institutions were among those who reported the highest problem level ratings for this issue relative to their comparison subgroups. This result aligns with findings from Townsend (2008) about transfer students’ frustration with loss of credit during transfer to receiving institutions. Results from our study extend Townsend’s (2008) finding and suggest that frustration with the transfer credit process may be a more pressing issue for lateral transfer students and transfer students at more selective institutions. Although we did find an interaction effect between type of institution and type of pathway, there is a limitation associated with this finding because the data did not meet all assumptions for an ANOVA; so caution should be taken in interpreting this finding.

Nonetheless, the mid-range effect size for differences between lateral and vertical transfer students for the “transfer credit process” raises concern because the study sites participate in and offer system admission programs designed to facilitate student movement between 4-year institutions (i.e., lateral transfer) within the same system. Further investigation is warranted to determine the underlying cause of higher problem ratings with “the transfer credit process” from lateral transfer students in particular. We wonder, for example, whether transfer from one 4-year institution to another 4-year institution was unplanned (i.e., not their original intent) or whether there are deeper issues related to system admission programs. The current process for system admission programs (i.e., weak agreements and/or lack of course transfer (Bers, 2013; Dowd, 2012)) may not be optimal for transfer in engineering. Again, this is an area worthy of future investigation to ensure that system admission programs are not leading prospective engineering students down a longer and less efficient path to degree attainment.

Based on reports from study participants, problem levels with “high academic expectations” appear to be less of an issue for students at open enrollment institutions than for students enrolled in more selective institutions. While this finding may be intuitive, to our knowledge, no other studies have made this this direct comparison between transfer students
at open enrollment institutions and those at more selective institutions. Drawing on qualitative data from interviews and focus groups, Townsend (2008) did find that vertical transfer students had to stretch to meet university expectations more often than lateral transfer students. Our results also show vertical transfer students reported higher problem levels for “high academic expectations” relative to lateral transfer students, but differences between participants’ response means were not statistically significant.

Based on themes that have emerged in prior qualitative studies focused on transfer students from community colleges who also identify as first generation college students and/or students of color (Bensimon & Dowd, 2009; Crisp & Nora, 2010; Reyes, 2011), it was not a surprise to find that first generation college students, transfer students at open enrollment institutions, Hispanic students, and vertical transfer students were among those who reported highest problem levels for the construct Competing Personal Demands. These subgroups of transfer students are also the same ones whose college choice decisions are often influenced by affordability and cost of attendance (Ogilvie & Knight, in preparation-a). Increased financial support may help these students overcome environmental pull factors that place extra demands or strain on their time and interfere with academic plans, progress, and priorities.

Results from our study indicate that transfer students at more selective institutions report higher problem levels with Integration into Community than transfer students at open enrollment institutions. This result corroborates and extends qualitative findings from Packard et al. (2011) and Townsend (2008) who found that transfer students struggle to make friends in environments where groups are formed during the freshmen year (Reyes, 2011; Townsend, 2008), especially at institutions that cater primarily to traditional age college students who live on campus and matriculate directly from high school to 4-year universities (Townsend, 2008). This finding could be related to an argument made by Townsend and Wilson (2006) which suggests that effective first-year student success programs (e.g., living-learning communities or other cohort based program designed to form academic communities) could have unintended consequences on the integration of transfer students. While engineering student success programs for traditional age college students are common at more selective, research intensive institutions, data from this study suggest that student success programs for transfer students
may not be as prevalent. We were surprised to find that non-Hispanic/Latino students reported higher problem levels with Integration into Community than Hispanic/Latino students. Based on participants’ responses in this study, non-Hispanic/Latino transfer students could potentially be an overlooked demographic group who could use more assistance with Integration into Community – especially since, historically, this group has not been the primary target audience or focus of more traditionally structured student support programs in engineering (e.g. diversity engineering programs, minority engineering programs, women in engineering programs) (Lichtenstein et al., 2014).

Because we had a sizeable population of Hispanic/Latino students in our sample, we also explored the relevance of “English language skills” as a potential problem in the post-transfer transition process. However, in this study, concerns over language skills did not bear out. On average, participants rated this sub-item between “1-Not at all a problem” and “2-Minor problem”. Although Hispanic/Latino students were slightly over-represented (+2%) in right tail of data distributions (3-Moderate Problem, 4-Serious problem), we did not find statistically significant differences in mean responses between Hispanic/Latino and non-Hispanic/Latino students.

Implications of these results for policy, practice and research are summarized in section 7.0.
5.0 Results and Discussion – Part II

Participants’ Perceptions of Receiving Institutions during Post-Transfer Transition

5.1 Results for Addressing Research Question 1

Participants were asked to respond to 16 sub-items with statements designed to capture their perceptions of their receiving institutions. Response means and standard errors of the means for each of the 16 sub-items are shown in Table 7.

Four constructs emerged following an exploratory factor analysis of the initial 16 sub-items: 1) Institutional Endorsement (α = .85); 2) Academically Engaging (α = .78); 3) Bias Against Transfer Students (α = .89); and 4) Adequate Financial Support (α = .71) (see Table 8). The construct Institutional Endorsement captures participants’ satisfaction with the receiving institution overall as indicated by their willingness: 1) to recommend the receiving institution to other transfer students; and 2) to attend the same receiving institution, even if they could start the process all over again. Academically Engaging captures participants’ satisfaction with the academic experience at the receiving institution, as indicated by their perceptions of: 1) finding the environment to be intellectually stimulating; and 2) finding the classes interesting and valuable. The construct Bias Against Transfer Students captures participants’ experiences with a climate that lacks transfer receptivity and instead fosters transfer stigma. Adequate Financial Support captures participants’ perceptions of their access to sufficient levels of financial aid (e.g., grants, loans, and scholarships) through the receiving institutions; this concept is an important antidote that can counter environmental pull, especially for students with financial need. Five sub-items from the initial list of 16 did not load on to any constructs.

The constructs Institutional Endorsement and Academically Engaging both, on average, received high rating levels of agreement from participants. This finding was a positive indication that, on average, students were satisfied with their receiving institution overall as well as with their academic experience.

On average, participants disagreed with concepts operationalized by the construct Bias Against Transfer Students as well as with sub-items focused on being treated like a number and finding it difficult (at the start) to learn how things work on campus. Similarly, participants generally agreed with the construct Adequate Financial Support and the sub-item “student
services are responsive to student needs.” Participants rated each of these constructs and sub-items, however, in the middle of the range of options, which suggests there are opportunities for improving transfer receptivity at receiving institutions.

Participants’ response means for the final two sub-items in Table 8 demonstrated less favorable perceptions of receiving institutions. On average, participants agreed with sub-items indicating that at the receiving institution “students are more concerned about ‘getting the grade’ instead of learning the material” and students need to take initiative “to benefit from what the receiving institution has to offer.” Receiving institutions have the most room for growth on these sub-items based on the mean values.

