Perceived Barriers to and Supports for Transfer to a STEM Bachelor's Degree Among Continuing-Generation and First-Generation Community College Students

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Curriculum and Instruction
(Integrative STEM Education)

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Keywords: first-generation college students, community college transfer, science, technology, engineering, and mathematics (STEM)

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ABSTRACT
(Academic)

This study examined the social and environmental supports and barriers that community college students perceive during their pursuit of transfer to a four-year college or university for the purpose of completing a bachelor’s degree in a STEM (Science Technology Engineering Math) major, and how these factors relate to their perceived likelihood of degree attainment. A total of 307 students across seven Virginia community colleges responded to an online survey including validated instruments for measuring perceived supports, barriers, and persistence intentions. Statistical analyses explored differences between first-generation and continuing-generation student perceptions based on two widely used but contrasting definitions of first-generation college student. The first manuscript addresses differences in student perceptions. First-generation students with no parental college experience had significantly lower reported support scores based on their lower perceived financial resources. No other differences were found. The second manuscript explores the relationship between student support and barrier perceptions and their persistence intentions, or perceived likelihood of successfully completing their degree. The entire sample of community college students demonstrated theory-consistent correlations. However, contrary to most published research that has taken place in the four-year setting, results for first- and continuing-generation subgroups were inconsistent. This study serves as a foundation for further research performed at the community college, where results may vary compared to four-year contexts.
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ABSTRACT
(Public)

Most published community college transfer research takes place at four-year colleges and universities, after students have successfully transferred. Less is known about the experiences of students pursuing transfer. This study examined the social and environmental supports and barriers that community college students perceive during their pursuit of transfer to a four-year college or university for the purpose of completing a bachelor’s degree in a STEM (Science Technology Engineering Math) major, and how these factors relate to their perceived likelihood of degree attainment. A total of 307 students across seven Virginia community colleges responded to an online survey including validated instruments for measuring perceived supports, barriers, and persistence intentions. Statistical analyses explored differences between first-generation and continuing-generation student perceptions based on two widely used but contrasting definitions of first-generation college student. The entire sample of community college students demonstrated theory-consistent correlations. However, contrary to most published research that has taken place in the four-year setting, results for first- and continuing-generation subgroups were inconsistent. This study serves as a foundation for further research performed at the community college, where results may vary compared to four-year contexts.
Dedication

This work is dedicated to the memory of Mr. Lewis W. Kimber, my fifth-grade teacher.
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Chapter 1: Introduction

Overview

America’s 936 public community colleges serve a unique role in higher education. They are tasked with preparing some students vocationally for the (often local) workforce, while preparing others to transfer to traditional four-year degree programs. Graduating students may leave with vocational certificates, associates degrees in a discipline, or transfer-oriented associates degrees for continuing to four-year schools. Students may also transfer credits to a four-year school without earning a degree from the community college. Although around 40% of all undergraduate students in the United States are studying at a community college (National Center for Education Statistics [NCES], 2021), most higher education research focuses on traditional four-year colleges and universities. This is especially unfortunate because it means the different social and environmental factors that community college students face compared to their four-year peers are often not accounted for in higher education research. The gap is problematic because community college students who intend to transfer to a baccalaureate program are far more likely to drop out compared to their peers at four-year schools (Causey et al., 2022) - meaning they never even reach the space in which most research takes place. Differences between two-year and four-year students range from easily quantifiable demographics and performance data to unique sociocultural experiences that cannot be fully articulated through statistics.

Some community college population demographics mirror those of four-year schools, while others show marked differences. Compiled data from the American Association of Community Colleges (AACC, 2022) and the National Center for Educational Statistics (2022) for the 2019-2020 academic year reveal both similarities and differences in population
demographics between community colleges and bachelor’s+ granting institutions. Community colleges and four-year colleges and universities have about the same percentage of female students (60%), Black or African American students (7%), Asian and Pacific Islander students (7%) and students who reported two or more races (4%). However, of the roughly six million students currently enrolled in public community colleges, 27% are Hispanic/Latino (versus 14% in four-year schools), 44% are White (versus 51%), and 1% are Native American (versus 0.5%) (AACC, 2022; NCES, 2022). By representation, community colleges have 50% of the national Hispanic/Latino college student population and 40% of Black and African American college students (AACC, 2022). Community college students also tend to be older than four-year college students. Whereas about 9% of students at four-year public institutions are 25 or older, at community colleges the number is 21% (NCES, 2021). While many comparisons end with gender, ethnicity, and age, these are not the only important sociodemographic categories by which public two-year colleges differ greatly from four-year institutions.

Approximately one-third of community college students nationwide are the first in their families to attend college (AACC, 2022). These first-generation college students, as well as those defined as not having a parent with a bachelor’s degree (Toutkoushian et al., 2018) are even more likely to be from lower-income households, be underrepresented minorities, have work commitments, and be responsible for dependent children or parents (Davis, 2010; Chen & Carrol, 2005; Pascarella et al. 2004). Nearly one third of American community college students work full-time (defined as 35 hours or more a week), with a total of 62% of full-time students working twenty or more hours a week, and 72% of part-time students working twenty or more hours a week (AACC, 2022). About 60% of public two-year college students are classified as independent compared to 36% of four-year undergraduates, while 32% are responsible for
dependents of their own, compared to 15% at four-year schools (NCES, 2015). Among students who are young parents aged 18 to 24 (single or otherwise), 47% attend community colleges, while only 15% attend public four-year colleges (Ryberg et al., 2021). Fifteen percent of community college students are single parents (AACC, 2022).

Given the diversity in age, culture, ethnicity, work experience, family obligations, financial stability, and academic and career goals, it should be expected that community college students have different experiences from their four-year counterparts. Despite the importance of two-year graduates and transfer students to the workforce, higher education research often omits community college students in studies that might otherwise yield different results. These differences have implications for outreach and retention efforts, as well as for development of methods to broaden the STEM graduate pipeline through community college transfer programs.

First-Generation College Students

According to multiple studies by the National Center for Education Statistics (NCES), about 50% of first-generation college students (defined as having no parental college) first attend two-year institutions after graduating from high school, with about 24% enrolling directly into four-year programs (Cataldi et al., 2018). First-generation students are far less likely than their continuing-generation counterparts (6% vs. 28%) to matriculate into a highly selective four-year institution after high school graduation. The 2017 report also points out the alarming generational disparity: while 42% of continuing-generation students had attained a bachelor’s degree within ten years of their sophomore year of high school, only 20% of first-generation students had done so (Redford & Hoyer, 2017).

Demographically and educationally, first-generation students share many similarities with community college students in general. According to the most recent (2015-2016) NCES
national postsecondary student financial aid study, parental income for first-generation students with no parental bachelor’s education is around $40,000, versus continuing-generation student parental income of around $90,000 (Radwin et al, 2018). First-generation students are more likely to attend college part-time while working more hours than continuing-generation students (NCES, 2018). College readiness is also a key issue with first-generation student populations, as 54% of students with no parental college education in their first or second year of college reported taking at least one a remedial course, compared to 31% of continuing-generation students. (Chen, 2016).

First-generation community college students are more likely to be female, older, employed full time, and supporting dependents (Nomi, 2005; NCES, 2019). Although they may take advantage of the much lower tuition rates for attaining a two-year degree or to lower the overall cost of a four-year degree through transfer, community college students in general, and first-generation community college students especially, are less likely to complete a two-year degree, transfer to a four-year school, or complete a STEM bachelor’s degree after transfer (Ishitani 2006; Nomi, 2005; Zhang, 2021). Demographic and degree completion data only tell part of the story. For instance, first-generation students “often encounter a campus environment and set of norms that are substantially different from those they previously experienced (Olson, 2014, p. 199).” Covarrubias et al. (2018) found through qualitative analysis that Hispanic/Latino and Asian American first-generation students were likely to encounter a “cultural mismatch”, where middle-class norms are different from those at home. These students were less likely to experience college as a function of independence, due to their interdependence with parents who often needed financial support, translation, and help taking care of children. Although there is a small but expanding body of research into the social and environmental factors that influence
first-generation students’ enrollment, persistence, and graduation in both community college and four-year schools, there is far less focus on the thousands of first-generation community college students who intend to transfer to a four-year degree program in a STEM field.

**Community College Transfer Students**

As many as 80% of students who begin their studies at a community college state that they intend to eventually earn a bachelor’s degree, yet only about 30% actually transfer, with only 13% completing a bachelor’s within six years (Shapiro, et al., 2017). Even in instances where community college transfer students’ attainment of a baccalaureate degree was similar to four-year students’, transfer students had lower wages eight years after first enrollment, partly due to delayed entry into the workforce because of credit loss at transfer (Xu et al., 2018). Community college students have also reported feeling the social stigma of entering a university from a two-year school (Shaw et al., 2019). Less is understood, however, about the experiences and beliefs of current community college students who intend to transfer to a four-year school. It is during this time at the two-year school, however, that retention and persistence are at greatest risk (see ACT, 2018). One avenue of research that is not robustly represented in the literature is the study of social and environmental factors, both supportive and antagonistic, that community college students experience during pursuit of transfer. Fortunately, there are applicable frameworks that can be used to help expand our understanding of these students’ experiences, with special attention to STEM transfer. Social cognitive career theory is one such framework, which considers psychological, social, cognitive, and external environmental factors in student career choice and educational persistence (Lent et al., 1994).
Social Cognitive Career Theory

Social cognitive career theory (SCCT) provides a framework for investigating career choice and academic persistence through the interplay of demographic characteristics, beliefs, interests, expectations, and external factors (Lent et al., 1994). Researchers use SCCT to investigate career interest and degree persistence among baccalaureate and graduate students across the spectrum of STEM fields. SCCT is primarily concerned with career and academic choice and development, and the role self-efficacy, outcome expectations, and career/academic interests play in goal choice and goal achievement (Lent et al., 1994). Self-efficacy beliefs refer to “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986, p. 391)." Outcome expectations are "beliefs about the consequences or outcomes of performing particular behaviors (p. 17)," and together with self-efficacy, assert influence over career interests and goals. SCCT studies often analyze how these factors contribute to STEM major persistence intentions, a subjective measure of an individual's perceived likelihood to continue to pursue a goal (Lent et al., 2003b; Lent et al., 2008; Lent et al., 2016). In most instances of SCCT research, the goal referred to by persistence intentions is successful graduation with a bachelor’s degree.

SCCT also considers the experiences and perceptions of students across socioeconomic class, race, and gender. Using the Contextual Supports and Barriers Scale (Lent et al., 2003b), researchers often determine the moderating effects of perceived social, family, financial, and instructional supports and barriers on students’ career goals and persistence intentions. However, more research is needed to compare perceived supports and barriers across demographics, including college generation status. Recently, researchers have used SCCT variables to predict first-generation college (university) students’ interest and persistence in math, science, and
engineering bachelor's degree programs (Navarro et al., 2019; Garriot et al., 2017, 2015, 2013; Olson, 2014). Despite the majority of SCCT studies focusing on four-year degree programs (Wang, 2013), the rich body of research and validated instruments can guide investigation at the community college.

**Rationale for the Study**

Community colleges account for nearly 40% of all higher education enrollment in the United States. Among the many roles they play is preparing students to transfer to four-year degree programs. Transfer-oriented associates degrees are an especially important part of the STEM workforce pipeline. Despite the importance of community college graduates and transfer students to the workforce, higher education research often omits community college students in studies that might otherwise yield different results. Even among racially homogenous populations, certain social factors influence two-year students in different and even opposite ways from their four-year college counterparts (Wang, 2013). In the literature, community college transfer research takes place most often at the four-year level, after students have successfully transferred.

Community colleges also have the largest share of first-generation college students (AACC, 2022) regardless of definition: those who do not have at least one parent with a bachelor’s degree, and those whose parents have never attended college. Understanding these first-generation students' challenges and perspectives is essential to developing interventions, advising, and curricula to increase overall community college graduation and transfer rates. Expanding this knowledge is especially consequential for students in STEM majors due to even greater disparities in transfer success compared to other major areas (Wang, 2016a). Gaps in the research are further exacerbated by disagreement on who qualifies as a first-generation college
student. The most widely used definition is a student whose parents or guardians have not attained a bachelor's degree (Ives & Castillo-Montoya, 2020). This definition is problematic for community college research because it inadvertently implies that community colleges, which typically offer the associate’s degree as their highest award, are not colleges.

Some scholars and organizations define first-generation students as those whose parents or guardians have at most a high school diploma, with no post-secondary education experience at all, while others define first-generation as those whose parents who have not attained a degree (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al., 2004). Even within and between federal and state governments, conflicting definitions are used (see Cataldi et al., 2018; Engle & Tinto, 2008). Davis (2010) argues that students whose parents have no post-secondary experience are "practically indistinguishable" from those whose parents have some college, but no bachelor's degree, and thus the "no bachelor's" definition should be used. This seems to be the prevailing opinion in both academic and government publications. However, the research that does distinguish between the two groups shows first-generation students whose parents have no postsecondary experience have lower household incomes, lower academic readiness benchmarks, and higher college dropout rates (Redford & Hoyer, 2017; American College Testing, 2016; Nomi, 2005). In their analysis of the multiple research definitions of first-generation college student, Toutkoushian et al. (2018) found that, depending on definition, the number of “first-generation” students in the 2002 nationwide Educational Longitudinal Study ranged between 22% and 77% of the total sample. Inconsistency in first-generation definitions makes it difficult to compare results across studies or make valid interpretations (LeBouef & Dworkin, 2021).
These two different definitions are often used arbitrarily, and seldom compared, in published research. The “no bachelor’s” definition implies that students with no parental postsecondary education will experience similar obstacles to those whose parents may have associate’s degrees or some experience at a four-year college or university. The “no college” definition excludes parents who may have had very little experience in college and are not able to provide guidance, such as how class schedules work or how to fill out financial aid forms. This study used survey item responses to categorize and compare first-generation students using the two most widely used but contrasting definitions: (1) the monolithic “no bachelor’s” group of all students who do not have a parent with a bachelor’s degree; (2) the “no college” subgroup of students whose parent(s) never attended college. Each group was compared against its corresponding continuing-generation group.

Social cognitive career theory has been used to explore college student STEM career choice and persistence in universities across the world. The standard battery of SCCT survey instruments assesses science and math self-efficacy, interest, outcome expectations, and perceived barriers and supports related to successfully completing a bachelor’s degree. The original 36-item Contextual Supports and Barriers Scale (Lent et al. 2003b) is often replaced with a shorter version that has yielded similar quantitative results (Lent et al., 2005a). To better understand community college students’ perceptions of STEM transfer barriers and supports, this study used the full instrument. Comparing perceptions of social and environmental barriers and supports between different groups of first-generation students could further illuminate what little research exists into the differences between these groups, and how best to define and categorize “first-generation” student. Olson (2014) investigated SCCT as a framework to aid recent first-generation graduates in transitioning to the world of work, concluding its utility in helping
counselors to help graduates more realistically evaluate options and make decisions. Using the expanded 36-item scale and analyzing individual conceptual clusters (e.g., social influences, financial barriers, discrimination) could yield a richer narrative of not only the hurdles students face but the social and family resources they perceive despite such impediments.

A better understanding of the barriers and supports community college students face while pursuing STEM transfer could help college administrators, faculty, and staff positively impact student success. The results of this study expand upon the existing body of SCCT research by addressing a different population of students than previous research to test the strength of relationships to persistence intentions. Finally, by comparing social cognitive factors instead of performance metrics, this study builds a foundation for future research into community college and first-generation students.

**Problem Statement**

The problem this study addresses is the lack of knowledge about community college students’ perceptions of social and environmental supports and barriers associated with successful transfer to a four-year STEM degree program, and how these perceptions differ between first-generation and continuing-generation students.

**Purpose of the Study**

The purpose of this study is to address the research gap regarding first-generation community college students’ social and environmental supports and barriers pertaining to transfer to a four-year STEM degree program. To accomplish these goals, the study was designed to: (1) describe first-generation community college students in terms of demographics, persistence intentions, and perceived supports and barriers pertaining to the goal of STEM transfer; (2) determine if there are significant differences in these factors between first-
generation students whose parents have no college experience and first-generation students whose parents have some college but no bachelor’s degree; (3) determine if there is a relationship between perceived supports and barriers and persistence intentions for STEM transfer among community college students and whether results differ based on generation status.

The study took place across seven geographically and demographically diverse Virginia community colleges during the fall semester of 2021. An anonymous online survey was disseminated to about 10,000 qualifying students. The survey comprised demographic questions, parental education questions, the 36-item Contextual Supports and Barriers Scale, and the 4-item Persistence Intentions Scale. Statistical analysis of the 307 responses was used to answer the study’s research questions.

Research Questions

The following research questions were addressed in this study:

1. How do first-generation community college students compare to their continuing-generation peers in terms of perceived supports, barriers, and persistence intentions related to the goal of STEM transfer?

2. What is the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students?
Chapter 2: Literature Review

Chapter 2 provides a review of the literature concerning community college transfer research and theories of student engagement, quantitative and qualitative research on first-generation college students, definitions of STEM used in this study, the theoretical bases for the development of pre-college STEM interests, the social cognitive career theory framework, and instruments used in the study.

Community College Transfer Research

A review of articles found through online library keyword search from the last ten years, combined with a manual search of article titles from the last five years of the Journal of Higher Education, Research in Higher Education, Community College Journal of Research and Practice, Community College Review, and Journal of Career Development yielded four general transfer-related categories. These are: student integration and engagement; social and cultural capital; transfer pathways; community college penalty. While there is overlap among these categories (for instance, the goal of most is to investigate and predict transfer success), each are distinct enough to have their own research agendas and commonly used frameworks.

Student Integration and Engagement

One framework considered throughout much of the research is Tinto's (1975, 1997, 2012) model of student integration and institutional departure. Tinto argued that students who feel connected both academically and socially to an institution are more likely to remain enrolled and eventually graduate. Joining clubs, working closely with faculty, and collaborating with peers in academic competitions are examples of activities that create and strengthen these important connections. Students who do not create these relationships may feel isolated and are more prone to leaving college before graduation. Pascarella and Terenzini (1980) developed a
multidimensional instrument to assess Tinto’s model of student departure, and found support for its predictive validity, while noting the strong contributions of student-faculty relationships to persistence. Students in the study (N = 773) who persisted had on average an entire standard deviation higher score on the two scales that measured student-faculty relationships.

Many scholars have argued that Tinto’s initial framework is incompatible with community college due to the assumed limited social interaction outside of the classroom (Braxton et al. 1997; Deil-Amen, 2011). However later research by Tinto (1997) and others (Braxton et al. 1997; Deil-Amen, 2011) provide evidence for social engagement happening in and around the classroom. Tinto (1997) extended his framework by integrating collaborative learning pedagogies within the classroom, which he showed increased social engagement in the community college setting. Braxton et al. (2000) found active learning significantly influenced students’ social integration, institutional commitment, and intent to return. In a study of community college students (N = 1,668), Wang, Lee, and Wagner (2017) demonstrated active learning has a direct effect on transfer intent, as well as in indirect effect through its influence on transfer self-efficacy. A qualitative study of community college students by Deil-Amen (2011) revealed students believed interaction with instructors, staff, and other students contributed strongly to their feelings of integration. In short, the greater the integration into the life of the college, especially the academic life, the greater the likelihood of persistence (Tinto, 1997; Pascarella & Terenzini, 1980; Astin, 1993; Deil-Amen, 2011).

Like Tinto's model of student integration, Astin's (1993) student involvement theory (also called the I-E-O for Input-Environment-Output) integrates social and academic involvement, while incorporating more demographic and environmental inputs. The inputs in the model include demographic variables such as race, gender, age, intended major and degree outcomes,
academic achievement, and finances. Environmental variables include experiences such as part-time and full-time work commitments, joining school clubs, working with faculty, and living with roommates. These variables closely parallel the types of involvement that affect persistence in Tinto’s student integration model, with faculty-student involvement considered an environmental variable (Myers et al., 2015).

Unlike Tinto’s model, Astin’s environmental variables also include institutional characteristics such as type of school (2-year vs. 4-year, public vs. private) and selectivity of school. Outputs are student characteristics after leaving college, including degree attainment, final GPA, career goals, and even political and religious views (Myers et al. 2015). Student gains (output) are proportional to the amount and quality of the student’s involvement (input). Though one might sum up Astin’s (1993) theory of student involvement as “you get out what you put in,” it was part of the analytical framework upon which Myers et al. (2015) developed their measurement model for community college student engagement, and subsequently found no direct effect of engagement on persistence. The authors, suggesting that engagement might have indirect effects on persistence, urged further research. Jorstad et al. (2017), using Myer’s survey instrument, found engagement – especially with advisors/counselors – was a predictor of persistence, but social capital was not. The authors' measurement of social capital, however, was based on self-reporting of parental involvement during high school. Considering the quantitative and qualitative evidence for the persistence benefits of student engagement, further research is in order. The effects of engagement on self-efficacy and outcome expectations, which have been shown to contribute to goal persistence (Lent et al., 2001), are only recently being explored (Wang, 2016b).
Social and Cultural Capital

Bourdieu (1986) defines social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition (p. 248)," such as a family being acquainted with college-educated professionals. Research has demonstrated how social capital plays a role in college attendance aspiration, enrollment, degree aspiration, and completion (Chen & Starobin, 2019; Wells, 2008; Pascarella et al., 2004; Coleman, 1988), and is especially a concern for community college students pursuing STEM degrees (Kruse et al., 2015).

According to Bourdieu (1986), cultural capital is the accumulated cultural assets that represent symbolic wealth (such as education and manner of speech). Pascarella et al. (2004) prefer Bills’ (2000) definition, which might best be called the application of cultural capital, as the “degree of ease and familiarity that one has with the 'dominant' culture of a society (p. 90).” It is this dominant college culture that first-generation students often find conflicting (Laanan & Jain, 2016; Pascarella et al., 2004).

Transfer student capital (TSC: Laanan et al., 2010) is an adaptation of Bourdieu’s theories of social and cultural capital applied specifically to the community college transfer context. TSC "indicates how community college students accumulate knowledge in order to negotiate the transfer process, such as understanding credit transfer agreements between colleges, grade requirements for admission into a desired major, and course prerequisites (p. 176)." It is influenced by both social and academic adjustment factors. Laanan (2004) developed the Laanan Transfer Student Questionnaire (L-TSQ) to better understand community college post-transfer students' experiences and identify factors that predict academic and social adjustment. Community college factors measured were quality of effort and general perceptions.
of courses, activities, and transfer process. Construct and content validity were determined through literature review, pilot testing, revision, and consulting students, psychometrists, scholars, and researchers (Laanan, 2004). One general limitation not of TSC theory but of the instruments typically used to measure it, the L-TSQ specifically, is they are intended for students who have already successfully transferred to a four-year institution.

Maliszewski and Hayes (2020) performed a qualitative descriptive case study design with interviews, on-site observations, and document analysis to expand understanding of sources of TSC and how it is used by community college students to navigate transfer to a public four-year institution. Seventeen transfer students (6 males, 11 females; 9 White, three Black, two Asian/Pacific Islander, 1 Hispanic or Latino, 1 Other, 1 NA) at a large mid-Atlantic university were interviewed using a semi-structured interview instrument with twelve questions regarding transfer student capital. Based on constructs predicted by the TSC framework, the researchers performed inductive and deductive coding of interview transcripts. Trustworthiness was established by sharing interview transcripts with participants to ensure information was accurate and complete. Multiple data sources were used for triangulation among interviews, observations, and documents, resulting in the rich description of students' lived experiences.

Maliszewski and Hayes (2020) found that the most common way students gain TSC is through families and peers. Peers were especially influential both before and after transfer, as students developed expectations from peer advice and observation. This is poignant given the importance of vicarious experience to the concept of self-efficacy (Bandura, 1986). The importance of family in building TSC cannot be overstated. Many first-generation students' families have little to no TSC to impart. As other scholars have noted, first-generation community college students have limited socialization opportunities, yet interaction with faculty
and advisors increases TSC. As a qualitative study, these findings are not generalizable (Creswell & Creswell, 2018), but they are in general accordance with other qualitative studies of community college students, especially underrepresented minorities and first-generation students (e.g., Clayton et al., 2019; Mendez & Bauman, 2018; Phinney & Haas, 2003).

**Community College Penalty**

One of the most widely investigated general categories of the current transfer research is what is often called community college penalty. Community college penalty generally refers to the assumption that community college students who transfer to a four-year institution are less likely to graduate with a bachelor’s degree compared to their peers who began at four-year institutions (Lichtenberger & Dietrich, 2016). Some studies in this category focus on areas such as transfer credit penalty or earnings penalty, but they all have in common their emphasis on determining if and how community college students are at a disadvantage after transfer. Multiple studies have refuted the community college penalty, often by employing definitions and measures they argue are more appropriate for this population (Xu et al., 2018; Lichtenberger & Dietrich, 2016; Monaghan & Attewell, 2015).

Umbach et al. (2019) examined individual and institutional characteristics associated with successful community college STEM transfer. Based on the theory of human capital, in which individuals invest in themselves by developing new skills and knowledge to increase their value (Becker, 1993), the authors analyzed data on 20,259 students across 16 North Carolina four-year colleges who had successfully transferred from one of the state's community colleges. Using community college, four-year college, and demographic characteristics as independent variables, and yearly GPA, persistence to spring and following fall semester, and graduation as dependent variables, the authors employed a cross-classified multilevel model to create a
"complex nesting data structure" in which students are cross-classified in both the community college from which they transferred and the four-year school into which they had transferred.

One especially important finding of Umbach et al.'s (2019) research that corroborates some studies (e.g., Lopez & Jones, 2017) and contradicts others (e.g., Johnson & King, 2017), was that number of credit hours earned at the community college was positively associated with GPA at the four-year school, by an average of .002 GPA points per prior credit hour earned (Umbach et al., 2019). Those who transferred in with an associate's degree had higher GPAs the first year compared to students who transferred without earning a degree at the community college. A study by Johnson & King (2017), however, reported slightly higher number of transfer credit hours for students who did not complete a bachelor's degree, regardless of whether they transferred with an associate's degree.

A potential threat to the validity of Umbach et al.’s (2019) findings is that nothing was known about the rigor of the courses taken at the community college. Student experience was also not examined; GPA, persistence, ethnicity, and gender were the only student characteristics measured. The SAT/ACT scores and high school GPAs were not available for three-fourths of the sample. The researchers also found that students who transferred in with an associate's degree had higher GPAs. GPA has been shown to be a predictor of persistence, while attaining an associate's degree before transfer increases chances of bachelor’s degree completion (Kopko & Costa, 2016; Monaghan & Attewell, 2015).

Mooring & Mooring (2016) used logistic regression analysis to examine predictors of timely baccalaureate attainment for underrepresented minority community college transfer students. The study drew 730 students, who transferred from a community college to a four-year school between 2003 and 2004 with the intention of earning a bachelor's degree, from the
nationwide National Center for Educational Statistics [NCES] Beginning Postsecondary Students Longitudinal Study of 2004-2009 [BPS 04/09] of 16,960 students. Mooring and Mooring’s study used as one of its independent variables the credential earned at the community college - none, associates, or career certificate. Statistical analysis revealed that factors that predicted timely graduation after transfer to a 4-year program from a community college varied by ethnicity. Black students benefited more from being in a transfer-oriented program, while Hispanic/Latino students benefited more from earning a certificate before transfer. Generally, transferring through some type of structured pathway was more beneficial.

The authors state that one limitation of their study was that they could not measure by subgroupings of race/ethnicity given the available data. Another consideration for the validity of this study is the potential bias for inflated community college GPA. Grade inflation in community college has been documented widely (e.g., Schutz et al., 2015; Friedl et al., 2012). Despite these phenomena, Pascarella et al. (2004) found that after the initial "transfer shock", community transfer students' GPA calculated by four-year school courses are not significantly different from their native peers by their third to fourth year.

**Transfer Pathways**

The most studied category of transfer research in the past five years has been community college transfer pathways, which may be defined generally as "enrolling at a community college before transferring to a 4-year institution (Hu & Ortagus, 2019, p. 246)." These are different from guided pathways, "an umbrella term used to describe highly structured student experiences that guide students on the pathway to completion (VCCS, n.d.)", meaning either entry into the labor market or transfer to a four-year institution. What the research and initiatives have in
common is their focus on improving the processes of course taking, advising, and course transfer mobility of community college students.

Bahr et al. (2017) explored community college student participation in STEM transfer curricula, with a focus on underrepresented students and how they navigate transfer compared to college-intended pathways. Starting with data from roughly three million students who entered the California Community College system from 2000-2009, the authors narrowed the focus to students who had taken at least one transferrable STEM course. This yielded around one million students. Through exploratory analysis and mapping of actual pathways versus course sequencing established by the colleges, the authors found multiple racial/ethnic differences in points of entry and exit in the STEM curriculum. Underrepresented minority students passed math, chemistry, and physics courses at "consistently and substantially lower" rates compared to White and Asian students, resulting in a higher rate of exit from the curricula and lower rate of transfer (Bahr et al., 2017, p. 447).