<table>
<thead>
<tr>
<th>Sub-items</th>
<th>Mean (N = 1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. [RI] is an intellectually stimulating place to be.</td>
<td>4.12</td>
<td>0.89</td>
</tr>
<tr>
<td>2. I would recommend to other transfer students to go to [RI].</td>
<td>4.11</td>
<td>1.03</td>
</tr>
<tr>
<td>3. If I could start over again, I still would go to [RI].</td>
<td>4.10</td>
<td>1.09</td>
</tr>
<tr>
<td>4. The courses I have taken at [RI] are interesting and worthwhile.</td>
<td>4.05</td>
<td>0.86</td>
</tr>
<tr>
<td>5. Because I am a “transfer student”, most teaching assistants tend to</td>
<td>3.88</td>
<td>1.02</td>
</tr>
<tr>
<td>underestimate my abilities. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Because I am a “transfer student”, most faculty tend to</td>
<td>3.76</td>
<td>1.12</td>
</tr>
<tr>
<td>underestimate my abilities. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. There is a stigma on campus against students who start at another</td>
<td>3.57</td>
<td>1.23</td>
</tr>
<tr>
<td>institution or community college. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Because I am a “transfer student”, most students tend to</td>
<td>3.52</td>
<td>1.27</td>
</tr>
<tr>
<td>underestimate my abilities. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Once at [RI], I had access to grants and loans to assist me in paying</td>
<td>3.38</td>
<td>1.21</td>
</tr>
<tr>
<td>for my college education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Student services are responsive to student needs.</td>
<td>3.33</td>
<td>0.95</td>
</tr>
<tr>
<td>11. Most students are treated like a ‘number’. (Reverse)</td>
<td>3.08</td>
<td>1.21</td>
</tr>
<tr>
<td>12. When I started, it was difficult learning how things work on campus.</td>
<td>3.07</td>
<td>1.22</td>
</tr>
<tr>
<td>(Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Once at [RI], I had access to scholarships to assist me in paying for</td>
<td>3.04</td>
<td>1.28</td>
</tr>
<tr>
<td>my college education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. The amount of financial aid that I receive at [RI] is adequate.</td>
<td>3.01</td>
<td>1.21</td>
</tr>
<tr>
<td>15. Generally, students are more concerned about &quot;getting the grade&quot;</td>
<td>2.28</td>
<td>1.14</td>
</tr>
<tr>
<td>instead of learning the material. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. If students expect to benefit from what [RI] has to offer, they have</td>
<td>1.98</td>
<td>0.87</td>
</tr>
<tr>
<td>to take the initiative. (Reverse)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree
Means are of weighted data.
Table 8. **General Perceptions of [RI]**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Sub-items</th>
<th>Mean (N =1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institutional Endorsement</strong></td>
<td>▪ I would recommend to other transfer students to go to [RI].</td>
<td>4.11</td>
<td>0.99</td>
</tr>
<tr>
<td>(α = .85)</td>
<td>▪ If I could start over again, I still would go to [RI].</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Academically Engaging</strong></td>
<td>▪ [RI] is an intellectually stimulating place to be.</td>
<td>4.09</td>
<td>0.80</td>
</tr>
<tr>
<td>(α = .78)</td>
<td>▪ The courses I have taken at [RI] are interesting and worthwhile.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bias Against Transfer Students</strong></td>
<td>▪ Because I am a “transfer student”, most teaching assistants tend to underestimate my abilities. (Reverse)</td>
<td>3.68</td>
<td>1.01</td>
</tr>
<tr>
<td>(α = .89)</td>
<td>▪ Because I am a “transfer student”, most faculty tend to underestimate my abilities. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ There is a stigma on campus against students who start at another institution or community college. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Because I am a “transfer student”, most students tend to underestimate my abilities. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adequate Financial Support</strong></td>
<td>▪ Student services are responsive to student needs.</td>
<td>3.33</td>
<td>0.95</td>
</tr>
<tr>
<td>(α = .71)</td>
<td>▪ Once at [RI], I had access to grants and loans to assist me in paying for my college education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Once at [RI], I had access to scholarships to assist me in paying for my college education.</td>
<td>3.14</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>▪ The amount of financial aid that I receive at [RI] is adequate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>-</strong></td>
<td>▪ Most students are treated like a ‘number’. (Reverse)</td>
<td>3.08</td>
<td>1.21</td>
</tr>
<tr>
<td><strong>-</strong></td>
<td>▪ When I started, it was difficult learning how things work on campus. (Reverse)</td>
<td>3.07</td>
<td>1.22</td>
</tr>
<tr>
<td><strong>-</strong></td>
<td>▪ Generally, students are more concerned about &quot;getting the grade&quot; instead of learning the material. (Reverse)</td>
<td>2.28</td>
<td>1.14</td>
</tr>
<tr>
<td><strong>-</strong></td>
<td>▪ If students expect to benefit from what [RI] has to offer, they have to take the initiative. (Reverse)</td>
<td>1.98</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree  
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree  
Means are of weighted data.
5.2. Results for Addressing Research Question 2 - Comparing Groups

Again, we employed a three step process to further explore the data and identify differences between subgroups of engineering transfer students. Results from left tail frequency count data, independent samples t-tests, and 2-way ANOVAs are reported in the sections that follow.

5.2.1 Exploring the Left Tail of Data Distributions. Table 9 summarizes percentages of study participants who responded to constructs and individual sub-items with ratings of a 1 or 2 (i.e., strongly disagree or disagree; and for reverse scale items - strongly agree or agree). For all constructs and two individual sub-items, low end ratings from the sample were fairly representative of low end ratings from respective subgroups of transfer students within the sample (i.e., less than 5% difference). For the remaining three sub-items, low end ratings from subgroups of transfer students were either overrepresented or underrepresented by margins of 5% or more. A higher percentage of transfer students at open enrollment institutions disagreed with the statement “student services are responsive to student needs“ (22% compared to 15% of all study participants). A lower percentage of lateral transfer students agreed with the statement “...[at the start] it was difficult learning how things work on campus” at 31% compared to 36% of all study participants. Lateral transfer students also agreed at a lower rate than all participants with the sub-item “...students are more concerned about ‘getting the grade’ instead of learning the material” (57% compared to 62% of all study participants).
Table 9. **General Perceptions of [RI]** – Student responses equal to 1-Strongly Disagree, 2-Disagree (Reverse Scale: 1-Strongly agree, 2-Agree); reported as a percentage of respective groupings.

<table>
<thead>
<tr>
<th>Perception</th>
<th>Total</th>
<th>Selective</th>
<th>Open</th>
<th>Lateral</th>
<th>Vertical</th>
<th>HIS = N</th>
<th>HIS = Y</th>
<th>1st Gen = N</th>
<th>1st Gen = Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Endorsement (2 items)</td>
<td>5%</td>
<td>5%</td>
<td>6%</td>
<td>7%</td>
<td>4%</td>
<td>6%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Academically Engaging (2 items)</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Bias Against Transfer Students (4 items)</td>
<td>8%</td>
<td>9%</td>
<td>6%</td>
<td>5%</td>
<td>10%</td>
<td>8%</td>
<td>7%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Student services are responsive to student needs.</td>
<td>15%</td>
<td>11%</td>
<td><strong>22%</strong></td>
<td>16%</td>
<td>14%</td>
<td>12%</td>
<td>19%</td>
<td>14%</td>
<td>16%</td>
</tr>
<tr>
<td>Adequate Financial Support (3 items)</td>
<td>15%</td>
<td>16%</td>
<td>13%</td>
<td>16%</td>
<td>15%</td>
<td>16%</td>
<td>14%</td>
<td>17%</td>
<td>12%</td>
</tr>
<tr>
<td>Most students are treated like a ‘number’. (Reverse)</td>
<td>32%</td>
<td>33%</td>
<td>29%</td>
<td>32%</td>
<td>32%</td>
<td>31%</td>
<td>33%</td>
<td>33%</td>
<td>31%</td>
</tr>
<tr>
<td>When I started, it was difficult learning how things work on campus. (Reverse)</td>
<td>36%</td>
<td>37%</td>
<td>34%</td>
<td><strong>31%</strong></td>
<td>39%</td>
<td>34%</td>
<td>38%</td>
<td>38%</td>
<td>34%</td>
</tr>
<tr>
<td>Generally, students are more concerned about &quot;getting the grade&quot; instead of learning the material. (Reverse)</td>
<td>62%</td>
<td>61%</td>
<td>64%</td>
<td><strong>57%</strong></td>
<td>65%</td>
<td>61%</td>
<td>63%</td>
<td>64%</td>
<td>61%</td>
</tr>
<tr>
<td>If students expect to benefit from what [RI] has to offer, they have to take the initiative. (Reverse)</td>
<td>77%</td>
<td>79%</td>
<td>73%</td>
<td>75%</td>
<td>78%</td>
<td>77%</td>
<td>76%</td>
<td>79%</td>
<td>73%</td>
</tr>
</tbody>
</table>
Table 10. Comparing means for subgroups: **General Perceptions of [RI]**

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>SEL</th>
<th>OPN</th>
<th>LAT</th>
<th>VERT</th>
<th>Not</th>
<th>HIS</th>
<th>Not</th>
<th>1st Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institutional Endorsement (2 items)</strong></td>
<td>4.22</td>
<td>3.88</td>
<td>4.04</td>
<td>4.14</td>
<td>4.11</td>
<td>4.10</td>
<td>4.16</td>
<td>4.06</td>
</tr>
<tr>
<td><strong>Academically Engaging (2 items)</strong></td>
<td>4.14</td>
<td>3.98</td>
<td>4.06</td>
<td>4.10</td>
<td>4.05</td>
<td>4.14</td>
<td>4.10</td>
<td>4.10</td>
</tr>
<tr>
<td><strong>Bias Against Transfer Students (4 items) (Reverse)</strong></td>
<td>3.61</td>
<td>3.81</td>
<td>3.78</td>
<td>3.62</td>
<td>3.64</td>
<td>3.73</td>
<td>3.68</td>
<td>3.69</td>
</tr>
<tr>
<td><strong>Student services are responsive to student needs.</strong></td>
<td>3.40</td>
<td>3.18</td>
<td>3.30</td>
<td>3.35</td>
<td>3.34</td>
<td>3.31</td>
<td>3.36</td>
<td>3.29</td>
</tr>
<tr>
<td><strong>Adequate Financial Support (3 items)</strong></td>
<td>3.11</td>
<td>3.23</td>
<td>3.04</td>
<td>3.21</td>
<td>3.05</td>
<td>3.27</td>
<td>3.05</td>
<td>3.30</td>
</tr>
<tr>
<td><strong>Most students are treated like a ‘number’. (Reverse)</strong></td>
<td>3.01</td>
<td>3.22</td>
<td>3.12</td>
<td>3.06</td>
<td>3.05</td>
<td>3.12</td>
<td>3.08</td>
<td>3.10</td>
</tr>
<tr>
<td><strong>When I started, it was difficult learning how things work on campus. (R)</strong></td>
<td>3.00</td>
<td>3.20</td>
<td>3.21</td>
<td>2.98</td>
<td>3.06</td>
<td>3.07</td>
<td>3.04</td>
<td>3.09</td>
</tr>
<tr>
<td><strong>Generally, students are more concerned about “getting the grade” instead of learning the material. (Reverse)</strong></td>
<td>2.30</td>
<td>2.25</td>
<td>2.35</td>
<td>2.25</td>
<td>2.32</td>
<td>2.23</td>
<td>2.26</td>
<td>2.31</td>
</tr>
<tr>
<td><strong>If students expect to benefit from what [RI] has to offer, they have to take the initiative. (R)</strong></td>
<td>1.94</td>
<td>2.05</td>
<td>2.01</td>
<td>1.96</td>
<td>1.96</td>
<td>1.99</td>
<td>1.95</td>
<td>2.01</td>
</tr>
</tbody>
</table>

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree
Means are of weighted data. ** p-value < .01, * p-value < .05
Effect size (Hedges' g): large ≥ .8; .8 > mid-range > .2; small ≤ .2
5.2.2 Independent Samples t-Tests. In comparing response means, we found statistically significant differences between varying subgroups for all four constructs and multiple sub-items. Table 10 summarizes results from the independents samples t-tests.