Courses through which students entered the curricula were predictors of advancement (Bahr et al., 2017). Entry into lowest level courses such as college algebra or introductory chemistry (versus transferrable general chemistry) was associated with less likely advancement to the next course. Underrepresented minority and female students were more likely to enter the curriculum in these lower-level courses. It should be noted that this study did not take into consideration students who began in remedial math courses. Ignoring remedial math potentially eliminates as many as 60% of the population of community college students (Chen, 2016), so it is difficult to accept their findings as generalizable.
Summary

It is a peculiar characteristic of community college research that most of it takes place outside of the community college. Until 2017, major national educational datasets excluded as many as sixty percent of community college students because they were not enrolled for 12 or more hours a semester (AACC, n.d.). The U.S. National Center of Educational Statistics still publishes undergraduate retention and graduation rates for first-time, full-time students (See https://nces.ed.gov/programs/coe/indicator/ctr). The bulk of transfer-related literature is situated in the four-year college or university. It is certainly useful to know the traits and beliefs of successful transfer students. More effective policies and interventions at the two-year level can result from this knowledge. Likewise, studies of community college transfer pathways and student attrition can help us understand when and where students make the decision to persist or leave. What is almost missing in the literature is consideration of the student’s perspective of the transfer hurdle while still at the community college. Social capital and transfer student capital are recognized for the important roles they play, but social capital is often measured by a single variable, such as income, or parental education, while TSC is often only measured after transfer.

Research into student engagement, integration and persistence is heavily influenced by the theories of Astin (1993) and Tinto (1993), subsequent critiques, and development of more inclusive models (e.g., Nora, 2002; Navarro, et al., 2014). As models expand, they include more factors that are relevant to community college and first-generation students. One constant among them is the importance placed upon interaction with faculty and advisors. This is especially important for transfer students, who may not understand the complexities of articulation agreements or transfer credit loss (Taylor, 2019; Giani, 2019). The benefits of accurate advising and faculty-student interaction on persistence and transfer are especially important because these
are areas college faculty and staff can proactively work to improve. Finally, many studies ask the student their highest intended degree, but few ask the student how confident they are that they can transfer successfully, and what factors they believe may promote or impede their progress.

**First-Generation College Students**

The definitions researchers use have consequences. They determine who gets studied and who gets overlooked – not only in research but in policy and practice (Toutkoushian et al., 2018). There is no single definition of first-generation college student that researchers agree upon (Ives & Castillo-Montoya, 2020; Nguyen & Nguyen, 2018; Davis, 2010). Even the United States Department of Education and multiple entities of the United States government use contrasting definitions (see Cataldi et al., 2018; Engle & Tinto, 2008). Although many journal articles on first-generation students do not even supply an operational definition, a synthesis of the literature and government publications yields two general interpretations. The most widely used meaning of a first-generation student is one whose parents or guardians have not attained a bachelor’s degree (Ives & Castillo-Montoya, 2020). This is the definition used by the Department of Education for the Federal Pell Grant (Engle & Tinto, 2008), the Federal TRIO Program (Quinn et al., 2019).

The second-most widely used definition of first-generation college student refers to students whose parents’ or guardians’ highest educational attainment is a high school diploma, GED, or less, and thus have no postsecondary education experience (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al. 2004). Likewise, the non-profit College Board’s definition is “students whose parents’ combined highest education completed was a high school diploma (Smith, et al., 2018, p. 10).” These are distinctly different interpretations, each with its own assumptions about who should and should not be counted as first-generation. Failing to explore
these meanings "limits the capacity to grasp how these students’ backgrounds and identities shape their decisions and relationships to others and to institutions, and risks reproducing the very inequality that education researchers wish to mitigate (Nguyen & Nguyen, 2018, p. 148)."

The Virginia Community College System, in which this study will take place, defines first-generation student as “a student who indicated on the online admission application that both parents did not attend a postsecondary institution (Northern Virginia Community College, 2018, p. 1)." This is consistent with the American Association of Community Colleges’ definition: “students whose parents have had no postsecondary education (Nomi, 2005, p. 3).” Davis (2010) uses the "no bachelor's" definition and argues that first-generation student status should not be determined by parents' years of college. It is instead "about being competent and comfortable navigating the higher-education landscape, about growing up in a home environment that promotes the college and university culture (p. 4)." Davis' preference, however, assumes that "no bachelors" and "no postsecondary" first-generation students are indistinguishable. What little research there is comparing both groups, however, shows clearly distinguishable quantitative and qualitative differences.

To differentiate between the usage of the terms used in research, the term first-generation will refer to students whose parents have not attained a bachelor's degree, while first-generation ("no college") and first-generation ("no bachelor’s") will be used where the distinction is relevant. The “no bachelor’s” definition subsumes the “no college” students. When referring to students whose parents have at least some college experience but no bachelor’s, first-generation ("some college, no bachelor’s") will be used.
Differentiating the Definitions of First-Generation College Student

Davis's (2010) conflation of first-generation ("no college") and first-generation ("no bachelor’s") students into a single group assumes that “the social capital provided to students whose parents have not received a bachelor’s degree will not markedly differ from those for whom neither parent attended college (Allan et al. 2016, p. 487).” His belief that the two groups are "practically indistinguishable" seems to be the prevailing opinion, given the wide use of the "no bachelor's" definition of first-generation student in the literature and by the federal government. Given the disadvantages associated with lower family income and lower social capital discussed earlier, it is reasonable to expect that students whose parents have no postsecondary experience are even more likely to experience disadvantages or to experience them in greater magnitude. A handful of studies lend credence to this hypothesis.

Cataldi et al. (2018) found not only that continuing-generation college students (parental bachelor’s degree or higher) dropped out less often at 14%, but first-generation students whose parents had no postsecondary experience dropped out more often at 33% than those whose parents had some postsecondary experience but no bachelor’s degree, at 26%. The percentage of first-generation "no college" versus "some college, no bachelor’s" students whose highest math was trigonometry or precalculus was 27% versus 35%, respectively. In their analysis of the NCES Longitudinal Study of 2002 through 2012, Redford and Hoyer (2017) found first-generation college students, defined as those “whose parents do not have any postsecondary education experience” made up 24% of 2002 high school sophomores. Students “with at least one parent who had some postsecondary education experience but did not have a bachelor’s degree” accounted for 34% (p. 3). High school sophomore students with no parental postsecondary education were more than twice as likely to live in a household with a 2002
income of $20,000 or less compared to their peers with some parental postsecondary education (27% versus 12%). Only 6% of students with at least one parent with a bachelor’s degree fell into this low-income category. While 13% of first-generation ("no college") and 16% of first-generation ("some college, no bachelor’s") high school sophomores had a GPA of 3.50 and above, 29% of continuing-generation students met the same achievement. There were fewer differences in reasons for leaving college without first obtaining a credential, but one notable difference is 31% of first-generation "no college" students chose Conflicts with demands at home, versus 23% of first-generation "no bachelor’s" students.

A strong indicator of high school student intent to attend college is the taking of the ACT exam (American College Testing, 2016). Throughout 2012-2015, 18% of students taking the ACT were “no college” first-generation students, compared to 24% of the “some college, no bachelor’s” group and 23% of the “one or more bachelor’s” group. The percent of high school graduates meeting three or more ACT college readiness benchmarks (English, reading, mathematics, and science) averaged 18% for the “no college” group, 30% for the “some college, no bachelor's” group, and 50% for the “one or more bachelor’s” group (p. 10). For those in community college, the barriers experienced due to personal finances, cost of computers, and family responsibilities were all reported as more frequent and more urgent for first-generation ("no college") students compared to ("some college, no bachelors") first-generation students (Nomi, 2005). Reasons for attending a community college are similar for both groups, except for the purpose of transfer, where the "some college, no bachelors" group is roughly 48% versus about 35% for "no college" group. Collectively, these findings illustrate the two prevailing definitions of first-generation college student are not effectively interchangeable.
First-Generation Status and College Persistence

Regardless of definition, first-generation students face a surfeit of impediments in their journey through college, and they are less likely than continuing-generation students to complete a degree or transfer from a two-year school to a four-year college or university. Yet there are many who do succeed and, given the four-year-centric measures of success that have dominated government accountability and academic research, there may be more than are generally accounted for (Ives & Castillo-Montoya, 2020). Whereas most theoretical frameworks for student persistence were created with four-year schools and universities in mind, community college student persistence issues are qualitatively different from those of four-year schools (Webb, 1989). Although the intersection of first-generation and STEM is represented in the literature, there is very little coverage of how successful graduates describe the attitudes, beliefs, and supports that enable their success (Burnett, 2017). What little there is, however, shows similar results to studies about successful first-generation students in general. These students succeed through hard work and resilience, actively seeking interaction with and mentorship from faculty, seeking help from college advisors and counselors, having a love for learning and their major, and having a supportive family.

Multiple studies reported students' belief in the role of hard work in their success. This was especially true of minority students, many of whom learned the value of industriousness from their working-class parents (Blackwell & Pinder, 2014; Gibbons & Woodside, 2014). Pascarella et al. (2004) observed that first-generation students who persisted in degree programs at four-year institutions were resilient enough that their initial disadvantages getting to the four-year school did not translate into further ones. Academically resilient students are those who persist despite barriers and disadvantages (Alva & Padilla, 1995), and have been associated with
a strong work ethic (Longwell-Grice et al., 2016). Perhaps this is one reason first-generation students with and without parental postsecondary exposure find themselves employed after earning a bachelor's just as often as continuing-generation graduates (Cataldi et al., 2018).

Quantitative and qualitative studies have revealed higher levels of resilience in first-generation students compared to their continuing-generation peers (Alvarado et al., 2017; Covarrubias et al. 2018). Often this hard work was inspired by the opportunity of triumphing over poverty or the general appeal of a high salary in a STEM field (Azmitia et al. 2018; Longwell-Grice et al., 2016; Conrad et al., 2009). Even first-generation minority graduates who did not have their family's support maintained their resilience and their goal to create a better life for themselves (Blackwell & Pinder, 2014). Intrinsic motivation, too, including love of learning, especially of science, was a major factor for many first-generation students (Portnoi & Kwong, 2019; Liversage et al., 2018; Demetriou et al., 2017; Longwell-Grice et al., 2016; Gibbons & Woodside, 2014; Archer et al. 2012). Often this enthusiasm was fueled by passionate faculty (Zhang & Ozuna, 2015; Gasiewski et al. 2012). Interaction with faculty was one of the most noted contributions to success, which is unsurprising given the evidence for faculty-student engagement to persistence (Nora et al., 2005; Tinto, 1997, 2012; Astin, 1993).

Many successful first-generation students were aided by, and sometimes actively sought, faculty interaction inside and outside of the classroom (Demetriou et al., 2017; Longwell-Grice et al., 2016; Crisp & Nora 2010; Conrad, 2009), and the earlier the interaction in community college, the more likely interaction continued after transfer (Fuentes et al, 2014). Successful students engage with faculty and seek mentors, and successful first-generation students do so despite their limited social capital and familiarity with the college environment. For example, first-generation Mexican American students, some of whom could not rely on family for
academic support, actively sought mentors, who, as one student put it, "inspired me to keep going (Rodriguez et al., 2019, p. 10)." These findings are consistent with Pascarella & Terenzini’s (2005) contention that increased student-faculty interaction reinforces the student-institution relationship and thus increases persistence.

First-generation students who transfer and complete a bachelor’s degree also know the importance of seeking guidance from advisors and college staff (Azmitia et al., 2018). Swecker et al. (2013) found that frequency of meeting with an advisor was the variable most strongly associated with first-generation continued enrollment status. Finding a helpful advisor increased the feeling of belongingness and improved persistence among first-generation women in STEM transfer (Packard et al., 2011). Hispanic/Latino, predominately first-generation, community college students were more likely to have higher GPAs and persistence rates if they spoke regularly with academic and career counselors (Tovar, 2015). Similar to intentionally engaging faculty, seeking advisors demonstrates resilience in overcoming some of the social capital constraints first-generation students often experience.

First generation college students who persist often report generous emotional support from their families (Azmitia et al. 2018; Longwell-Grice et al. 2016). There is an expanding volume of qualitative research on female and racial and ethnic minority success, with many of those interviewed being first-generation college students. First-generation women who transferred from community college into STEM degree programs found family support to be a major influence in their persistence (Packard et al., 2011). Some students had only general parental support because their parents had not attended college, but this was still a major influence on their persistence (Rodriguez et al., 2019; Longwell-Grice et al. 2016). First-generation Hispanic and Black students who transferred successfully into STEM programs did
not let their parents' lack of education and ability to help them with coursework discourage them (Crisp et al., 2009).

Supportive faculty, advisors, and family play a critical role in first-generation, female, Hispanic/Latino, and African American students' persistence in college (Tovar, 2015), in STEM degree programs (Katrevich & Aruguete, 2017), as well as their successful transfer from community college (Packard et al., 2011). This is consistent with Nora’s (2002) model of Student/Institution Engagement Model, which maintains that frequent quality interaction with the institution (i.e., faculty, staff, and peers) influences persistence and transfer outcomes. Many of these findings are consistent with student engagement models such as Tinto’s (1997, 2012) student integration framework and Astin’s (1993) student involvement theory. Successful students in these studies were engaged in their discipline and with the institution, communicated often with faculty and mentors, and took the initiative to seek advice from transfer and career counselors. It should be noted that the students in these studies were exceptions, as most first-generation college students do not complete a degree (Cataldi et al., 2018). They showed exceptional fortitude and a willingness to adapt. However, as Blackwell and Pinder (2014) put it, "[i]t is not possible to reproduce that strong internal drive found in these students; however, the environmental factors can be improved to facilitate a set of constructs that can be expanded to include school influence as well as parental support (p. 55)."

**First-Generation Status and Underrepresented Groups**

Beyond the challenges of being a first-generation student, female and ethnic minority students may feel resistance and alienation, a sense of not belonging, which presents an extra challenge to their academic success (Shapiro & Sax, 2011; Owens et al., 2011). They may not identify with the dominant perceptions of what scientists and engineers "look like" that pervade
STEM courses and careers (Byars-Winston & Rogers, 2019; Rodriguez et al., 2017; Packard et al., 2011). As Jackson et al. (2013) point out, marginalized groups face compounded challenges at the intersection of race and gender, both in the community college and especially in the more rigorous academic culture of four-year colleges and universities. Underrepresented minorities are also more likely than White students (25% versus 16%, respectively) to be tracked into vocational (non-transfer-oriented) programs (Crisp & Nuñez, 2014). This phenomenon is also known as "cooling out", or the cumulative steps, often inadvertent or well-intended, that convince students perceived as ill-prepared for baccalaureate education to forego their intentions of transfer and instead opt for an occupational degree or credential (Clark, 1960). As minority and female students are more likely to be first-generation (Crisp & Nuñez, 2014), these concerns are especially relevant. However, recent scholarship has called into question the “cooling out” phenomenon and has even shown a “heating up” of initially non-transfer associate’s degree-seeking students switching to transfer-oriented programs (Monaghan & Atewell, 2015).

Women make up a disproportionately smaller percentage of physical science, engineering, and computer science majors compared to men, with representation of women of color even less equitable (Zhang, et al., 2019; Perez-Felkner, et al., 2019; Rodriguez et al., 2017; Hill et al., 2010). Female students, especially in community college, are also statistically more likely to be first-generation (regardless of definition) and have family and parental commitments (Davis, 2010; Chen & Carrol, 2005; Pascarella et al. 2004). Even for women who successfully navigate gender stereotyping and engendered science identity to achieve a STEM degree and career, such experiences in the workplace can reduce their engagement and career confidence (Veelen et al., 2019).
A sense of belonging and the perceived racial climate of the institution are significant factors for minority student adjustment (Owens et al., 2010). First-generation students of color have expressed a heightened sense of safety concerns and the need for more supportive and diverse campus culture at predominately White institutions (Adams & McBrayer, 2020). Qualitative research has shown that, even in a majority Black university, first-generation Black and African American students often lack the social capital and family support needed to help them avail themselves of faculty and institutional resources (Parks-Yancy, 2012). Many received well-intended but detrimental "advice" from family members who often did not understand that time outside of the classroom was not necessarily "free time." This is consistent with what many White and Hispanic/Latino first-generation college students have experienced; students do not know how to obtain resources from faculty and institutional contacts because their families are not able to pass down this social capital (Pascarella, et al., 2004; Bourdieu, 1986).

By far, the largest number of qualitative studies of first-generation students by group in the last five years have focused on students classified as Hispanic or Latino. Among Hispanic/Latino migrant farmworkers enrolled as first-generation university students, greater resilience predicted higher GPA even when controlling for pre-college characteristics. However, resilience was not predictive of persistence, with full-time work and family responsibilities weighing heavily on rate of leaving college (Mendez & Bauman, 2018). A case study of often-overlooked non-Mexican Hispanic/Latino first-generation students showed how these students took personal responsibility for their education, both because of the importance to their families of a college education to break the cycle of poverty and because their otherwise supportive families were unable to offer help with collegiate issues (Clayton, et al., 2019). This stands as an interesting contrast against first-generation students whose lack of parental education predicts
negative consequences, though as a qualitative study it is not generalizable (Creswell & Creswell, 2018).

First-generation students are also more likely to be non-traditional or "adult" learners. Although there are multiple meanings and definitions of non-traditional, Bean and Metzner’s (1985) criteria are a student that is at least one of the following: part-time attending; living off-campus; older than 24. As the first two criteria are common among all groups of community college students, being 25 years and older is a common meaning and one adopted by the Virginia Community College System (VCCS, 2019; Bean & Metzner, 1985). First-generation status on community college transfer-track students aged 25 and over was found to have no effect on intent to transfer (Rosenberg, 2016). In a qualitative study of 17 non-traditional-aged students from low-income families without college educations, 13 of the participants (5 out of 6 men and 8 out of 11 women) stated their father was more influential than their mother in shaping their views of work and educational attainment. Strong work ethic and motivation from intrinsic rewards were common characteristics. Of those older students who completed college, mentors were considered especially helpful to their persistence (Gibbons & Woodside, 2014).

Summary

Defining first-generation college student is a challenge. One definition ignores potentially millions of students who, despite their parents’ forays into postsecondary education, may not be aware of all the norms and procedures of college. This definition also defines a community college associate’s degree holder as not having attending college, which is especially fraught when researching community college populations. The other definition is inclusive but ignores the differences between those whose parents have no college experience and those whose parents may have associate’s degrees or may have even transferred – albeit without attaining a
bachelor’s afterwards. Even if we compare both groups, the intersection of race and gender with first-generation status guarantees myriad of experiences that cannot be considered typical for all first-generation students (Nguyen & Nguyen, 2018). Although each ethnic group and gender therein experiences different forms of discrimination, stereotype proliferation, and the gamut of levels of socioeconomic status, first-generation students of all backgrounds tend to have much in common. Regardless of demographic or definition, first-generation students are more likely than continuing-generation peers to be lower income, non-traditional aged, more than twice as likely to leave before degree completion, have lower high school GPAs, require remedial coursework in college, lack basic knowledge about applying to college and degree requirements once in college, and express a lack of mentors and role models (Cataldi et al., 2018; Engle & Tinto, 2008; Chen & Carroll, 2005; Pascarella et al., 2004). These disadvantages are exacerbated by racial and gender discrimination, including stereotypes promulgated by parents, educators, peers, and co-workers (Fernández-García, 2019; Veelen, 2019). Those who do persist to degree completion are more often those who have frequent interactions with faculty and advisors, access to mentors, support from family, and greater ability to cope with social and environmental barriers (Heller & Cassady, 2017; Wang, Lee, & Prevost, 2017; Packard et al., 2011).

**Defining STEM**

In researching course-taking patterns of community college students beginning in STEM, Wang (2016b) defined STEM courses based on Classification of Instructional Programs (CIP) codes, a taxonomic coding scheme created by the U.S. Department of Education to "facilitate the organization, collection, and reporting of fields of study and program completions (NCES, 2010, p. 1)." Wang's list of STEM programs included those with the following 2-digit CIP codes: 01 (agriculture sciences), 03 (natural resources and conservation), 11 (computer and information
science), 14 (engineering), 15 (engineering technologies/technicians), 26 (biological and biomedical sciences), 27 (mathematics and statistics), 40 (physical sciences), 41 (science technologies/technicians), and 47 (mechanic/repair technologies/technicians).

Wang (2016b) noted that categories 15, 41, and 47 have a strong occupational orientation, meaning their associated degree programs are not transfer-oriented. Except for the lack of codes 51 for health professions and related programs, and 60 for health professions residency programs, these codes are consistent with the U.S. Department of Veteran's Affairs' list of approved STEM fields of study for scholarship and GI benefit purposes. According to Veteran's Affairs, a STEM field of study is a field of study included in the CIP taxonomy within the two-digit series containing: biological or biomedical science, physical science, science technologies or technicians, computer and information science and support services, mathematics or statistics, engineering, engineering technologies or an engineering-related field, a health profession or related program, a medical residency program, an agriculture science program or a natural resources science program, or other subjects and fields identified by the Secretary as meeting national needs (U.S. Department of Veteran's Affairs, 2020).

In their analysis of beginning postsecondary student longitudinal data for developing a classification model for community college pathways to the STEM workforce, Noy & Zeidenberg (2017) distinguish between science and engineering (S&E) programs and technician programs by whether the student will require more education (i.e. a four-year degree) to enter the workforce. Their categorizing of STEM degree programs generally accords with the NCES' (Chen, 2009), with S&E programs including biological and biomedical sciences, engineering, physical sciences, and mathematics and statistics, while technician programs include engineering technologies (e.g., mechatronics), computer and information sciences, science
technologies/technicians (e.g., solar energy technician), and agriculture (Noy & Zeidenberg, 2017). Their placement of computer science (versus computer information sciences) in the technician category instead of S&E is contrary to most classifications and not explained. Despite this issue, their conclusions are noteworthy: there are sub-baccalaureate STEM programs that lead to the workforce, there are more "traditional" science, math, and engineering transfer-oriented programs, and (perhaps most importantly) there are many students in non-transfer-oriented technician programs whose stated goal is also to eventually obtain a bachelor's degree.

Lundy-Wagner and Chan (2016), in their classification of STEM programs in the Virginia Community, use the example of CIP code 11 (Computer and Information Sciences and Applications), which includes programs in both computer science and data entry, to illustrate how misleadingly broad this taxonomic scheme can be. They warn that "without a consistent framework that is attuned to the nuances of community college STEM programs, the field will remain unable to attain consistency and comparability between study results on this topic (p. 6)."

The researchers, in collaboration with the VCCS and other community college experts, developed a classification scheme "relevant to policy making for postsecondary STEM credentials (p. 6)." Their three STEM program categories are: (1) traditional STEM fields such as engineering and biology; (2) allied health STEM fields including licensed practical nursing and occupational therapy programs; (3) technology and technician STEM fields, including automotive technology, mechatronics, and air conditioning repair. Only the traditional STEM fields category has a transfer orientation. These programs all fall into either the Associate of Science (AS) degree program or the Associate of Arts & Science (AA&S) degree program, both of which are transfer-oriented.
Wang’s (2016a) Expanding STEM Talent Survey groups baccalaureate STEM programs based on the National Science Board's (2018) groupings, also similar to Lundy-Wagner and Chan’s (2016) traditional STEM field taxonomy. These categories, chosen by the student via survey, are Biological, agricultural, or environmental life sciences, Computer or mathematical sciences, Engineering or engineering technologies, and Physical sciences including chemistry, physics, astronomy, etc. Due to their previous use in similar research, general consonance with VCCS transfer pathways, and comprehensive nature, these four categories were used for the present study.

Summary

STEM is as difficult to define as it is easy to spell. In a community college with occupational/technical degrees that have been used to transfer, STEM could encompass anything from biology to solar cell technician courses. The immediate STEM degree goal of transfer is a bachelor’s degree. Life and environmental sciences, agricultural sciences, physical sciences, math, computer science, and engineering represent the alignments of VCCS transfer-oriented associates degrees, and the categories identified as STEM – minus healthcare professional programs.

STEM Career Choice Development

Research into career choice has traditionally focused on adolescents and adults, but a growing body of knowledge shows that the career development process begins in early childhood (Gottfredson, 1996; Hartung et al., 2005, Tuijl et al., 2016). As such, the study of career choice, with its implication of happening at a later age, is best subsumed under the study of career development (Tuijl et al., 2016). This process, which results in the initial choice of career and educational attainment, includes career exploration, awareness, interests, aspirations,
and expectations - all of which are affected by social and environmental factors such as socioeconomic class (SES), family influences, and societal influences (Hartung et al., 2005). Vocational aspirations refer to "preferences about work under ideal circumstances" and reflect "information about self-concept, perceived opportunities, interests, and hopes (Tuijl et al. 2016, p. 171)." Life-span approaches to career development, such as Super's (1980) “life-span, life-space” theory and Gottfredson's (1996) “circumscription and compromise” theory highlight childhood as a formative period for career development, in which children learn about the world of work and themselves in that world (Tuijl et al. 2016; Hartung et al. 2005).

Career development, which can be defined as "the lifelong psychological and behavioral processes as well as contextual influences shaping one's career over the life span" (Niles & Harris-Bowlsbey, 2005, p. 12) is actively taking place during the elementary school years (Super, 1980; Gottfredson, 1996). Seligman et al. (1991) interviewed twenty-four 9 and 10-year-olds about their career aspirations and found that half believed that they had already made decisions that would impact their future careers. Trice & McClellan (1994) found that 23% of a group of 40-to-55-year-olds stated they had made important decisions during childhood that led to their adult careers. Career education programs have been integrated throughout primary and elementary schools in the United States (Mupinga & Caniglia, 2019).

The National Office for School Counselor Advocacy [NOSCA] provides recommendations for career education in their Elementary School Counselor's Guide (NOSCA, 2012). These include such suggestions as "[e]ncourage teachers to incorporate college and career information into their curriculum through assignments that include reading, writing, speaking and presenting activities (p. 11)." In the state of Virginia, administrative legal code 8VAC20-131-140, states that:
“Each middle and secondary school shall provide for the early identification and enrollment of students in a program with a range of educational and academic experiences related to college and career readiness in and outside the classroom, including an emphasis on experiences that will motivate disadvantaged and minority students to prepare for a career or postsecondary education.” (8VAC20-131-140. College and Career Readiness; Career Exposure, Exploration, and Planning; and Opportunities for Postsecondary Credit, Section A)

The law also states that all elementary school children will begin an academic and career plan portfolio “to include information about interests, values such as dependability and responsibility, and skills supporting decisions about their future interests and goals (8VAC20-131-140, Section C, Paragraph 2), which later informs their formal academic and career plan in middle school and high school, with a focus on vocational or postsecondary education. It is evident that both research and practice have acknowledged the importance of career development throughout the K-12 years. Several STEM-related studies have taken this into account, highlighting mechanisms and mediators of career interest through the lens of different theoretical frameworks.

Knowledge of occupations and concept of “self-in-occupation” have been observed in children as young as age ten (McGee & Stockard, 1991). A longitudinal study beginning with 208 second graders surveyed every two years until 12th grade (with 50% attrition) supported Gottfredson's (1996) theory of career development. Children began shifting from the "fantasy" stage of career aspirations after 8th grade and by the end of high school showed a significant inclination toward realistic occupational aspirations (Helwig, 2001). Children’s science aspirations are largely formed between the ages of 10 and 14 (Archer et al. 2012), which
corresponds to Gottfredson’s (1996) “orientation to social valuation” stage of development, ages 9 to 13. During this stage, children become far more aware of social class and occupational hierarchy, “and they understand the tight links among income, education, and occupation (p. 97).” Career aspirations become progressively stable from adolescence to adulthood. In a longitudinal study of 18,311 8th through 12th graders from the National Educational Longitudinal Study (NLES) nationally representative dataset, Rojewsky and Yang (1997) found that occupational aspirations remained relatively stable throughout high school, and early aspirations significantly predicted later ones.

It is also during the elementary school years that concepts of gender and class stereotyping begin to form. Gender stereotyping "reflects societal norms of personal characteristics, activities, studies, occupations and lifestyles (e.g., work-family balance) that are deemed appropriate for men and women" and is "transferred, implicitly and explicitly, through parenting, education, and the media (Tuijl et al. 2016, p. 167)." Brown (2002) cautioned that any comprehensive theory of career development must work across race and gender, allowing for explication of the differences in experience faced by underrepresented racial/ethnic minority male populations. Using multiple sources of self-efficacy instruments based on SCCT, Fernández-Garcia et al. (2019) found that among 2,364 Spanish sixteen-year-olds, boys had a stronger conviction than girls that their parents believed they had qualities for success in technology and science. Rojewski and Yang (1997) observed that, while high school students in general were more likely to aspire to “moderate prestige occupations”, females were more likely to trend to either higher or lower prestige occupations (p. 404). Logistic regression on a nationally representative sample of 21,444 American 9th grade students revealed the most important predictors of STEM career aspirations were race, gender, SES, math interest, and
science self-efficacy; minority, female, and lower-SES students were less likely to aspire to a STEM career (Mau & Li, 2018).