In comparing response means of participants from open enrollment institutions to those from more selective institutions, we found statistically significant differences for a total of six constructs and sub-items: 1) Institutional Endorsement; 2) Academically Engaging; 3) Bias Against Transfer Students; 4) “student services are responsive to student needs”; 5) “most students are treated like a number”; and 6) “when I started, it was difficult learning how things work on campus”. Effect sizes for these differences were small, with the exception of two; the effect size of differences for Institutional Endorsement and “student services are responsive to student needs” were considered mid-range. Transfer students at more selective institutions reported significantly higher response means (i.e., higher level of agreement) for: 1) Institutional Endorsement; 2) Academically Engaging; and 3) “student services are responsive to student needs.” Transfer students at open enrollment institutions reported statistically significant higher response means (i.e., higher level of disagreement) for: 1) Bias Against Transfer Students; 2) “most students are treated like a number”; and 3) “when I started, it was difficult learning how things work on campus.”

For the vertical versus lateral transfer student comparison, we found statistically significant differences in response means for a total of three constructs and sub-items: 1) Bias Against Transfer Students; 2) Adequate Financial Support; and 3) “[at the start] difficult learning how things work on campus (R)”. Effect sizes for all were considered small. Lateral transfer students reported statistically significant higher response means (i.e., higher level of disagreement) to Bias Against Transfer Students and “[at the start] difficult learning how things work on campus (R)”. Vertical transfer students reported a higher response mean (i.e., higher level of agreement) to the construct Adequate Financial Support.

In comparing response means from Hispanic/Latino students to non-Hispanic/Latino students, we found a statistically significant difference in response means for the construct Adequate Financial Support; the effect size was mid-range. For this construct, Hispanic/Latino students reported a higher response mean (i.e., higher level of agreement) than non-
Hispanic/Latino students. Similar findings emerged in our comparison of first generation and non-first generation college students. We found a statistically significant difference (mid-range effect size) in response means for the construct Adequate Financial Support. First generation college students reported a higher response mean (i.e., higher level of agreement) than non-first generation college students.

In summary, we identified significantly different response means between subgroups of engineering transfers for all four constructs and three sub-items. We did not find statistically significant differences in response means between subgroups for two sub-items: 1) “...students are more concerned about ‘getting the grade’ instead of learning the material”; and 2) “if students expect to benefit from what [RI] has to offer, they have to take the initiative”.

**5.2.3 2-way ANOVA Testing Interaction Effects.** Looking across subgroups (see Table 10), we identified a total of three constructs and sub-items with statistically significant differences between two or more subgroups of engineering transfer students: 1) Bias Against Transfer Students; 2) Adequate Financial Support; and 3) “[at the start] difficult learning how things work on campus.” For each construct and sub-item, we ran multiple 2-way ANOVAs to explore interactions effects between subgroups. We did not find any statistically significant interaction effects between subgroups for Bias Against Transfer Students or Adequate Financial Support. However, for 1 out of 5 imputed data sets we did find a statistically significant interaction effect between type of institution and type of pathway for the sub-item “[at the start] difficult learning how things work on campus” (note: caution should be taken when considering this result, as the finding was not consistent across imputations). Both vertical and lateral transfer students at more selective institutions reported lower levels of disagreement than students at open enrollment institutions. However, the difference between transfer students at open enrollment institutions and selective institutions was greater for lateral transfer students than vertical transfer students (see Figure 5).
5.3 Discussion

Drawing on data from a large and diverse sample population, an objective of these analyses is to increase understanding and awareness of areas where subgroups of engineering transfer students respond similarly and where they respond differently with respect to their perceptions of their receiving institutions. Comparison of participants’ response means based on type of institution yielded the largest number (n=6) of statistically significant differences; comparisons based on student status as Hispanic/Latino and student status as first generation college student each yielded the least number (n=1) of statistically significant differences. We discuss these findings by theme (i.e., constructs and items) in the paragraphs below.

Based on participants’ favorable responses for the constructs Institutional Endorsement and Academic Engaging, engineering transfer students in this study appear to be satisfied with their receiving institutions and the courses taken at their receiving institutions. Study participants at more selective institutions reported statistically significantly higher ratings (i.e.,
levels of agreement), but responses from participants at open enrollments were also favorable and positive indicators of student satisfaction. To our knowledge, no other studies have made this direct comparison between transfer students at open enrollment institutions and those at more selective institutions.

Another encouraging finding was the result that participants (in aggregate) generally disagreed with the construct Bias Against Transfer Students. However, we did find that vertical transfer students and students at more selective institutions reported statistically significant lower level levels of disagreement to the same construct than their respective counterparts. We did not find a statistically significant interaction effect between type of institution and type of pathway. Together, these findings suggest that transfer stigma and/or experiences with biases against transfer students may be more prevalent for vertical transfer students as well as transfer students who enroll in more selective institutions. In a study by Townsend (2008), vertical transfer students did not express experiences with transfer bias. However, multiple other studies have identified cases where transfer students experienced feelings of marginalization (Owens, 2010; Packard et al., 2011) and encountered “attitudes and treatment signaling that they [did] not belong because of age, ethnicity, and gender” or perceptions that transfer students lacked adequate preparation (Reyes, 2011, p. 241). Results from our study add an extra layer of specificity to findings from prior studies regarding students within the transfer student population in engineering who may be more susceptible to transfer stigma and/or transfer bias.

In aggregate, participants generally agreed with the sub-item “student services are responsive to student needs” and the construct Adequate Financial Support; they disagreed with two sub-items focused on being treated like a number and finding it difficult (at the start) to learn how things work on campus. Although leaning in a positive direction signaling a supportive educational environment, participants’ response means were not on the high end; levels of agreement and disagreement were somewhat moderate. This finding based on aggregate data suggests that there may be opportunities to improve transfer receptivity at receiving institutions.
For example, we found that students at open enrollment institutions reported lower levels of agreement than students at more selective institutions to the statement “student services are responsive to student needs.” In and of itself, this finding was surprising to us because we also found that students at open enrollment institutions reported significantly higher levels of disagreement with the statements “most students are treated like a number” and “when I started, it was difficult learning how things work on campus” than their counterparts at more selective institutions. Nevertheless, responding to transfer student needs begins first with understanding their needs. A limitation of this study is that administering closed-ended question precludes our ability to further elaborate on participants’ responses and dive deeper into students’ needs. However, in a related qualitative study, Ogilvie and Knight (under review) asked engineering transfer students at two open enrollment institutions to reflect on their post-transfer experiences, identify their perceived needs, and offer recommendations on supports the receiving institution could provide to meet these perceived needs. Students’ recommendations for the receiving institutions included more assistance with getting involved on campus, building personal networks, and understanding institutional resources (Ogilvie & Knight, under review). Together, these findings can inform practice so that student services at both open enrollment and more selective institutions can take proactive approaches to address transfer student needs.

For Adequate Financial Support, we found that non-Hispanic/Latino students, non-first generation college students, and lateral transfer students reported lower levels of agreement than their respective counterparts. These results also were surprising, especially given that vertical transfer students, Hispanic/Latino students, and first generation college students were among those who reported the highest problem level ratings for “cost of attendance” (reported in section 4.2.2 and discussed in 4.3). However, aspects of our results do corroborate findings relevant to lateral transfers from a previous study. Townsend (2008) reported that lateral transfer students were most vocal about the need for more scholarship money for transfer students; she explained that institutional aid was available for vertical transfer students who earned Associate’s degrees but not for lateral transfer students. Thus, in our study, it is feasible that non-Hispanic/Latino students, non-first generation college students, and lateral transfer
students were limited with respect to adequate financial support and more vocal about their potential lack of access to scholarships, grants, and other forms of financial aid through receiving institutions. [Note: We did not find significant interaction effects between subgroups.] An increase in scholarships earmarked to recruit and support transfer students could expand funding available to students who have financial constraints (including non-Hispanic/Latino students and non-first generation college students) who may not qualify for need-based grants but instead must rely on loans and outside employment (i.e., personal finances) to pay for their education.