**Career Choice and the Community College**

Three concepts that are useful for investigating community college students’ career choice beliefs are career decision-making self-efficacy (CDSE), career maturity, and career identity. CDSE refers to the self-efficacy related to one’s ability to make career decisions (Taylor & Betz, 1983). Career maturity refers to an individual’s ability and preparedness to make competent career choices (Crites & Savickas, 1996). Career identity is “characterized by clarity, coherence, and stability of perceived occupational motivation and abilities (Skorikov & Vondracek, 2007, p. 143),” while career identity evaluation is the act of “engaging in in-depth career exploration and identification with one’s career (Stringer & Kerpelman, 2014, p. 310).” Stringer and Kerpelman (2014) found that parental support for career was predictive of CDSE in community college students, and CDSE was predictive of career identity evaluation. CDSE was even more predictive than work experience, but unlike with four-year college students, was not predictive of career identity evaluation. The authors hypothesized that this may be because parents of community college students are less likely to have college experiences to draw on. These findings appear to be consistent with the concepts of social and cultural capital, in which lower-SES parents would have less academic social capital to transfer to their offspring (Bourdieu, 1986). Harlow & Bowman (2016) established that even though first-generation students reported lower career maturity than continuing-generation students, community college students from both groups ranked higher than their four-year school counterparts.
Summary

Career interest, the antecedent to career choice, is a developmental process that begins in childhood and progresses through adolescence, where it begins to solidify in early adulthood. These formative years are also when gender, racial, and social class stereotypes begin to take hold, which can harm perceptions of “appropriate” types of work (Tuijl et al., 2016). The naïve or “fantastic” beliefs of early childhood begin to slowly give way to more realistic options as children develop interests, assess their abilities and learn more about the world of work. As children's science aspirations form during the transition from childhood to adolescence (Archer et al. 2012), so does their understanding of how certain professions are represented among different social classes, and the relationships between education, occupation, and status (Gottfredson 1996). Race, gender, and SES all play a role in career development, with females and underrepresented minority students having lower levels of STEM career interest by around 9th grade (Mau & Li, 2018), when career interest begins to stabilize (Rojewsky & Yang, 1997; Gottfredson, 1996). By the time students enter community college, they have some degree of interest in and have made tentative decisions about a career path. CDSE and career maturity are not automatic states that crystalize upon matriculation, but the choice of a major, certificate or degree program, or transfer-oriented trajectory is an expression of career decision-making.

The Theoretical Basis for Persistence Intentions

This study seeks to explain how first-generation students’ perceptions of social and environmental supports and barriers differ from their continuing-generation peers, and how these factors relate students’ intent to persist in transferring to a STEM bachelor’s degree program. Ajzen (n.d. b) defines intent as "an indication of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior." Malle and Knobe
(2001) illustrated three requirements for differentiating an intention from a desire. An intention must be something a person can make happen for themselves, not a wish for an outcome. Second, an intention requires practical reasoning to determine whether one is capable of performing an action and whether other desires outweigh the desire to perform the action. Third, an intention requires some degree of commitment, including early investment in resources to accomplish the goal, accepting opportunity costs of not pursuing a different goal, and acceptance of the possible results of not achieving the goal.

An example that accords with Malle and Knobe's (2001) model is the student who wants to earn a bachelor's degree in computer science. If he simply sits at home and wishes he had a degree, it is not an intention but a desire. If he realizes that he must take action and enroll in college, he is beginning to form an intention. Determining whether he has the time, funds, and ability is a practical reasoning process. Assuming he decides he is capable, he weighs the opportunity costs of not expending financial and mental resources in college and instead working a low-paying job with few responsibilities, against spending four or more years in college working toward a degree that will lead to financial and social rewards. At this point, the would-be student must make some sort of material commitment to turn this desire into an intention. Enrolling in a community college as a computer science transfer major is an example of early investment in the goal. It is then the degree of goal commitment that determines whether the intent to attain a computer science degree leads to goal attainment.

The Theory of Planned Behavior (TPB: Ajzen, 1991) posits that intention is a product of attitudes toward an intended behavior and the perceived social pressure to engage (or not engage) in that behavior. These two influences are moderated by perceptions of one's ability to perform the behavior. TPB has shown both theoretical and empirical support for strength of intention as a
reliable indicator of eventual goal completion (Fichten, Amsel et al., 2016; Witt et al., 2014). Using Ajzen's (n.d. a) guide to developing TPB instruments, Fichten et al. (2014) developed a TPB Postsecondary Graduation Questionnaire that included a five-item intention scale. Example intention scale items include *I intend to complete my program of studies*, *I will try to complete my program of studies*, and *All things considered, it's possible that I might not complete my program of study*. In a longitudinal study of 123 Canadian college students, the instrument correctly classified 83% of the entire sample, predicting 74% of premature leavers and 86% of graduates based on strength of intent scale scores (Fichten, Amsel et al., 2016). In a longitudinal study of 175 university students and 75 community college students, the instrument correctly classified 74% of graduates/transfers and premature leavers. The method of determination was to divide the mean of the intention scores into the binary variable for weak and strong intention (Fichten, Heiman et al., 2016). A potential problem with this instrument, despite its predictive ability, is the wording of the items. Students, especially those whose first language is not English, may not understand the distinctions among the items beginning with "I intend", "I will try", "I expect", and "I am determined".

Sniehotta et al. (2014) contend that TPB has not been rigorously tested empirically, and that it has not stood up adequately against the few empirical tests that have been performed. Ogden (2015) points out that "four boxes", meaning the four constructs of the model, are used to predict everything from healthy eating to organ donation. LaMorte (2019) notes that TPB does not account for other variables that factor into intention, such as mood, experience, fears, environmental and economic factors, and the acquisition of resources to be successful. (A look at Ajzen's (n.d. b) website, however, shows a model with background factors including mood, income, ethnicity, and stereotypes, though these are not elaborated upon.).
Lent et al. (1994), in their Social Cognitive Career Theory (SCCT), also describe an intention as an antecedent to actual behavior, and in accordance with Bandura's (1986) social cognitive theory, use the term *choice goal* to represent an intention to engage in a particular activity or to produce a particular outcome. SCCT also examines *intent to persist*, a subjective measure of an individual's determination and perceived likelihood to continue to pursue a goal (Lent et al., 2003a; Lent et al., 2008; Lent et al., 2016). This concept is very similar to TPB's intent construct, as are the instruments used to measure them.

Lent et al. (2003b) developed a four-item Persistence Intentions Scale, conceptually similar to Ajzen's (n.d. a) TPB behavioral measures, to measure intent to persist in engineering degree programs. Unlike Fichten et al.'s (2014) survey items, the Persistence Intentions Scale has distinct items with clear wording. The four items are *I intend to major in an engineering field*, *I plan to remain enrolled in an engineering major over the next semester*, *I think that a bachelor's degree in engineering is a realistic goal for me*, and *I am fully committed to completing my engineering degree*. These items generally match with Malle and Knobe's (2001) requirements of decision to act, practical reasoning about ability to achieve a goal, and both short-term and long-term commitment. Persistence intentions scores have been positively correlated with actual persistence in engineering degree-seekers, and in SCCT theory-consistent manner with self-efficacy, outcome expectations, interests, contextual barriers and contextual supports (Lent et al., 2003b).

Figure 1 shows the SCCT choice model, with shaded boxes representing the model variables measured in most SCCT studies, according to the results of a meta-analysis of 143 SCCT studies over a thirty-year period (Lent et al., 2018).

Note. Shaded boxes represent the most common constructs measured in research. Used with permission of Robert Lent.

Social Cognitive Factors Relating to Persistence Intentions

SCCT is primarily concerned with career and academic choice and development, and the role self-efficacy, outcome expectations, and career/academic interests play in goal choice and goal achievement (Lent et al., 1994). Self-efficacy beliefs refer to “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986, p. 391).” Self-efficacy beliefs are the major determinants of thought and action in social cognitive theory (Lent & Brown, 2006). Outcome expectations are "beliefs about the consequences or outcomes of performing particular behaviors (p. 17)," and together with self-efficacy, assert influence over interests, choice goals, and choice actions. Choice goals in SCCT are “an individual's intention to engage in a particular activity or to produce a particular outcome, addressing questions such as, how much and how well do I want to do this?” (Lent, 2005, p. 105).
For example, a student with high self-efficacy in chemistry, as well as strong positive outcome expectations of earning a degree in chemical engineering (e.g., high salary, rewarding work) would, according to SCCT, be more likely to have greater interest in attaining a degree (the choice goal) and be more likely to successfully graduate with a bachelor's in chemical engineering (the final choice action). Although it may seem like common sense that someone would want to pursue a career in a field in which they excel and that will be financially and personally rewarding, many SCCT studies return different parameter estimates for self-efficacy, outcome expectations, and perceived barriers. Often these differences are found between racial/ethnic and gender categories (Lent & Brown, 2019). For instance, Garriott, Navarro, et al. (2017) found that, contrary to expectations, self-efficacy in math and science did not significantly predict persistence intentions for university engineering students. One explanation for these differences is the influence of social, cultural, and environmental factors.

In SCCT, the social, cultural, and environmental influences fall into two categories – distal (background) contextual affordances and proximal environmental influences. Distal contextual affordances help shape social cognition and interest, and include influences such as skill development, cultural and gender role socialization, parental status, and work hours (Lent et al., 2001; Wang, 2016a). Proximal environmental influences, which come into play at critical choice junctures, include emotional and financial support, job availability, perceived social barriers and supports, and organizational policy and practices (Lent et al., 2001; Wang, 2016a). These contextual factors can directly and indirectly affect both ability and willingness to transform interest into goals and goals into actions/attainment. Beneficial environmental conditions (such as access to supportive family and access to mentors) aid in navigating the path
to goal achievement, while detrimental conditions (such as a culture that does not prize education or an environment of racial discrimination) hinder the process (Lent et al., 2002).

**Instruments Used in This Study**

The instrument chosen to quantitatively measure student perceived contextual supports and barriers is Lent et al.’s (2003b) Contextual Supports and Barriers Scale, comprising a 15-item perceived social and environmental supports scale, and a 21-item perceived social and environmental barriers scale. The instrument selected to quantify students’ subjective measure of their perceived likelihood to successfully transfer and complete their four-year STEM degree, their intention to persist, is Lent et al.’s (2003b) 4-item Persistence Intentions scale. Development, usage, psychometric properties, validity, reliability, and limitations of each instrument are discussed in the following sections. The validity of an instrument refers to its ability to produce scores that are accurate, meaningful, reflect the true theoretical meaning of its construct, and allow the researcher to draw good conclusions about the population being studied through the sample being measured (Creswell, 2008; Rovai et al., 2016). The evaluative judgement of validity should be supported by both theoretical rationale and empirical evidence (Messick, 1995). Reliability refers to the consistency and repeatability in scores across multiple administrations of an instrument (Creswell, 2008). The following sections explain evidence of different types of validity for each instrument, as well as reliability and potential limitations.

**Contextual Supports and Barriers Scale**

Perceived social and environmental supports for, and barriers to transfer were measured using Lent et al.’s (2003b) Contextual Supports and Barriers Scale. This 36-item instrument uses a Likert scale ranging from 1 (Not at all likely) to 5 (Very Likely) to measure perceived supports (15 items) and barriers (21 items) to college degree attainment. Although initially used to
measure supports and barriers perceptions of engineering degree-seeking students, the scale and its individual subscales have also been used in the context of physical and biological science, computer science, and mathematics degree goals for undergraduate and high school students (Peña-Calvo, 2016; Garriot et al., 2013; Lent et al., 2008; Lent et al., 2003a, 2003b). Support items are divided into four conceptual clusters: (a) social support and encouragement; (b) instrumental assistance; (c) access to role models and mentors; (d) financial resources. Barrier items are divided into four conceptual clusters: (a) social or family influences; (b) financial constraints; (c) instructional barriers; (d) gender and race discrimination.

The conceptual clusters, confirmed factors, and individual items of the Contextual Supports and Barriers Scale are all represented in the literature of college attrition and persistence, and are especially important to first-generation and community college students. These include the importance of mentors and role models (Deil-Amen, 2011; Engle & Tinto, 2008; Wallace et al., 2000), financial and work constraints (Cataldi et al., 2018; Ishitani, 2006), gender and racial discrimination (Fernández-García, 2019; Veelen et al., 2019), positive and negative family influences (Tate et al., 2015; Blackwell & Pinder, 2014; Archer et al., 2012;), peer interaction, support, and acceptance (Deil-Amen, 2011; Pascarella et al., 2004), and interaction with faculty and staff (Wang, Sun et al., 2017; Deil-Amen, 2011; Pascarella et al., 2004; Tinto, 1997).

The original prompt for the instrument is During your time at this university pursuing an engineering degree, how likely will you be to... The modified prompt for the instrument for this study was: During your time at this college pursuing transfer to a four-year bachelor’s degree program in the STEM degree area you indicated in Question 2, how likely will you be to...

Examples of support scale items include: Feel that your family members support this decision,
and Have enough money saved up to be able to complete your education in this field. Examples of barrier scale items include Receive negative comments or discouragement about your major from family members, and Receive unfair treatment because of your racial or ethnic group.

Validity and Reliability

Content validity, or the extent to which an instrument’s items represent all aspects of a construct (Creswell, 2008), for the Contextual Supports and Barriers scales (Lent et al., 2003b) was established through review of the literature and existing instruments pertaining to career and educational barriers and supports, through expert review, and qualitative coding of interviews with two-year and four-year college students (Lent et al., 2001, 2002, 2003b). The conceptual clusters, confirmed factors, and individual items are all represented in the literature of college attrition and persistence, and are especially important to first-generation and community college students. These include the importance of mentors and role models (Deil-Amen, 2011; Engle & Tinto, 2008; Wallace et al., 2000), financial and work constraints (Cataldi et al., 2018; Ishitani, 2006), gender and racial discrimination (Fernández-García, 2019; Veelken et al., 2019), positive and negative family influences (Tate et al, 2015; Blackwell & Pinder, 2014; Archer et al., 2012;), peer interaction, support, and acceptance (Deil-Amen, 2011; Pascarella et al., 2004), and interaction with faculty and staff (Wang, Sun et al., 2017; Deil-Amen, 2011; Pascarella et al., 2004; Tinto, 1997).

Criterion validity, or the degree to which scores relate to an expected outcome or criterion (Creswell, 2008), of the Contextual Supports and Barriers Scale has been established through multiple SCCT studies in which greater barrier scores have correlated to lower academic self-efficacy and lower degree persistence intentions (Kim & Seo, 2014; Peña-Calvo et al., 2014; Lent et al., 2001, 2003b). The barrier scale has shown to correlate negatively, and the support
scale positively, with barrier coping efficacy scales (Lent et al., 2001). These results are corroborated by SCCT studies (e.g., Turner et al., 2019; Fort & Murariu, 2018) that yield similar results using different instruments to measure barriers and supports, including those that use the Luzzo & McWhirter (2001) Perceptions of Barriers Scale, Zimet et al.’s (1988) Social Supports scale, and the revised Fennema-Sherman Math Attitudes Scale - Short Form (Fennema & Sherman, 1976; Turner et al., 2004).