Despite higher ratings for Institutional Endorsement from participants at more selective institutions, the same group reported significantly lower levels of disagreement to the following statements: 1) Most students are treated like a ‘number’; and 2) When I started, it was difficult learning how things work on campus. Findings indicate that these areas may be less important for study participants at open enrollment institutions; moreover, transfer receptivity may be lacking at the more selective institutions included in this study. Prior research on transfer students at large, research universities yielded similar findings. During post-transfer transition processes, students experienced difficulty in finding assistance, and they wanted more guidance soon after the transfer (Owens, 2010; Townsend & Wilson, 2006). In our study, with respect to the statement “...[at start] it was difficult learning how things work on campus,” we identified a statistically significant interaction effect between type of institution and type of pathway, which revealed that this item was less of an issue for lateral transfer students at open enrollment institutions. Findings from our study suggest that transfer students (both vertical and lateral) at selective institutions and vertical transfer students at open enrollments institutions stand to benefit the most from new early interventions (i.e., administrative efforts, programs, and services) that facilitate student integration and improve transfer receptivity.

In general, participants agreed that at their receiving institutions students were “more concerned about getting the grade instead of learning the material.” This result suggests that transfer students may perceive the academic environment at receiving institutions as competitive, although we do not have baseline information for this sub-item about their sending institutions. This finding does align with prior research that draws attention to transfer
students’ perceptions and experiences with moving from a supportive community at their sending institution to a more competitive environment at the receiving institution (Packard et al., 2011; Reyes, 2011; Valenzuela, 2006).

Finally, participants generally agreed that students “have to take the initiative” if they expect to benefit from what the receiving institution has to offer. While we did not find statistically significant differences in response means between subgroups of engineering transfer students, first generation college students and others with lower levels of social and cultural capital may experience a delay in recognizing and responding to this “want it, come and get it” culture. This claim is informed by findings from Martin et al. (2013) who found that students with limited access to social capital experienced delayed recognition and activation of resources which can lead to difficult university transitions. Prior research suggests that transfer students can benefit from an introduction to their receiving institutions’ mission to better understand institutional culture and how it drives the attitudes and behaviors of faculty, staff, and students (Townsend & Wilson, 2006). This recommendation is applicable in our in context as well so that transfer students understand institutional expectations from matriculation; they may have to take the initiative if they expect to benefit from the receiving institution’s suite of educational opportunities.

Implications for policy, practice and research are summarized in section 7.0.
6.0 Results and Discussion – Part III

Participants’ Perceptions of the Adjustment Process and Social Support at Receiving Institutions during Post-Transfer Transition

6.1 Results for Addressing Research Question 1

Participants responded to 18 sub-items with statements designed to capture transfer students’ perceptions of the adjustment process and social supports at their receiving institutions. Response means and standard errors of the means for each of the 18 sub-items are shown in Table 11.

Four constructs emerged from an exploratory factor analysis of the 18 sub-items: 1) Established Peer Community (Full Integration) (α = .80); 2) Large Institution (α = .74); 3) Fitting into Community (with Ease) (α = .79); and 4) Academic Transition (with Ease) (α = .61) (see Table 12). The construct Established Peer Community (Full Integration) is comprised of sub-items that illustrate scenarios where student integration (academic and social) has occurred; examples include reports of students feeling a sense of belonging within the institution or students feeling like they have friends and academic peers upon whom they can rely for support. The construct Large Institution is comprised of sub-items that describe students experiencing challenges related to size of the institution. Fitting into Community (with Ease) includes sub-items that illustrate scenarios where students find it easy to establish new connections with peers at their receiving institutions; this construct offers one way to assess transfer receptivity (or measure social adjustment). The construct Academic Transition (with Ease) includes sub-items that illustrate scenarios where students adapt to the academic environment at receiving institutions with ease; this construct offers one way to measure academic adjustment (Laanan et al., 2010b; Young & Litzler, 2013). Four of the 18 sub-items did not load on to any constructs. Final loadings of sub-items in this study did not align perfectly (sub-item by sub-item) with prior work by Laanan and colleagues, who proposed new measures to assess transfer student adjustment in three ways – academically, socially, and psychologically (Jackson, 2010; Laanan, 2007; Laanan et al., 2010b). Differences in the ways sub-items loaded may be attributed to the following: 1) this study extends prior research to a new context; 2) items were customized for this particular study, as the Engineering Transfer
Student Survey included additional sub-items; and 3) the factors in this study have greater specificity.

On average, participants agreed with the constructs Established Peer Community (Full Integration) and Fitting into Community (with Ease), and they also agreed with the sub-item “easy to find my way around campus.” Similarly, participants generally disagreed with the construct Large Institution and sub-items focused on feelings of alienation, higher comfort level making friends with transfer students versus non-transfer students, and higher comfort level spending time with friends from the sending institution versus receiving institution. These constructs and sub-items, rated in the middle of the range by participants, suggest there still are opportunities for improving transfer receptivity, students’ perceptions of social support, and the adjustment process at receiving institutions.

Participants rated the construct Academic Transition (with Ease) at the lowest end of the scale. On average participants’ disagreed with sub-items embedded within this scale; their academic transitions to their receiving institutions were not easy.
Table 11. Adjustment process and social support at [RI]

<table>
<thead>
<tr>
<th>Sub-items</th>
<th>Mean (N = 1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If I have to miss class, I have someone who will share their notes with me.</td>
<td>3.81</td>
<td>1.06</td>
</tr>
<tr>
<td>2. I have a close friend or classmate whom I can turn to if I need support.</td>
<td>3.79</td>
<td>1.09</td>
</tr>
<tr>
<td>3. It is easy to find my way around campus.</td>
<td>3.71</td>
<td>0.96</td>
</tr>
<tr>
<td>4. I am invited to social gatherings outside of class.</td>
<td>3.63</td>
<td>1.10</td>
</tr>
<tr>
<td>5. I feel a sense of belonging within the university.</td>
<td>3.58</td>
<td>1.14</td>
</tr>
<tr>
<td>6. The large classes intimidate me. (Reverse)</td>
<td>3.52</td>
<td>1.19</td>
</tr>
<tr>
<td>7. It is easy to make friends at [RI].</td>
<td>3.51</td>
<td>1.04</td>
</tr>
<tr>
<td>8. I am meeting as many people and making as many friends as I want at [RI].</td>
<td>3.47</td>
<td>1.09</td>
</tr>
<tr>
<td>9. I am involved in on-campus events and activities at [RI].</td>
<td>3.38</td>
<td>1.19</td>
</tr>
<tr>
<td>10. I often feel overwhelmed by the size of the student body. (Reverse)</td>
<td>3.37</td>
<td>1.16</td>
</tr>
<tr>
<td>11. Upon transferring I felt alienated at [RI]. (Reverse)</td>
<td>3.30</td>
<td>1.20</td>
</tr>
<tr>
<td>12. Adjusting to the social environment at [RI] has been easy.</td>
<td>3.26</td>
<td>1.13</td>
</tr>
<tr>
<td>13. I feel more comfortable making friends with transfer students than non-transfers. (Reverse)</td>
<td>3.25</td>
<td>1.07</td>
</tr>
<tr>
<td>14. I have a lot in common with the other students in my classes at [RI].</td>
<td>3.20</td>
<td>1.12</td>
</tr>
<tr>
<td>15. Adjusting to the academic standards or expectations at [RI] has been easy.</td>
<td>3.06</td>
<td>1.16</td>
</tr>
<tr>
<td>16. I feel more comfortable spending time w/ friends that I made at the previous college I attended. (Reverse)</td>
<td>3.06</td>
<td>1.17</td>
</tr>
<tr>
<td>17. I experienced a drop in grades (GPA) during my first semester at [RI]. (Reverse)</td>
<td>2.73</td>
<td>1.41</td>
</tr>
<tr>
<td>18. My level of stress increased when I started at [RI]. (Reverse)</td>
<td>2.32</td>
<td>1.12</td>
</tr>
</tbody>
</table>

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree
Means are of weighted data.
Table 12. Adjustment process and social support at [RI]

<table>
<thead>
<tr>
<th>Construct</th>
<th>Sub-items</th>
<th>Mean (N=1067)</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established Peer Community (Full Integration) (α = .80)</td>
<td>- It is easy to find my way around campus.</td>
<td>3.71</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>- If I have to miss class, I have someone who will share their notes with me.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- I have a close friend or classmate whom I can turn to if I need support.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- I am invited to social gatherings outside of class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- I feel a sense of belonging within the university.</td>
<td>3.64</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>- I am involved in on-campus events and activities at [RI].</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Institution (α = .74)</td>
<td>- The large classes intimidate me. (Reverse)</td>
<td>3.44</td>
<td>1.04</td>
</tr>
<tr>
<td></td>
<td>- I often feel overwhelmed by the size of the student body. (Reverse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitting into Community (with Ease) (α = .79)</td>
<td>- It is easy to make friends at [RI].</td>
<td>3.36</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>- I am meeting as many people and making as many friends as I want at [RI].</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Adjusting to the social environment at [RI] has been easy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- I have a lot in common with the other students in my classes at [RI].</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>- Upon transferring I felt alienated at [RI]. (Reverse)</td>
<td>3.30</td>
<td>1.20</td>
</tr>
<tr>
<td>-</td>
<td>- I feel more comfortable making friends with transfer students than non-transfers. (Reverse)</td>
<td>3.25</td>
<td>1.07</td>
</tr>
<tr>
<td>-</td>
<td>- I feel more comfortable spending time w/ friends that I made at the previous college I attended. (Reverse)</td>
<td>3.06</td>
<td>1.17</td>
</tr>
<tr>
<td>Academic Transition (with Ease) (α = .61)</td>
<td>- Adjusting to the academic standards or expectations at [RI] has been easy.</td>
<td>2.70</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>- I experienced a drop in grades (GPA) during my first semester at [RI].</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- My level of stress increased when I started at [RI].</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree
Means are of weighted data.

6.2. Results for Addressing Research Question 2 - Comparing Groups

6.2.1 Exploring the Left Tail of Data Distributions. Table 13 summarizes percentages of study participants who responded to constructs and individual sub-items with ratings of a 1 or 2 (i.e., strongly disagree or disagree; and for reverse scale items - strongly agree or agree). For two constructs and one sub-item, low end ratings from subgroups of transfer students were either overrepresented or underrepresented by margins of 5% or more.
A higher percentage of transfer students enrolled in more selective institutions disagreed with the Academic Transition (with Ease) construct (35% compared to 28% of all study participants). Conversely, lower percentages of students at open enrollment institutions and students who identified as Hispanic/Latino disagreed with the same Academic Transition (with Ease) construct (at 14% and 23%, respectively). Responses from students at open enrollment institutions were also under-represented in the left tail of the data distribution for the construct Large Institution and the statement “I feel more comfortable making friends with transfers than non-transfer students.” A lower percentage of students at open enrollment institutions agreed that the Large Institution was a challenge for them (7% compared to 13% of all participants). And, a smaller percentage of those students at open enrollment institutions agreed with the statement about feeling “more comfortable with making friends with transfers than non-transfer student” (14% compared to 22% overall).

For the remaining two constructs (Established Peer Community and Fitting into Community) and three individual sub-items (easy to find way around campus, feeling alienated, and more comfort spending time with friends from sending institution), low end ratings from the overall sample were fairly representative of low end ratings from respective subgroups of transfer students (i.e., less than 5% difference).
Table 13. **Adjustment process and social support at [RI]** – Student responses equal to 1-Strongly Disagree, 2-Disagree (Reverse Scale: 1-Strongly agree, 2-Agree); reported as a percentage of respective groupings.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Selective</th>
<th>Open</th>
<th>Lateral</th>
<th>Vertical</th>
<th>HIS = N</th>
<th>HIS = Y</th>
<th>1st Gen = N</th>
<th>1st Gen = Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>N= 1067</td>
<td></td>
<td>715</td>
<td>352</td>
<td>403</td>
<td>662</td>
<td>613</td>
<td>454</td>
<td>642</td>
<td>402</td>
</tr>
<tr>
<td>It is easy to find my way around campus.</td>
<td>12%</td>
<td>12%</td>
<td>10%</td>
<td>13%</td>
<td>11%</td>
<td>12%</td>
<td>11%</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td>Established Peer Community (Full Integration) (5 items)</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>4%</td>
<td>5%</td>
<td>5%</td>
<td>4%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Large Institution (2 items)</td>
<td>13%</td>
<td>16%</td>
<td>7%</td>
<td>12%</td>
<td>14%</td>
<td>15%</td>
<td>11%</td>
<td>14%</td>
<td>11%</td>
</tr>
<tr>
<td>Fitting into Community (with Ease) (4 items)</td>
<td>9%</td>
<td>9%</td>
<td>8%</td>
<td>8%</td>
<td>10%</td>
<td>10%</td>
<td>7%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Upon transferring I felt alienated at [RI]. (Reverse)</td>
<td>25%</td>
<td>26%</td>
<td>23%</td>
<td>26%</td>
<td>25%</td>
<td>26%</td>
<td>25%</td>
<td>26%</td>
<td>23%</td>
</tr>
<tr>
<td>I feel more comfortable making friends with transfer students than non-transfers. (Reverse)</td>
<td>22%</td>
<td>26%</td>
<td>14%</td>
<td>19%</td>
<td>24%</td>
<td>23%</td>
<td>20%</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>I feel more comfortable spending time w/ friends that I made at the previous college I attended. (Reverse)</td>
<td>30%</td>
<td>28%</td>
<td>32%</td>
<td>31%</td>
<td>29%</td>
<td>27%</td>
<td>34%</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td>Academic Transition (with Ease) (3 items)</td>
<td>28%</td>
<td>35%</td>
<td>14%</td>
<td>25%</td>
<td>30%</td>
<td>32%</td>
<td>23%</td>
<td>29%</td>
<td>29%</td>
</tr>
</tbody>
</table>
### Table 14. Comparing means for subgroups: Adjustment process and social support at [RI]

<table>
<thead>
<tr>
<th></th>
<th>SEL</th>
<th>OPN</th>
<th>LAT</th>
<th>VERT</th>
<th>Not</th>
<th>HIS</th>
<th>effect size</th>
<th>Not</th>
<th>1st Gen</th>
<th>effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=</td>
<td>715</td>
<td>352</td>
<td>403</td>
<td>662</td>
<td>613</td>
<td>454</td>
<td></td>
<td>642</td>
<td>402</td>
<td></td>
</tr>
<tr>
<td>It is easy to find my way around campus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.68</td>
<td>3.77</td>
<td>3.66</td>
<td>3.74</td>
<td>3.66</td>
<td>3.78</td>
<td>* S -0.13</td>
<td>3.71</td>
<td></td>
<td>3.72</td>
</tr>
<tr>
<td>Established Peer Community (Full Integration) (5 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.69</td>
<td>3.53</td>
<td>** S</td>
<td>-0.19</td>
<td>3.63</td>
<td>3.64</td>
<td>3.66</td>
<td>3.70</td>
</tr>
<tr>
<td>Large Institution (2 items) (Reverse)</td>
<td>3.34</td>
<td>3.65</td>
<td>** M</td>
<td>0.31</td>
<td>3.51</td>
<td>3.40</td>
<td></td>
<td>3.38</td>
<td>3.52</td>
<td>* S -0.14</td>
</tr>
<tr>
<td>Fitting into Community (with Ease) (4 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.32</td>
<td>3.43</td>
<td>3.35</td>
<td>3.36</td>
<td>3.30</td>
<td>3.43</td>
<td>* S -0.15</td>
<td>3.40</td>
<td>3.31</td>
<td></td>
</tr>
<tr>
<td>Upon transferring I felt alienated at [RI]. (Reverse)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.30</td>
<td>3.31</td>
<td></td>
<td></td>
<td>3.30</td>
<td>3.31</td>
<td></td>
<td>3.27</td>
<td>3.34</td>
<td>3.32</td>
</tr>
<tr>
<td>I feel more comfortable making friends with transfer students than non-transfers. (Reverse)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.22</td>
<td>3.31</td>
<td></td>
<td>3.30</td>
<td>3.22</td>
<td>3.26</td>
<td>3.24</td>
<td>3.26</td>
<td></td>
<td>3.23</td>
</tr>
<tr>
<td>I feel more comfortable spending time w/ friends that I made at the previous college I attended. (Reverse)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.12</td>
<td>2.91</td>
<td>* S</td>
<td>-0.18</td>
<td>3.02</td>
<td>3.08</td>
<td></td>
<td>3.16</td>
<td>2.92</td>
<td>* M 0.21</td>
</tr>
<tr>
<td>Academic Transition (with Ease) (3 items) (Mixed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.53</td>
<td>3.06</td>
<td>** M</td>
<td>0.59</td>
<td>2.85</td>
<td>2.62</td>
<td>** M -0.25</td>
<td>2.62</td>
<td>2.82</td>
<td>** M -0.23</td>
</tr>
</tbody>
</table>

* Construct includes a combination of items measured with scale and reverse-scale. Refer to Table 12.

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree
Reverse Scale: 1-Strongly agree, 2-Agree, 3-Neither agree nor disagree, 4-Disagree, 5-Strongly disagree
Means are of weighted data. ** p-value < .05. Effect size (Hedges’ g): large ≥ .8; .8 > mid-range > .2; small ≤ .2

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6.2.2 Independent Samples t-Tests. In comparing response means, we found statistically significant differences between varying subgroups for all four constructs and two sub-items. Table 14 summarizes results from the independents samples t-tests.

For participants at open enrollment institutions versus those at more selective institutions, we found statistically significant differences for a total of four constructs and sub-items: 1) Established Peer Community (Full Integration); 2) Large Institution; 3) more comfort spending time with friends from sending institution; and 4) Academic Transition (with Ease). Based on response means, transfer students at open enrollment institutions reported significantly higher levels of agreement with the construct illustrating Academic Transition (with Ease), and higher levels of disagreement with experiencing challenges with the Large Institution relative to students at selective institutions (effect sizes for both were considered mid-range). Transfer students at more selective institutions reported significantly higher levels of agreement with the construct representing Established Peer Community (Full Integration) and higher levels of disagreement with the statement about feeling more comfortable spending time with friends from the sending institution. Effect sizes for both differences were small.

For the vertical versus lateral transfer student comparison, we found statistically significant differences (mid-range effect sizes) in response means for the construct illustrating Academic Transition (with Ease). For this construct, lateral transfer students reported higher response means (i.e., higher level of agreement) than vertical transfer students.