The hypothesized relationships between perceived barriers and supports and persistence intentions have been observed in multiple studies using the full scales or (more commonly) the 9-item social supports and 5-item social barriers subscales. Although the 21-item full barriers scale failed to correlate with persistence intentions in the initial study of students in introductory psychology courses (Lent et al., 2001), subsequent studies have shown expected correlation from both scales. The full scales have shown to relate significantly to persistence intentions as hypothesized in studies of racially diverse engineering students (Lent et al., 2003b), Spanish university students across multiple STEM majors (Peña-Calvo et al., 2014), and South Korean undergraduate engineering students (Kim & Seo, 2014). The social barriers and social supports conceptual clusters of the instrument have related as hypothesized to persistence intentions among low-income prospective first-generation college students (Garriot et al., 2013), Hispanic/Latino engineering students (Flores et al., 2017), and minority undergraduate students with disabilities (Dutta et al., 2015).

Construct validity was further established for the Contextual Supports and Barriers scales through exploratory and confirmatory factor analyses (Lent et al., 2005a). Results indicated two support subscales (Social and Financial) and three barrier subscales (Social, Instrumental, and Gender). Kim and Seo (2014) arrived at the same results through their confirmatory factor
analysis of the instrument translated into Korean for their study of South Korean engineering students. Peña-Calvo et al. (2016) focused on the sources of supports and barriers, rather than the monolithic “social” subscales, represented by the instrument. In their exploratory factor analysis of responses from 811 STEM undergraduate university students in Spain, the researchers determined four factors for each scale: perceiving teaching staff supports/barriers; perceived peer supports/barriers; perceived family supports/barriers; perceived financial supports/barriers. Gender and racial discrimination did not score sufficiently high enough to be accepted as a latent factor, but this could be due to greater perception of racial homogeneity in the Spanish sample (Peña-Calvo et al., 2016).

Due to the strong relationship between social support and barrier factors and their corresponding full-scale scores, Lent and colleagues used only the social conceptual cluster questions as the supports scale for further research, with similar results to the full-scale studies (e.g., Lent et al., 2005a, 2008, 2010). Other SCCT researchers have used these subscales and corroborated the relationships between barriers and supports to persistence intentions (Navarro et al., 2019, 2014; Flores et al., 2017; Garriot et al., 2013). Although the social supports and social barriers subscales provide similar correlational results to the full 15- and 21-item scales, respectively, the present study relies on the full instrument to better characterize the range of experiences of community college students.

The Contextual Supports and Barriers Scale has demonstrated reliability across multiple contexts. Lent and colleagues reported coefficient alpha values of .88 for the supports scale and .90 for the barriers scale in their 2001 study, and scores of .92 and .94 for supports and barriers, respectively, in their 2003 study of engineering students. Kim and Seo (2014) reported coefficient alpha values of .87 for the supports scale and .85 for the barriers scale in a study of
660 South Korean engineering students. The social supports and barriers subscales, widely used in place of the full instrument, reported coefficient alpha values of .90 for supports and .84 for barriers among engineering students in both historically Black and predominately White institutions (Lent et al., 2005a), .90 for supports and .76 for barriers among prospective first-generation college students (Garriot et al., 2013), and between .72 and .86 for Italian and Portuguese high school students (Lent et al., 2003a).

**Limitations**

The Contextual Barriers and Supports Scale does have several limitations. While the 9-item social supports and 5-item social barriers subscales have been widely used in SCCT research, the full scales have seen less utilization. More research is needed to better understand the types of barriers and supports faced by students, as well as determine how these may differ among minority, underserved, and first-generation populations (Lent & Brown, 2019; Peña-Calvo et al., 2016; Kim & Seo, 2014). Due to the scale’s focus on student perceptions, and without more longitudinal research, it is difficult to ascribe predictive validity beyond the scale’s correlation to SCCT factors. For this reason, although it can be said that higher barrier scores are predictors of lower persistence intentions, which have been shown in some studies to predict actual persistence (Lent et al., 2016; Lent et al., 2003b), it cannot be said generally that a higher score on the barriers scale predicts college dropout. Finally, there are instruments that explore more deeply individual constructs, such as the 12-item Parental Encouragement Scale (Gloria, 2005) and Luzzo and McWhirter’s (2001) 33-item Perceptions of Barriers scale that addresses more fully racial and gender discrimination.

Despite its limitations, the Conceptual Supports and Barriers scale was used for this study because of its coverage of the major support and barrier factors identified as important to first-
generation college students’ degree persistence, and its performance as predicted across multiple
diverse samples. Although the full scale’s mean scores do not identify the types of supports and
barriers a student faces, they are still suitable for determining whether the two first-generation
student subgroups (no college versus no bachelor’s) perceive different overall amounts of
supports and barriers. Further, descriptive statistics elaborate upon student perceptions of the
individual conceptual clusters (e.g., financial resources, access to mentors and role models) of
the instrument.

**Persistence Intentions Scale**

Lent et al.'s (2003b) Persistence Intentions Scale was used to measure students’ intention
to persist in STEM transfer. This four-item instrument uses a Likert scale ranging from 1 (*Not at
all likely*) to 5 (*Very Likely*) to quantify a students’ subjective measure of their perceived
likelihood to successfully complete a college degree (Lent et al., 2003b). The Persistence
Intentions Scale was initially used in the context of engineering degree persistence intentions.
The scale has been adapted to multiple STEM majors including life sciences, physical sciences,
computing, and mathematics (Peña-Calvo, 2016; Dutta et al., 2015; Lent et al., 2008).

The prompt for the Persistence Intentions scale is, *Using the scale below, indicate your
level of agreement with each of the following statements.* The four original items are: *I intend to
major in an engineering field; I plan to remain enrolled in an engineering major over the next
semester; I think that earning a bachelor’s degree in engineering is a realistic goal for me; I am
fully committed to getting my college degree in engineering.*

The prompt for the present study was adjusted to: *Using the scale below, indicate your
level of agreement with each of the following statements about the STEM major you indicated in
Question 2.* The response items were adjusted for this study as follows: *I intend to major in my
chosen STEM field; I plan to remain enrolled in my major, or transfer to four-year program in my major, over the next semester; I think that earning a bachelor's degree in my chosen STEM field is a realistic goal for me; I am fully committed to getting my bachelor’s degree in my chosen STEM field.

**Validity and Reliability**

Content validity for Lent et al.’s (2003b) Persistence Intentions scale was established through review of the literature and existing instruments concerning goal choice and intentions, particularly Bandura’s (1986) social cognitive theory and Ajzen and Fishbein’s (1988) Theory of Planned Behavior (TPB). TPB has shown both theoretical and empirical support for strength of intention as a reliable indicator of eventual goal completion (Fichten et al., 2016; Witt et al., 2014). The persistence intention scale is conceptually similar to Ajzen and Fishbein’s (1980) TPB-based instrument but designed to be specific to degree completion (Lent et al., 2003b). The four items on the persistence intentions scale also accord with Malle and Knobe’s (2001) philosophical and operational treatise on intentions, in which an intention comprises: (a) the decision to act on a goal; (b) practical reasoning about one's ability to achieve a goal; (c) both short-term commitment; (d) long-term commitment.

Predictive validity for the Persistence Intentions Scale has been established in longitudinal studies through its prediction of actual persistence among undergraduate engineering students and its correlation to hypothesized social cognitive factors (Lent et al., 2016; Lent et al., 2003b). SCCT incorporates Bandura’s (1997) theory that perceived self-efficacy is a major determinant of intention (Lent & Brown, 2006). Multiple studies support this claim, with self-efficacy instruments correlating as hypothesized to persistence intentions (e.g., Garriot et al., 2017; Peña-Calvo et al., 2016; Dutta et al., 2015; Lent et al., 2005b). Structural
equation modeling has shown persistence intentions, as hypothesized, are directly and indirectly affected by self-efficacy and directly affected by interests (Flores et al., 2017; Garriot et al., 2017; Dutta et al., 2015; Lent et al., 2008; 2005b). Accordingly, persistence intentions scores have correlated as predicted in SCCT theory-consistent manner with outcome expectations, interests, and perceived barriers and supports to STEM degree attainment (Flores et al., 2017; Garriot et al., 2017; Lent et al., 2016, 2015, 2010, 2005a, 2005b, 2003b; Navarro et al., 2019, 2014; Morris & Lent, 2019).

SCCT’s focus on persistence intentions is based on the evidence of strong associations between intentions and actual persistence revealed by college attrition and persistence research (e.g., Cabrera, 1992; Pascarella & Terenzini, 1980; Bean & Metzner, 1985). The Persistence Intentions Scale has been shown to be predictive of actual persistence in undergraduate engineering students across as few as two and as many as six semesters (Lent et al., 2003b; 2016). Although structural equation modeling and path analyses in some studies have not always confirmed each hypothesized path in the SCCT choice model (Lent & Brown, 2019), the persistence intentions scale has demonstrated reliability and consistently related to perceived contextual barriers and supports across race, gender, country, and STEM degree area. Though the scale consists of only four items, each item operationalizes one of the four requirements for defining an intention according to Malle and Knobe’s (2001) monograph distinguishing intention from desire. Conceptually similar to some TPB-based graduation intention instruments (e.g., Fichten et al.’s, 2014), Lent et al.’s instrument uses clear, unambiguous language that does not risk conflation of the terms “try” and “expect” with the word “intend.”

Coefficient alphas for the persistence intentions scale have ranged from .91 to .95 for samples of introductory engineering students (Lent et al. 2008, 2005a), .92 for Hispanic/Latino
and White engineering students (Navarro et al., 2014), .79 for 1,208 computer science students, roughly half from historically Black colleges and universities and half from primarily White institutions (Lent et al., 2008), .72 for first-generation Hispanic/Latino and White engineering students (Garriott et al., 2017), and .92 for 115 underrepresented minority students with disabilities who expressed interest in STEM fields (Dutta et al., 2015).

**Limitations**

The persistence intentions scale is not without its limitations. There are few longitudinal SCCT studies that can attest to the scale’s ability to predict actual persistence toward a college degree. Most studies are cross-sectional and performed in four-year college and university settings, and there is a recognized need to investigate community college and first-generation college students (Lent & Brown, 2019; Garriot et al., 2017). Finally, it is doubtful that a quantitative measure, regardless of the quality of design and number of assessed dimensions, can ever capture the entirety of the abstract concept of “intention.” What it does offer is a way to quantitatively compare students’ perceptions of their own likelihood to transfer and complete their bachelor’s degree. Measuring and comparing those perceptions are important to the present study as well as informing further SCCT research.
CHAPTER 3: STEM Transfer Supports and Barriers

Abstract

This study examined the social and environmental supports and barriers that community college students perceive during their pursuit of transfer to a four-year college or university for the purpose of completing a bachelor’s degree in a STEM (Science Technology Engineering Math) major. A total of 307 students across seven Virginia community colleges responded to an online survey including validated instruments for measuring perceived supports, barriers, and persistence intentions. Statistical analyses explored differences between first-generation and continuing-generation student perceptions based on two widely used but contrasting definitions of first-generation college student. First-generation students with no parental college experience had significantly lower reported support scores compared to continuing-generation students and first-generation students with some parental postsecondary experience but no parental bachelor’s degree. These differences were based solely on their lower perceived financial resources. No other differences were found between any group, contrary to first-generation college student research at predominately four-year institutions. This study serves as a foundation for further research performed at the community college, where results may vary compared to four-year contexts.

Introduction

America's 936 public community colleges serve a unique role in higher education. They prepare some students for the local job market through career certificates and two-year associates degrees while preparing others for transfer to baccalaureate degree programs at four-year colleges and universities. States promote their community colleges as accessible, low-cost solutions to education and workforce pipeline deficits, especially in science, technology,
engineering, and mathematics (STEM) fields. However, despite that around 40% of all undergraduate students in the United States are attending a community college (National Center for Education Statistics [NCES], 2021), the preponderance of published higher education research focuses on "traditional" four-year colleges and universities. This is especially unfortunate for community college students intending to transfer to a four-year degree program, who are far more likely to drop out compared to their peers at four-year schools (Causey et al., 2022). Many of these students never reach the space in which most transfer research takes place. The unique social, economic, and environmental obstacles that community college students face in their pursuit of transfer are crucial but understudied factors that have personal and broader economic repercussions.

Although some community college population demographics mirror those of four-year schools (e.g., percentage of women), there are many demographic differences. Community colleges have a greater percentage of students who are underrepresented minorities, over 25 years old, working full time, and responsible for dependents (AACC, 2022; NCES, 2022; Ryberg et al., 2021). Compared to their four-year college peers, fewer community college students have a parent or guardian with a college degree (AACC, 2022). Approximately one-third of community college students nationwide are the first in their families to attend college (AACC, 2022). These first-generation college students are even more likely to be from lower-income households, be underrepresented minorities, have work commitments, and be responsible for dependent children or parents (Davis, 2010; Chen & Carrol, 2005; Pascarella et al. 2004). First-generation college students tend to have lower GPAs, require more remedial courses, lack basic knowledge about negotiating college processes and degree requirements, and drop out more frequently compared to their continuing-generation college peers (Cataldi et al., 2018; NCES,
A recent survey by Soria et al. (2021) found that even in large public research universities, first-generation students were more likely to experience food insecurity, housing insecurity, and domestic abuse, made worse by the economic and social effects of the COVID-19 pandemic.

Understanding these first-generation students' challenges and perspectives is essential to developing interventions, advising, and curricula to increase overall community college graduation and transfer rates. Expanding this knowledge is especially consequential for students in STEM majors due to even greater disparities in transfer success compared to other major areas (Wang, 2016a). Gaps in the research are further exacerbated by disagreement on who qualifies as a first-generation college student. The most widely used definition is a student whose parents or guardians have not attained a bachelor's degree (Ives & Castillo-Montoya, 2020). This definition is problematic for community college research because it inadvertently implies that community colleges, which typically offer the associate's degree as their highest award, are not colleges. Others define first-generation students as those whose parents or guardians have at most a high school diploma, with no post-secondary education experience at all, while others define first-generation as those whose parents who have not attained a degree (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al., 2004). Even within and between federal and state governments, conflicting definitions are used (see Cataldi et al., 2018; Engle & Tinto, 2008). Davis (2010) argues that students whose parents have no post-secondary experience are "practically indistinguishable" from those whose parents have some college, but no bachelor's degree, and thus the "no bachelor's" definition should be used. This seems to be the prevailing opinion in both academic and government publications. However, the research that does distinguish between the two groups shows first-generation “no college” students experience
lower household income, lower academic readiness benchmarks, and higher college dropout rates (Redford & Hoyer, 2017; American College Testing, 2016; Nomi, 2005). In their analysis of the multiple research definitions of first-generation college student, Toutkoushian et al. (2018) found that, depending on definition, the number of “first-generation” students in the 2002 nationwide Educational Longitudinal Study ranged between 22% and 77% of the total sample. Inconsistency in first-generation definitions makes it difficult to compare results across studies or make valid interpretations (LeBouef & Dworkin, 2021).

**Studying Transfer**

A review of the most recent literature on college transfer corroborates Wang's (2012) conclusion that very few transfer-related studies have explored the influence of psychological factors such as students' attitudes, beliefs, perceptions, and motivational characteristics on their interest in and commitment to transfer. However, STEM degree interest and persistence are studied extensively in the four-year context, often through the lens of social cognitive career theory (Lent, Brown, & Hackett, 1994, 2000). Social cognitive career theory (SCCT) provides a framework for investigating career choice and academic persistence through the interplay of demographic characteristics, beliefs, interests, expectations, and external factors. Researchers use SCCT to investigate career interest and degree persistence among baccalaureate and graduate students across the spectrum of STEM fields. SCCT also considers the experiences and perceptions of students across socioeconomic class, race, and gender. Recently, researchers have used SCCT variables to predict first-generation college students' interest and persistence in math, science, and engineering bachelor's degree programs (Navarro et al., 2019; Garriot et al., 2017, 2015, 2013). Despite the overwhelming focus on four-year degree programs, the rich body of
SCCT research can guide both quantitative and qualitative investigation into STEM transfer and first-generation community college students.

This study examines community college STEM majors’ perceptions of the supports and barriers they will experience during their time at the community college while pursuing transfer. Special attention is paid to the differences in responses between first- and continuing-generation college students. This study was guided by SCCT’s emphasis on the importance of contextual influences (e.g., family, peers, finances) on degree persistence and Wang’s (2016a) SCCT-based STEM Transfer Model, which situates transfer research within the community college context.

An anonymous survey was emailed to students across seven Virginia community colleges during the fall semester of 2021. The survey included two validated scales from Lent et al.’s (2003b) battery of SCCT instruments along with demographic and parental education questions. A total of 307 students completed the survey, a roughly 3% response rate. Depending on definition, students ranged from 87 first-generation (“no college”) and 220 continuing generation (“some college, no degree), to 155 first-generation (“no bachelor’s) and 152 continuing-generation (“bachelor’s or higher”).

Literature Review

The definitions researchers use have consequences. They determine who gets studied and who gets overlooked – not only in research but in policy and practice (Toutkoushian et al., 2018). There is no single definition of first-generation college student that researchers agree upon (Ives & Castillo-Montoya, 2020; Nguyen & Nguyen, 2018; Davis, 2010). Even the United States Department of Education and multiple entities of the United States government use contrasting definitions (see Cataldi et al., 2018; Engle & Tinto, 2008). Although many journal articles on first-generation students do not even supply an operational definition, a synthesis of
the literature and government publications yields two general interpretations. The most widely used meaning of a first-generation student is one whose parents or guardians have not attained a bachelor's degree (Ives & Castillo-Montoya, 2020). This is the definition used by the Department of Education for the Federal Pell Grant (Engle & Tinto, 2008), the Federal TRIO Program (Quinn et al., 2019).

The less-used definition of first-generation college student refers to students whose parents’ or guardians’ highest educational attainment is a high school diploma, GED, or less, and thus have no postsecondary education experience (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al. 2004). Likewise, the non-profit College Board’s definition is “students whose parents’ combined highest education completed was a high school diploma (Smith, et al., 2018, p. 10).” These are distinctly different interpretations, each with its own assumptions about who should and should not be counted as first-generation. Failing to explore these meanings "limits the capacity to grasp how these students’ backgrounds and identities shape their decisions and relationships to others and to institutions, and risks reproducing the very inequality that education researchers wish to mitigate (Nguyen & Nguyen, 2018, p. 148)."

The Virginia Community College System, in which this study took place, defines first-generation student as “a student who indicated on the online admission application that both parents did not attend a postsecondary institution (Northern Virginia Community College, 2018, p. 1)." This is consistent with the American Association of Community Colleges’ definition: “students whose parents have had no postsecondary education (Nomi, 2005, p. 3)." Davis (2010) uses the "no bachelor's" definition and argues that first-generation student status should not be determined by parents' years of college. It is instead "about being competent and comfortable navigating the higher-education landscape, about growing up in a home environment that
promotes the college and university culture (p. 4).” Davis' preference, however, assumes that "no bachelors" and "no college" first-generation students are indistinguishable. What little research there is comparing both groups, however, shows clearly distinguishable quantitative and qualitative differences.

To differentiate between the usage of the terms used in research, the term first-generation will refer to students whose parents have not attained a bachelor's degree, while first-generation ("no college") and first-generation ("no bachelor’s") will be used where the distinction is relevant. The “no bachelor’s” definition subsumes the “no college” students. When referring to students whose parents have at least some college experience but no bachelor’s, first-generation ("some college, no bachelor’s") will be used.

**Differentiating the Definitions of First-Generation College Student**

Davis's (2010) conflation of first-generation ("no college") and first-generation ("no bachelor’s") students into a single group assumes that “the social capital provided to students whose parents have not received a bachelor’s degree will not markedly differ from those for whom neither parent attended college (Allan et al. 2016, p. 487).” The notion that the two groups are "practically indistinguishable" seems to be the prevailing opinion, given the wide use of the "no bachelor's" definition of first-generation student in the literature and by the federal government. Given the disadvantages associated with lower family income and lower social capital discussed earlier, it is reasonable to expect that students whose parents have no postsecondary experience are even more likely to experience disadvantages or to experience them in greater magnitude. A handful of studies lend credence to this hypothesis.

Cataldi et al. (2018) found not only that continuing-generation college students dropped out less often at 14%, but first-generation students whose parents had no postsecondary
experience dropped out more often at 33% than those whose parents had some postsecondary experience but no bachelor’s degree, at 26%. The percentage of first-generation "no college" versus "some college, no bachelor’s" students whose highest math was trigonometry or precalculus was 27% versus 35%, respectively. In their analysis of the NCES Longitudinal Study of 2002 through 2012, Redford and Hoyer (2017) found first-generation college students, defined as those “whose parents do not have any postsecondary education experience” made up 24% of 2002 high school sophomores. Students “with at least one parent who had some postsecondary education experience but did not have a bachelor’s degree” accounted for 34% (p. 3). High school sophomore students with no parental postsecondary education were more than twice as likely to live in a household with a 2002 income of $20,000 or less compared to their peers with some parental postsecondary education (27% versus 12%). Only 6% of students with at least one parent with a bachelor’s degree fell into this low-income category. While 13% of prospective first-generation "no college" and 16% of first-generation "some college, no bachelor’s" high school sophomores had a GPA of 3.50 and above, 29% of continuing-generation students met the same achievement. There were fewer differences in reasons for leaving college without first obtaining a credential, but one notable difference is 31% of first-generation "no college" students chose Conflicts with demands at home, versus 23% of first-generation "some college, no bachelor’s" students.

A strong indicator of high school student intent to attend college is the taking of the ACT exam (American College Testing, 2016). Throughout 2012-2015, 18% of students taking the ACT were “no college” first-generation students, compared to 24% of the “some college, no bachelor's” group and 23% of the “one or more bachelor’s” group. The percent of high school graduates meeting three or more ACT college readiness benchmarks (English, reading,
mathematics, and science) averaged 18% for the “no college” group, 30% for the “some college, no bachelor's” group, and 50% for the “one or more bachelor’s” group (p. 10). For those in community college, the barriers experienced due to personal finances, cost of computers, and family responsibilities were all reported as more frequent and more urgent for first-generation "no college" students compared to "some college, no bachelors" students (Nomi, 2005). Reasons for attending a community college were similar for both groups, except for the purpose of transfer, where the "no bachelors" group is roughly 48% versus about 35% for "no postsecondary" group. Collectively, these findings illustrate the two prevailing definitions of first-generation college student are not effectively interchangeable.

First-Generation Status and College Persistence

Regardless of definition, first-generation students face a surfeit of impediments in their journey through college, and they are less likely than continuing-generation students to complete a degree or transfer from a two-year school to a four-year college or university. Yet there are many who do succeed and, given the four-year-centric measures of success that have been embraced by so much of academic research, there may be more of these students than are generally accounted for (Ives & Castillo-Montoya, 2020). Whereas most theoretical frameworks for student persistence were created with four-year schools and universities in mind, community college student persistence issues are qualitatively different from those of four-year schools (Webb, 1989). Although the intersection of first-generation and STEM is represented in the literature, there is very little coverage of how successful graduates describe the attitudes, beliefs, and supports that enable their success (Burnett, 2017). What little there is, however, shows similar results to studies about successful first-generation students in general. Following is an overview of how these students succeed through hard work and resilience, actively seeking
interaction with and mentorship from faculty, seeking help from college advisors and counselors, having a love for learning and their major, and having a supportive family.

Multiple studies reported students' belief in the role of hard work in their success. This was especially true of minority students, many of whom learned the value of industriousness from their working-class parents (Blackwell & Pinder, 2014; Gibbons & Woodside, 2014). Pascarella et al. (2004) observed that first-generation students who persisted in degree programs at four-year institutions were resilient enough that their initial disadvantages getting to the four-year school did not translate into further ones. Academically resilient students are those who persist despite barriers and disadvantages (Alva & Padilla, 1995), and have been associated with a strong work ethic (Longwell-Grice et al., 2016). Perhaps this is one reason first-generation students with and without parental postsecondary exposure find themselves employed after earning a bachelor's just as often as continuing-generation graduates (Cataldi et al., 2018).

Quantitative and qualitative studies have revealed higher levels of resilience in first-generation students compared to non-first-generation peers (Alvarado et al., 2017; Covarrubias et al. 2018). Often this hard work was inspired by the opportunity of triumphing over poverty or the general appeal of a high salary in a STEM field (Azmitia et al. 2018; Longwell-Grice et al., 2016; Conrad et al., 2009). Even first-generation underrepresented minority graduates who did not have their family's support maintained their resilience and their goal to create a better life for themselves (Blackwell & Pinder, 2014). Intrinsic motivation, including love of learning, especially of science, has been a major factor for many first-generation students’ persistence (Portnoi & Kwong, 2019; Liversage et al., 2018; Demetriou et al., 2017; Longwell-Grice et al., 2016; Gibbons & Woodside, 2014; Archer et al. 2012). Often this enthusiasm was fueled by passionate faculty (Zhang & Ozuna, 2015; Gasiewski et al. 2012). Interaction with faculty was
one of the most noted contributions to success, which is unsurprising given the evidence for faculty-student engagement to persistence (Nora et al., 2005; Tinto, 1997, 2012; Astin, 1993).

Many successful first-generation students were aided by, and sometimes actively sought, faculty interaction inside and outside of the classroom (Demetriou et al., 2017; Longwell-Grice et al., 2016; Crisp & Nora 2010; Conrad, 2009), and the earlier the interaction in community college, the more likely interaction continued after transfer (Fuentes et al, 2014). Successful students engage with faculty and seek mentors, and successful first-generation students do so despite their limited social capital and familiarity with the college environment. For example, first-generation Mexican American students, some of whom could not rely on family for academic support, actively sought mentors, who, as one student put it, "inspired me to keep going (Rodriguez et al., 2019, p. 10)." These findings are consistent with Pascarella & Terenzini's (2005) contention that increased student-faculty interaction reinforces the student-institution relationship and thus increases persistence.

First-generation students who transfer and complete a bachelor's degree also know the importance of seeking guidance from advisors and college staff (Azmitia et al., 2018). Swecker et al. (2013) found that frequency of meeting with an advisor was the variable most strongly associated with first-generation continued enrollment status. Finding a helpful advisor increased the feeling of belongingness and improved persistence among first-generation women in STEM transfer (Packard et al., 2011). Hispanic/Latino, predominately first-generation, community college students were more likely to have higher GPAs and persistence rates if they spoke regularly with academic and career counselors (Tovar, 2015). Similar to intentionally engaging faculty, seeking advisors demonstrates resilience in overcoming some of the social capital constraints first-generation students often experience.
First generation college students who persist often report generous emotional support from their families (Azmitia et al. 2018; Longwell-Grice et al. 2016). There is an expanding volume of qualitative research on female and racial and ethnic minority success, with many of those interviewed being first-generation college students. First-generation women who transferred from community college into STEM degree programs found family support to be a major influence in their persistence (Packard et al., 2011). Some students had only general parental support because their parents had not attended college, but this was still a major influence on their persistence (Rodriguez et al., 2019; Longwell-Grice et al. 2016). First-generation Hispanic/Latino and Black students who transferred successfully into STEM programs did not let their parents' lack of education and ability to help them with coursework discourage them (Crisp et al., 2009).

Supportive faculty, advisors, and family have shown to play a critical role in first-generation, female, Hispanic, and African American students' persistence in college (Tovar, 2015), in STEM degree programs (Katrevich & Aruguete, 2017), as well as their successful transfer from community college (Packard et al., 2011). This is consistent with Nora’s (2002) model of Student/Institution Engagement Model, which maintains that frequent quality interaction with the institution (i.e., faculty, staff, and peers) influences persistence and transfer outcomes. Many of these findings are consistent with student engagement models such as Tinto’s (1993, 2012) student integration framework and Astin’s (1993) student involvement theory. Successful students in these studies were engaged in their discipline and with the institution, communicated often with faculty and mentors, and took the initiative to seek advice from transfer and career counselors. It should be noted that the students in these studies were exceptions, as most first-generation college students do not complete a degree (Cataldi et al.,

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They showed exceptional fortitude and a willingness to adapt. However, as Blackwell and Pinder (2014) stated, "[i]t is not possible to reproduce that strong internal drive found in these students; however, the environmental factors can be improved to facilitate a set of constructs that can be expanded to include school influence as well as parental support (p. 55)."

**First-Generation Status and Underrepresented Groups**

Beyond the challenges of being a first-generation student, female and ethnic minority students may feel resistance and alienation, a sense of not belonging, which presents an extra challenge to their academic success (Shapiro & Sax, 2011; Owens et al., 2010). They may not identify with the dominant perceptions of what scientists and engineers "look like" that pervade STEM courses and careers (Byars-Winston & Rogers, 2019; Rodriguez et al., 2017; Packard et al., 2011). As Jackson et al. (2013) point out, marginalized groups face compounded challenges at the intersection of race and gender, both in the community college and especially in the more rigorous academic culture of four-year colleges and universities. Underrepresented minorities are also more likely than White students (25% versus 16%, respectively) to be tracked into vocational (non-transfer-oriented) programs (Crisp & Nuñez, 2014). This phenomenon is also known as "cooling out", or the cumulative steps, often inadvertent or well-intended, that convince students perceived as ill-prepared for baccalaureate education to forego their intentions of transfer and instead opt for an occupational degree or credential (Clark, 1960). However, recent scholarship has called into question the “cooling out” phenomenon and has even shown a “heating up” of initially non-transfer associate’s degree-seeking students switching to transfer-oriented programs (Monaghan & Atewell, 2015).