In comparing response means from Hispanic/Latino students to non-Hispanic/Latino students, we found statistically significant differences for a total of five constructs and sub-items: 1) “easy to find my way around campus”; 2) Large Institution; 3) Fitting into Community (with Ease); 4) more comfort spending time with friends from sending institution; and 5) Academic Transition (with Ease). Effect sizes for these differences were small with the exception of mid-range effect sizes for Academic Transition (with Ease) and the statement about feeling more comfortable spending time with friends from their sending institution. Hispanic/Latino students reported significantly higher levels of agreement with the constructs Fitting into Community (with Ease) and Academic Transition (with Ease) and the statement “easy to find my way around campus”; they reported higher levels of disagreement with
experiencing challenges with the Large Institution. Non-Hispanic/Latino students reported statistically significant higher levels of disagreement with the statement about feeling more comfortable spending time with friends from the sending institution.

Finally, for the comparison of first generation college students to non-first generation college students, we found statistically significant differences in response means for the construct representing Established Peer Community (Full Integration), but the effect size was small. Non-first generation college students reported significantly higher response means (i.e., higher levels of agreement) than first generation college students.

In summary, we identified statistically significant different response means between subgroups of engineering transfers for all four constructs and two sub-items. We did not find statistically significant differences in response means between subgroups for two sub-items: 1) “upon transferring I felt alienated at [RI]”; and 2) “I feel more comfortable making friends with transfer students than non-transfers”.

6.2.3 2-way ANOVA Testing Interaction Effects. Looking across subgroups (see Table 14), we identified a total of 4 constructs and sub-items with statistically significant differences between two or more subgroups of engineering transfer students: 1) Established Peer Community (Full Integration); 2) Large Institution; 3) more comfort spending time with friends from sending institution; and 4) Academic Transition (with Ease). For each construct and sub-item, we ran multiple 2-way ANOVAs to explore interactions effects between subgroups. The following paragraphs summarize statistically significant findings from our analyses.

For the construct Academic Transition (with Ease), we identified a statistically significant interaction effect between type of institution and type of pathway [5 of 5 imputations]. Figure 6 illustrates that both vertical and lateral transfer students at more selective institutions found the Academic Transition more challenging. Relative to the other comparison groups, lateral transfer students at open enrollment institutions reported higher levels of agreement with the construct Academic Transition (with Ease). There is a limitation associated with this finding, however. Because of unequal variance and unequal sample size for these particular groups for this variable, the data did not meet all assumptions for an ANOVA, so caution should be taken in interpreting this finding.
6.3 Discussion

Drawing on data from a large and diverse sample population, an objective of these analyses is to increase understanding and awareness of areas of variation between subgroups of engineering transfer students in their perceptions of the adjustment process and social support at their receiving institutions. Our comparison of means based on student status as Hispanic/Latino yielded the largest number (n=5) of statistically significant differences; comparisons based on type of pathway and student status as first generation college student equally yielded the least number (n=1) of statistically significant differences. Effect sizes for statistically significant differences were either small or mid-range.

In general, participants reported fairly positive responses to constructs and sub-items related to transfer student integration and the adjustment processes at receiving institutions. For example, participants (in aggregate) generally agreed with the sub-item “easy to find my...
way around campus” and constructs Established Peer Community (Full Integration) and Fitting into Community (with Ease). They disagreed with the construct Large Institution and sub-item “feeling alienated at [receiving institution].” While participants’ response means leaned positively, our data suggest that there is still room to improve transfer receptivity and students’ experiences with the post-transfer adjustment process. For example, participants from the more selective institutions in our study (two of the largest institutions in the nation with over 50,000 students) reported lower levels of disagreement with the construct Large Institution; this finding suggests that they experienced more difficulty during the adjustment process because of institution size and logistics of attending a large institution. Similarly, Townsend and Wilson (2006) identified size of institution as one obstacle to transfer student integration.

Participants at open enrollment institutions and participants who identified as first generation college students both reported lower levels of agreement with the construct Established Peer Community (Full Integration), which may be an area for concern. At minimum, this finding raises the question of why—do lower levels of agreement to Established Peer Community (Full Integration) reflect a lack of need for academic peer support or a lack of awareness of the need for academic peer support? Based on the nature of closed ended questions employed in this study, we are not able to fully explore answers to these questions, but it is an area worthy of further investigation. Also worthy of more investigation, this finding could relate back to Competing Personal Demands, as both of these subgroups reported significantly higher problem levels than their respective counterparts (see Competing Personal Demands, reported in 4.2.2 and discussed in section 4.3). Drawing on prior studies that identify environment pull as an obstacle to transfer student integration (Packard et al., 2011; Reyes, 2011; Townsend & Wilson, 2009), it is feasible that Competing Personal Demands could be a reason for open enrollment and first generation participants’ lower agreement levels to Established Peer Community (Full Integration). Our future analytical modeling work will investigate this relationship.

In aggregate, participants were generally indifferent (i.e., neither agreed nor disagreed) about their comfort level or preferences for making friends with other transfer students and spending time with friends from their sending institution. This finding corroborates results
from a related study; Ogilvie and Knight (under review) found that engineering transfer
students wanted more opportunities both during and after orientation to meet both transfer
students and non-transfer students in their engineering departments. Participants highly
valued peer-to-peer connections within their major, and their peers’ status as transfer or non-
transfer was not as critical. With respect to comfort levels for “spending time with
friends...[from] their previous institution,” participants at open enrollment institutions and
participants who identified as Hispanic/Latino both reported lower levels of disagreement. This
finding suggests that students from those subgroups may have preferences for spending time
with friends from their previous institutions. Given that the two open enrollment institutions
included in this study have strong, active regional partnerships with the local 2-year
institutions, participants may have friendships that formed at the 2-year institution that carried
over to the 4-year institution (Ogilvie & Knight, under review). This finding is not an area of
great concern so long as those students are not isolated from the rest of the 4-year student
body.

Finally, the construct Academic Transition (with Ease) surfaced as one area where
participants’ response means (in aggregate) were less than positive, which is an area of
concern. Vertical transfer students and transfer students at more selective institutions
reported lower levels of agreement with the construct Academic Transition (with Ease); this
finding suggests they found the academic transition to be more challenging than their
respective counterparts. While both of these findings may seem intuitive, to our knowledge, no
other studies have made this direct comparison between transfer students at open enrollment
institutions and those at more selective institutions. As for the vertical transfer students and
their lower levels of agreement, this result was not a surprise based on findings from prior
research (Shealy et al., 2013; Townsend, 2008). Using GPA data from a relatively small sample
of vertical and lateral transfer (n=121), Shealy et al. (2013) illustrate that GPA shock was more
common for vertical transfer students than for lateral transfer students. Similarly, through
interviews and focus groups, Townsend (2008) identified that vertical transfer students had to
stretch to meet university expectations more often than lateral transfer students. Our
quantitative result for vertical transfer students and their perspectives on Academic Transition (with Ease) builds and expands on findings from both of these studies.

Conversely, we did find it surprising that non-Hispanic/Latino students also reported lower levels of agreement to the construct Academic Transition (with Ease). Based on participants’ responses in this study, it appears that non-Hispanic/Latino transfer students could potentially be an overlooked demographic group who need more assistance with the academic transition and acclimating to their new receiving institution (i.e., Fitting into Community, Large Institution). It may be especially important to explore this subgroup in greater detail because this group has not been the primary target audience or focus of more traditionally structured student support programs in engineering (e.g. diversity engineering programs, minority engineering programs, women in engineering programs) (Lichtenstein et al., 2014; Riley et al., 2014).
7.0 Implications

7.1 Implications for Research

Results from this study offer a number of implications for research. First, our study contributes to a shift in research on transfer students from an agenda that primarily focused on input/output models for predicting transfer students’ outcomes to one that focuses on increased understanding of transfer students’ experiences with post-transfer transition processes. Our study yields findings that help us better understand engineering transfer students’: 1) perspectives on problems encountered during the post-transfer transition process; 2) general satisfaction with and perceptions of their receiving institutions; and 3) perceptions of the adjustment process and social support available at their receiving institutions. For example, engineering transfer students cited “cost of attendance,” “the transfer credit process,” and meeting “high academic expectations” as their top three problems post-transfer to the receiving institutions. While perceptions of their receiving institutions were generally positive, engineering transfer students experienced varying challenges during the adjustment period, which suggests there are opportunities for receiving institutions to further improve transfer receptivity and expedite academic integration for engineering transfer students. Adding new information to a growing body of literature on post-transfer transition processes, these findings can be used to help answer the how and why questions relevant to transfer student persistence and degree attainment.

Second, our study advances research on post-transfer transition processes by filling the need for more: 1) multi-institutional studies; 2) discipline specific studies; and 3) studies that disaggregate data to explore subpopulations of transfer students (Bahr et al., 2013). Our findings demonstrate the nuances that exist between subgroups of engineering transfer students. For example, the academic transition was perceived as a bigger challenge by transfer students at more selective institutions, vertical transfer students, and non-Hispanic/Latino transfer students than their respective counterparts. With this study, we provide additional evidence to illustrate the importance of disaggregating data during research analyses, especially if we seek to increase understanding and awareness of areas of variation for subgroups of engineering transfer students (Lichtenstein et al., 2014; Ro & Knight, 2016; Ro et
al., 2016). Based on our findings, future research on engineering transfer students should seek to account for such differences, as opposed to considering “transfer students” as a single block of students who share similar experiences.

Finally, through this study we identified multiple areas worthy of future research. Further investigation is warranted to determine the underlying cause of higher problem ratings from lateral transfer students with “the transfer credit process,” for example. Similarly, additional research is needed to better understand students’ perceived needs and explain why students at open enrollment institutions reported lower levels of agreement than students at more selective institutions to the statement “student services are responsive to student needs.” And finally, additional research is needed to understand why participants at open enrollment institutions and participants who identified as first generation college students both reported lower levels of agreement with the construct Established Peer Community (Full Integration), which is a potential area for concern. We wonder, for example, whether lower levels of agreement to that construct reflect a lack of need for academic peer support or a lack of awareness of the importance of academic peer support.

7.2 Implications for Policy and Practice

Our study also has multiple implications for policy and practice, especially for 4-year institutions that seek to advance engineering transfer student success, improve transfer receptivity, increase engineering transfer student graduation rates, and reduce to time to degree completion. First, this study brings to light engineering transfer students’ perspectives on problems encountered during the post-transfer transition process. Findings from this research can help administrators, faculty members, and staff at sending and receiving institutions key in on the more problematic aspects of transfer that require additional attention. Second, this study captures engineering transfer students’ perceptions of their receiving institutions and perceptions of the adjustment process. Based on participants’ perceptions of their receiving institutions and adjustment processes, this study provides an assessment of strengths and weakness at the four research sites with respect to student integration and transfer receptivity. We take our results a step further and raise awareness of
subgroups who may face unique challenges during post-transfer transition processes. These findings can help administrators, faculty members, and staff at receiving institutions design or customize programs and services to address pressing needs and further enhance engineering transfer students’ perceptions of fit (academically and socially) with their new institutions. The following recommendations for policy and practice are customized based on findings from this research.

7.2.1 Recommendations. Receiving institutions should seek out solutions that jointly address engineering transfer students’ challenges with “the transfer credit process” and “cost of attendance.” While highest levels of concern around “the transfer credit process” were raised by lateral transfer students and students at more selective institutions, improvements to the transfer credit process could simultaneously address “cost of attendance” – an area of heightened concern for transfer students who are vertical transfers, Hispanic/Latino, and/or first generation college students. Solutions that control students’ cost by adopting processes and policies that improve efficiency of transfer credit and reduce time to degree completion (i.e., transferred courses count as actual credit towards engineering degree plan) would yield benefits for multiple subgroups of engineering transfer students. Alternatively, increased financial support (including on campus employment) is needed to help transfer students who do not qualify for need-based grants and are required to take out loans to pay for their education and/or work while enrolled in school. Moreover, adequate financial support helps transfer students overcome environmental pull factors that interfere with their academic plans by placing extra demands and strain on students’ time.

Receiving institutions should be more intentional in their efforts to further enhance transfer receptivity on their respective campuses. While there is equal opportunity for improvement, our data suggest that transfer receptivity may be more limited (or lacking to a greater extent) on the campuses of more selective institutions. Participants at more selective institutions reported favorable responses to constructs for Institutional Endorsement and Academically Engaging; however, they were also less enthusiastic based on their levels of disagreement with statements related to “students being treated like a number” and “[at start] it was difficult learning how things worked on campus.” These particular issues appear to be
more prominent than transfer student bias for participants at more selective institutions. Moreover, findings from our study suggest that vertical transfers at open enrollment institutions could also benefit from early interventions (i.e., administrative efforts, programs, and services) that facilitate student integration and improve transfer receptivity. Therefore, while early interventions at open enrollment institutions may need to focus attention on the needs of vertical transfer students, selective institutions should be more attentive to the needs of both vertical and lateral transfers. Specific recommendations from students not captured within this set of closed-ended survey items can be found in Ogilvie and Knight (under review) and Davis et al. (2017).

Receiving institutions should employ strategic partnerships and focused efforts and interventions to address transfer students’ perceived challenges with meeting “high academic expectations” and navigate the academic transition. Highest levels of concern around meeting “high academic expectations” rest with students at more selective institutions. Therefore, stronger coordination between elite (more selective) 4-year institutions and regional 2-year institutions is necessary to close gaps in academic expectations and create a seamless transfer for engineering students who enroll in these more selective institutions. Berger and Malaney (2003) found that transfer students who knew what to expect post-transfer reported higher levels of satisfaction with their receiving institutions. Thus, early and accurate exposure to the academic rigor and expectations that exist at receiving institutions is critical to preparing students to navigate the academic transition with greater ease. Promising models that seek to accomplish this include Texas A&M University’s Engineering Academies, which offers co-enrollment to students simultaneously at both 2-year and 4-year institutions. For more details, refer to Perez et al. (2016) and Cortez et al. (2015).

Guided by Tinto’s theory of integration, we know there is a relationship between students’ perception of fit with the institution and their persistence (Tinto, 1993). Moreover, Townsend and Wilson (2009) demonstrate that Tinto’s theory is relevant to understanding and explaining the academic and social integration needs of transfer students. In short, they found that transfer students tend to prioritize academic integration over social integration; and, their needs for social integration are often satisfied through connections made during their academic
integration (Townsend & Wilson, 2009). Informed by these findings and results from our study, we conclude that receiving institutions should place more emphasis on designing programs, services, and networks that fast-track academic integration for engineering transfer students at their new institutions. Proactive efforts, led by faculty and staff at receiving institutions, that engage transfer students early on to satisfy academic integration needs would expedite students’ post-transfer adjustment period and further enhance their perceptions of fit (academically and socially) with their new institutions. Intended outcomes include transfer students who are better connected to their peers, well-informed on available resources, and overall more confident, independent, and self-sufficient.

Past efforts have focused primarily on engaging and increasing retention rates of first-year students in engineering; however, programs and services designed to meet the integration needs of engineering transfer students should no longer be an afterthought. Moving forward, receiving institutions could create transfer student learning communities (staffed with peer mentors representing each engineering discipline) that meet weekly for the first two months of the semester and then taper off during the later part. Additionally, receiving institutions could pre-register or assign engineering transfer students to similar sections of basic sequence courses (e.g. Physics, Static, Mechanics of Solids, Thermodynamics) to facilitate the formation of study groups for these new students.
**8.0 Conclusion**

In this study on engineering transfer students’ experiences with post-transfer transition processes at 4-year universities, we identified: 1) two emergent constructs from their perceptions of problems during transfer to their receiving institution; 2) four emergent constructs from their perceptions of their receiving institutions; and 3) four emergent constructs from their perceptions of the adjustment process and social support at their receiving institutions. “Cost of attendance,” “the transfer credit process,” and “high academic expectations” surfaced as the top three problems for engineering transfer students’ during transfer to their receiving institutions. While perceptions of their receiving institutions were generally positive, engineering transfer students experienced a variety of challenges during the adjustment period (e.g., Academic Transition, difficulty at start with “learning how things work on campus”).

In our comparison of subgroups of engineering transfer students, we identified multiple cases where participants’ response means were different. Among those most notable, we found that students from more selective institutions reported statistically significantly greater challenges than their counterparts with the following: 1) problems – “transfer credit process,” “high academic expectations”; 2) perceptions of receiving institution – at start “difficult learning how things work on campus”; and 3) perceptions of adjustment process – the Academic Transition. Lateral transfer students and transfer students at more selective institutions aligned with respect to greater challenges with “the transfer credit process,” whereas vertical transfer students and transfer students at more selective institutions aligned with respect to greater challenges with the academic transition and at the start finding it difficult to learn how things work on campus.

Findings from this study suggests there are opportunities for receiving institutions to further improve transfer receptivity and expedite academic integration for engineering transfer students. Proactive efforts, led by faculty and staff at receiving institutions, that engage transfer students early to satisfy academic integration needs would expedite students’ post-transfer adjustment period and further enhance their perceptions of fit (academically and socially) with their new institutions.
References for Manuscript 3


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Chapter 6: Conclusions

6.1 Summary

The purpose of this study was to develop a clearer understanding of transfer student pathways as a potential means to broaden participation in engineering. This research joins and expands the small body of literature on engineering transfer students and brings data to higher education administrators so they can make more informed adjustments to their existing institutional practices.

Structured as a manuscript style dissertation, this investigation offers a synthesis of recent literature on engineering transfer students and yields important findings on engineering transfer student movement through the higher education system at two distinct phases: 1) at the beginning of their higher education pathways in an investigation of students' reasons for starting at another institution and factors that influence their decisions to transfer; and 2) at the phase immediately following transfer in an investigation of the transition experience for students who transfer to a 4-year institution.

6.1.1 Conclusions and Implications from Manuscript 1 - Transfer Students in Engineering: A Synthesis of Recent Literature Focused on Characteristics, Outcomes, & Experiences. Four overarching themes emerged from a synthesis of recent literature on engineering transfer students. First, the transfer pathway offers the potential to broaden participation and diversify the engineering workforce. Second, engineering transfer students vary and should not be considered a homogeneous group. Third, for most students, the transfer pathway to an engineering degree is not 2+2 (i.e., time to degree). Fourth, transfer students in engineering face barriers throughout the pathway. Findings from this synthesis suggest that future research on engineering transfer students and their experiences should disaggregate and analyze data by subgroups to more fully understand this unique student population. That approach was adopted in my dissertation research in Manuscripts 2 and 3.

Future research should place less emphasis on generating input/output models to predict outcomes for engineering transfer students (i.e., GPA performance); instead, future research should shift focus toward investigating students’ experiences while they are enrolled in the postsecondary education system. Those kinds of studies can help increase understanding
of how and why some students succeed and others do not. Additional areas worthy of future investigation include identifying factors that hinder transfer for pre-engineering students as well as factors that increase time to degree completion (post-transfer) for transfer students in engineering.

6.1.2 Conclusions and Implications from Manuscript 2 - Pursuing Alternate Pathways to a 4 Year Engineering Degree: Understanding Students’ Reasons for Starting at another Institution and Factors that Influence Their Decisions to Transfer. Transfer students identified Financial/Affordability, Non-Academic Commitments, and Academic Flexibility as the top reasons why they started their postsecondary educations at a different institution than their current one. Top factors in students’ decisions to transfer to their current 4-year institutions included: Institutional Prestige, “convenience and location”, Financial/Affordability, and Ease of Transfer. With the exception of Institutional Prestige and Ease of Transfer, students from open enrollment institutions, vertical transfer students, Hispanic/Latino students, and first-generation college students reported higher levels of importance than their counterparts for each of the top reasons and factors highlighted above. Additionally, we found that both Hispanic/Latino students and first-generation college students, on the vertical transfer pathway in particular, are making postsecondary pathway decisions with increased levels of concern around affordability. This finding was even more acute for Hispanic/Latino students who transferred to open enrollment institutions.

This research extended findings from prior studies – both qualitative and quantitative - by ranking reasons and factors and adding additional layers of granularity that identify differences between subgroups in the sample. Schools of engineering interested in boosting enrollments can use our findings related to factors that influenced engineering transfer students’ decisions to transfer to their current institution to better position themselves to appeal to (and capture) a larger market of engineering transfer students in the future. To tap into the broader base of human capital that resides in 2-year public colleges as a means to bolster STEM talent in the U.S. workforce, findings from this study suggest that institutions of higher education must think about marketing and branding that that goes beyond promotion of academic rankings and to embrace new messaging and practices that address affordability and
academic flexibility. In addition, based on results in Manuscript 2, future research should investigate the role of institutional agents in helping engineering transfer students navigate transfer processes. We are unable to make a strong claim about whether those individuals are simply not important or effective or whether students had infrequent interactions with such agents. Additional research should focus on those questions.

6.1.3 Conclusions and Implications from Manuscript 3 - Problems, Perceptions, and Adjustments: Understanding the Transition Experience for Engineering Transfer Students at 4-Year Institutions. Cost of attendance, the transfer credit process, and high academic expectations surfaced as the top three problems for engineering transfer students’ during transfer to their receiving institutions. While perceptions of their receiving institutions were generally positive, engineering transfer students experienced a variety of challenges during the adjustment period (e.g., Academic Transition, difficulty at start with “learning how things work on campus”). Additionally, we found that students from more selective institutions reported greater challenges than their counterparts with the following: 1) problems – transfer credit process, high academic expectations; 2) perceptions of receiving institution – at start “difficult learning how things work on campus;” and 3) perceptions of adjustment process – the Academic Transition. Findings from this study suggests there are opportunities for receiving institutions to further improve transfer receptivity and expedite academic integration for engineering transfer students. Proactive efforts, led by faculty and staff at receiving institutions, that engage transfer students early on to satisfy academic integration needs would expedite students’ post-transfer adjustment period and further enhance their perceptions of fit (academically and socially) with their new institutions.

This study adds new information to a growing body of literature on post-transfer transition processes, and it demonstrates the nuances that exist between subgroups of engineering transfer students. Findings from this research can help administrators, faculty members, and staff at sending and receiving institutions key in on the more problematic aspects of transfer that require additional attention. Future investigation is warranted to better understand students’ perceived needs and explain why, for example, students at open enrollment institutions reported lower levels of agreement than students at more selective
institutions to the statement “student services are responsive to student needs.” Similarly, additional research is needed to determine the underlying causes of higher problem ratings from lateral transfer students with “the transfer credit process” relative to vertical transfer students.

6.2 Conclusions across the Study

A review of findings across manuscripts yields additional insights that further increase our understanding of engineering transfer students. First, in Manuscript 2 and 3, we observed that four subgroups of engineering transfer students (i.e., students at open enrollment institutions, Hispanic/Latino students, first generation college students, and vertical transfer students) consistently reported significantly higher levels of concern about cost and affordability; these concerns have influenced their postsecondary pathway decisions as they moved though the higher education system from one institution to the next.

Second, we observed different patterns in the results from Manuscript 2 and 3. In our investigation of students’ experiences with post-transfer transition processes (Manuscript 3), significant differences between participants emerged primarily on the basis of institution type. Conversely, significant differences between participants in our investigation of reasons and factors that influence students' postsecondary pathway decisions (Manuscript 2) were distributed across all four subgroups (i.e., type of institution, type of pathway, student status as Hispanic/Latino, student status as first generation college student). Additionally, effect sizes for these differences (Manuscript 2) tended to be larger in magnitude than those identified in Manuscript 3. These findings suggest that perspectives and experiences of participants in our study were more different at the beginning of their higher education pathways than at the phase immediately following transfer to their new receiving institutions. Thus, engineering transfer students may vary more broadly in their reasons for starting their postsecondary educations at another institution; however, within the confines of specific types of receiving institutions (i.e., open enrollment institutions, more selective institutions), their experiences with post-transfer transition processes tend to be more similar. Although this study produced new findings to increase understanding of engineering students who completed the transfer
process into a 4-year institution, it did not include perspectives from students who initially wanted to transfer into engineering but were unsuccessful in their efforts. As a result, future research on pre-transfer students in engineering is warranted. In addition, future research on students from this particular demographic will require strong partnerships with 2-year institutions who would play a central role in identifying those students.

6.3 Next Steps on the NSF Project

This study serves as foundational work for a larger investigation, funded by the National Science Foundation (NSF EEC - 1428502), that explores the relationship between transfer student capital and academic achievement and degree attainment for engineering transfer students (Ogilvie et al., 2015, 2016, 2017). Findings from the aforementioned manuscripts inform the second phase of quantitative analyses, which will include building analytical models to explore relationships between transfer student capital and: 1) outcome variables (academic achievement and degree attainment), and 2) adjustment variables for engineering transfer students. The proposed model to investigate the role of transfer student capital in academic achievement and degree attainment for engineering transfer students is illustrated in Figure 1. In addition to gathering and interrogating the survey data described in this dissertation, our team and research partners have also obtained student record data for each of the survey respondents. These institutional data include information about students’ mode of admission, major, transferred credit hours, enrollment patterns throughout their time at the 4-year institution, overall university and major grade-point averages, academic performance data for their first four semesters post-transfer, and degree attainment information when applicable. By linking education outcome data to survey responses on respondents' experiences with navigating the transfer process and transitioning between institutions, the study takes a holistic approach to understand engineering transfer students and their pathways to an engineering degree.
Figure 1. Future work: proposed model to investigate the role of transfer student capital in academic achievement and degree attainment for engineering transfer students; adapted and modified from Laanan et. al.’s framework for Transfer Student Capital (Laanan & Hernández, 2011; Laanan et al., 2010b). University records serve as the data source for variable(s) identified with an asterisk*.

Although beyond the scope of my dissertation specifically, I also was responsible for collecting qualitative data via 18 semi-structured focus groups with 84 students, administrators, faculty, and staff who were either transfer students or whose university roles require interaction with and support of transfer students. Focus groups were held at the four 4-year institutions described in the dissertation as well as at their partner community colleges. Focus group protocols used Laanan’s transfer student capital framework to frame interview questions, which will allow for proper mixing with the quantitative data in future analyses. The objectives of these interviews were to identify: 1) institutional policies and practices that facilitate success and enable transfer pathways into engineering at 4-year universities for transfer students, 2) ways institutions hinder transfer students in their transition to engineering at 4-year universities, and 3) ways institutions help students accumulate and leverage their transfer student capital. All interviews were audio recorded and transcribed. High-level summaries of those focus groups—as well as institutional reports of survey data—have been provided to each partner institution.

Collectively, our project will continue bringing qualitative and quantitative findings to higher education administrators as well as the broader scholarly community to improve
understanding of barriers and perceptions that prevent more students from transferring into engineering at 4-year institutions. We hope our research helps institutions and policymakers make informed adjustments to their existing institutional practices and policies.
Complete Reference List


DISСERТАTION: Transfer Student Pathways to Engineering Degrees


DISSEPTION: Transfer Student Pathways to Engineering Degrees


DISCUSSION: Transfer Student Pathways to Engineering Degrees


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DISSERTATION: Transfer Student Pathways to Engineering Degrees


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Ogilvie, A. M., & Knight, D. B. (under review). Transfer students’ recommendations for enhancing success and easing the transition into the middle years of engineering at receiving institutions.


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