Women make up a disproportionately smaller percentage of physical science, engineering, and computer science majors compared to men, with representation of women of
color even lower (Zhang, et al., 2019; Perez-Felkner, et al., 2018; Rodriguez et al., 2017; Hill et al., 2010). Female students, especially in community college, are also statistically more likely to be first-generation (regardless of definition) and have family and parental commitments (Davis, 2010; Chen & Carrol, 2005; Pascarella et al. 2004). Even for women who successfully navigate gender stereotyping and engendered science identity to achieve a STEM degree and career, such experiences in the workplace can reduce their engagement and career confidence (Veelen et al., 2019).

A sense of belonging and the perceived racial climate of the institution are significant factors for minority student adjustment (Owens et al., 2010). First-generation students of color have expressed a heightened sense of safety concerns and the need for more supportive and diverse campus culture at predominately White institutions (Adams & McBrayer, 2020). Qualitative research has shown that, even in a majority Black university, first-generation Black students often lack the social capital and helpful family support needed to help them avail themselves of faculty and institutional resources (Parks-Yancy, 2012). Many received well-intended but detrimental "advice" from family members who often did not understand that time outside of the classroom was not necessarily "free time." This is consistent with what many White and Hispanic first-generation college students have experienced; students do not know how to obtain resources from faculty and institutional contacts because their families are not able to pass down this social capital (Pascarella, et al., 2004; Bourdieu, 1986).

First-generation students are also more likely to be non-traditional or "adult" learners. Although there are multiple meanings and definitions of non-traditional, Bean and Metzner's (1985) criteria is a student who is at least one of the following: part-time attending; living off-campus; older than 24. As the first two criteria are common among all groups of community
college students, being 25 years and older is a common meaning and one adopted by the VCCS (VCCS, 2019; Bean & Metzner, 1985). First-generation status on community college transfer-track students aged 25 and over was found to have no effect on intent to transfer (Rosenberg, 2016). In a qualitative study of 17 adults from low-income families without college educations, 13 of the participants (5 out of 6 men and 8 out of 11 women) stated their father was more influential than their mother in shaping their views of work and educational attainment. Strong work ethic and motivation from intrinsic rewards were common characteristics. Of those who completed college, mentors were considered especially helpful to their persistence (Gibbons & Woodside, 2014).

**Summary of First-Generation College Student Research**

Defining first-generation college student is a challenge. One definition ignores potentially millions of students who, despite their parents’ forays into postsecondary education, may not be aware of all the norms and procedures of college. This definition also defines a community college associate’s degree holder as not having attended college, which is especially fraught when researching community college populations. The other definition is inclusive but ignores the differences between those whose parents have no college experience and those whose parents may have associate’s degrees or may have even transferred – albeit without attaining a bachelor’s afterwards. Even if we compare both groups, the intersection of race and gender with first-generation status guarantees myriad of experiences that cannot be considered typical for all first-generation students (Nguyen & Nguyen, 2018). Although each ethnic group and gender therein experiences different forms of discrimination, stereotype proliferation, and the gamut of levels of SES, first-generation students of all backgrounds tend to have much in common.
Regardless of demographic or definition, first-generation students are more likely than continuing-generation peers to be lower income, non-traditional aged, more than twice as likely to leave before degree completion, have lower high school GPAs, require remedial coursework in college, lack basic knowledge about applying to college and degree requirements once in college, and express a lack of mentors and role models (Cataldi et al., 2018; Engle & Tinto, 2008; Chen & Carroll, 2005; Pascarella et al., 2004). These disadvantages are exacerbated by racial and gender discrimination, including stereotypes promulgated by parents, educators, peers, and co-workers (Fernández-García, 2019; Veelen, 2019). Those who do persist to degree completion are more often those who have frequent interactions with faculty and advisors, access to mentors, support from family, and greater ability to cope with social and environmental barriers (Heller & Cassady, 2017; Wang, Lee, & Prevost, 2017; Packard et al., 2011).

**Defining STEM**

In researching course-taking patterns of community college students beginning in STEM, Wang (2016b) defined STEM courses based on Classification of Instructional Programs (CIP) codes, a taxonomic coding scheme created by the U.S. Department of Education to "facilitate the organization, collection, and reporting of fields of study and program completions (NCES, 2010, p. 1)." Wang's list of STEM programs included those with the following 2-digit CIP codes: 01 (agriculture sciences), 03 (natural resources and conservation), 11 (computer and information science), 14 (engineering), 15 (engineering technologies/technicians), 26 (biological and biomedical sciences), 27 (mathematics and statistics), 40 (physical sciences), 41 (science technologies/technicians), and 47 (mechanic/repair technologies/technicians).

Wang (2016b) noted that categories 15, 41, and 47 have a strong occupational orientation, meaning their associated degree programs are not transfer-oriented. Except for the
lack of codes 51 for health professions and related programs, and 60 for health professions residency programs, these codes are consistent with the U.S. Department of Veteran's Affairs's list of approved STEM fields of study for scholarship and GI benefit purposes. According to Veteran's Affairs, a STEM field of study is a field of study included in the CIP taxonomy within the two-digit series containing: biological or biomedical science, physical science, science technologies or technicians, computer and information science and support services, mathematics or statistics, engineering, engineering technologies or an engineering-related field, a health profession or related program, a medical residency program, an agriculture science program or a natural resources science program, or other subjects and fields identified by the Secretary as meeting national needs (U.S. Department of Veteran's Affairs, 2020).

In their analysis of Beginning Postsecondary Students 2004/2009 longitudinal study data for developing a classification model for community college pathways to the STEM workforce, Noy & Zeidenberg (2017) distinguish between science and engineering (S&E) programs and technician programs by whether the student will require more education (i.e., a four-year degree) to enter the workforce. Their categorizing of STEM degree programs generally accords with the NCES' (Chen, 2009), with S&E programs including biological and biomedical sciences, engineering, physical sciences, and mathematics and statistics, while technician programs include engineering technologies (e.g., mechatronics), computer and information sciences, science technologies/technicians (e.g., solar energy technician), and agriculture (Noy & Zeidenberg, 2017). Their placement of computer science (versus computer information sciences) in the technician category instead of S&E is contrary to most classifications and not explained. Despite this issue, their conclusions are noteworthy: there are sub-baccalaureate STEM programs that lead to the workforce, there are more "traditional" science, math, and engineering transfer-
oriented programs, and (perhaps most importantly) there are many students in non-transfer-oriented technician programs whose stated goal is also to eventually obtain a bachelor's degree.

Lundy-Wagner and Chan (2016), in their classification of STEM programs in the VCCS, use the example of CIP code 11 (Computer and Information Sciences and Applications), which includes programs in both computer science and data entry, to illustrate how misleadingly broad this taxonomic scheme can be. They warn that "without a consistent framework that is attuned to the nuances of community college STEM programs, the field will remain unable to attain consistency and comparability between study results on this topic (p. 6)." The researchers, in collaboration with the VCCS and other community college experts, developed a classification scheme "relevant to policy making for postsecondary STEM credentials (p. 6)." Their three STEM program categories are: (1) traditional STEM fields such as engineering and biology; (2) allied health STEM fields including licensed practical nursing and occupational therapy programs; (3) technology and technician STEM fields, including automotive technology, mechatronics, and air conditioning repair. Only the traditional STEM fields category has a transfer orientation. These programs all fall into either the Associate of Science (AS) degree program or the Associate of Arts & Science (AA&S) degree program, both of which are transfer-oriented.

Wang’s (2016a) Expanding STEM Talent Survey groups baccalaureate STEM programs based on the National Science Board's (2018) groupings, similar to Lundy-Wagner and Chan’s (2016) traditional STEM field taxonomy. These categories, chosen by the student via survey, are Biological, agricultural, or environmental life sciences, Computer or mathematical sciences, Engineering or engineering technologies, and Physical sciences including chemistry, physics,
Astronomy, etc. Due to their previous use in similar research, general consonance with VCCS transfer pathways, and comprehensive nature, these four categories were used for this study.

**A Social Cognitive Approach to Studying Community College Students**

Social cognitive career theory (SCCT) is primarily concerned with career choice and development, and the role self-efficacy, outcome expectations, and career/academic interests play in goal choice and goal achievement (Lent et al., 1994). Self-efficacy beliefs refer to “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986, p. 391).” Self-efficacy beliefs are the major determinants of thought and action in social cognitive theory (Lent & Brown, 2006). Outcome expectations are "beliefs about the consequences or outcomes of performing particular behaviors (p. 17)," and together with self-efficacy, assert influence over interests, choice goals, and choice actions. Choice goals in SCCT are “an individual's intention to engage in a particular activity or to produce a particular outcome, addressing questions such as, how much and how well do I want to do this?” (Lent, 2005, p. 105). When the choice goal of a particular study is completing a degree, the variable studied is often referred to as persistence intention. Persistence intentions are defined, in accordance with the SCCT construct, as a subjective measure of an individual's perceived likelihood to continue to pursue a goal (Lent et al., 2003b; Lent et al., 2008; Lent et al., 2016). Unlike performance metrics, persistence intentions reflect individual student beliefs about how likely they are to succeed and can be correlated to their perceived supports and barriers.

For example, a student with high self-efficacy in chemistry, as well as strong positive outcome expectations of earning a degree in chemical engineering (e.g., high salary, rewarding work) would, according to SCCT, be more likely to have greater interest in attaining a degree.
(the choice goal) and be more likely to continue their degree program (persistence intentions) and successfully graduate with a bachelor's in chemical engineering (the final choice action). Although it may seem like common sense that someone would want to pursue a career in a field, they are good at and that will be financially and personally rewarding, many SCCT studies return different parameter estimates for self-efficacy, outcome expectations, and perceived barriers, often for racial/ethnic and gender categories (Lent & Brown, 2019). For instance, Garriott, Navarro, et al. (2017) found that, contrary to expectations, self-efficacy in math and science did not significantly predict persistence intentions for first-generation engineering students. One explanation for these differences is the influence of social, cultural, and environmental factors.

In SCCT, the social, cultural, and environmental influences fall into two categories – distal (background) contextual affordances and proximal environmental influences. Distal contextual affordances help shape self-efficacy and interest, and include influences such as skill development, cultural and gender role socialization, parental status, and work hours (Lent et al., 2001; Wang, 2016a). Proximal environmental influences, which come into play at critical choice junctures, include emotional and financial support, job availability, perceived social barriers and supports, and organizational policy and practices (Lent et al., 2001; Wang, 2016a). These contextual factors can directly and indirectly affect both ability and willingness to transform interest into goals and goals into actions/attainment. Beneficial environmental conditions (such as access to supportive family and access to mentors) aid in navigating the path to goal achievement, while detrimental conditions (such as a culture that does not prioritize education or an environment of racial discrimination) hinder the process (Lent et al., 2002).

Although SCCT has been used to study various STEM majors and first-generation bachelor’s seeking students, there is little published research performed at the community
college. This study seeks to determine whether first-generation community college students pursuing STEM transfer perceive different levels of supports, barriers, and persistence intentions compared to their continuing-generation peers. This study is also unique in that it is the first to compare results for both definitions of first-generation college student and their associated continuing-generation groups.

**Research Question**

The research question explored in this study was, how do first-generation community college students compare to their continuing-generation peers in terms of persistence intentions and perceived supports and barriers related to the goal of STEM transfer?

Six hypotheses were tested to answer the research question:

**Ho1:** There is no significant difference in perceived supports for STEM transfer between continuing-generation and first-generation (no college) community college students.

**Ho2:** There is no significant difference in perceived supports for STEM transfer between continuing-generation community college students and first-generation (no bachelor’s) community college students.

**Ho3:** There is no significant difference in perceived barriers to STEM transfer between continuing-generation and first-generation (no college) community college students.

**Ho4:** There is no significant difference in perceived barriers to STEM transfer between continuing-generation community college students and first-generation (no bachelor’s) community college students.
Ho5: There is no significant difference in STEM transfer persistence intentions between continuing-generation and first-generation (no college) community college students.

Ho6: There is no significant difference in STEM transfer persistence intentions between continuing-generation and first-generation (no bachelor’s) community college students.

Ho7: There is no significant difference in perceived supports for STEM transfer based on highest parental education (No College, Some College but No Bachelor's, Bachelor's+)

Ho8: There is no significant difference in perceived barriers to STEM transfer based on highest parental education (No College, Some College but No Bachelor's, Bachelor's+)

Ho9: There is no significant difference in STEM transfer persistence intentions based on highest parental education (No College, Some College but No Bachelor's, Bachelor's+).

**Theoretical Framework**

Four major elements comprise the theoretical framework for this study. First, the research into first-generation community college students, and their quantitatively and qualitatively different experiences compared to continuing-generation students. Second, the evidence against the notion, implicit or explicit, that first-generation students whose parents have no postsecondary experience are effectively indistinguishable from those whose parents have postsecondary experience but no bachelor’s degree (e.g., Davis, 2010). Third, Lent et al.’s (1994) Social Cognitive Career Theory (SCCT) of educational and career choice, which hypothesizes
the effects of social and environmental influences on career goals and the strength of intention to persist in accomplishing those goals. Fourth, Wang’s (2016a) SCCT-based STEM Transfer Model, which situates the goal of transfer itself as the central phenomenon to be studied, primarily within the context of the community college. This study uses two instruments from the SCCT battery of instruments to compare perceived STEM transfer supports and barriers and the student’s perceived likelihood of successfully transferring and completing a STEM bachelor’s degree.

Definitions

*First-generation college students* (FGCS) in this study are defined in two ways. *First-generation* ("no college") refers to students who report no parental college experience whatsoever. *First-generation* ("no bachelor’s") refers to all students who indicate no parental bachelor’s degree or higher, including those with no college, some college, and associate’s degrees. The “no bachelor’s” definition is consistent with the federal TRIO program’s definition of first-generation college student (Higher Education Act of 1965, 1998). When the term first-generation is used without qualifiers, the more inclusive “no bachelor’s” definition should be assumed.

*Continuing-generation college students* (CGCS) are defined in this study according to their first-generation counterpart groups. Continuing-generation ("some college") refers to students who indicate at least one parent with some college experience. This definition is consistent with the first-generation ("no college") definition. Continuing-generation ("bachelor’s+") refers to students who indicate at least one parent with a bachelor’s degree or higher. This definition is consistent the first-generation ("no bachelor’s") definition and with the

For the purposes of this study, a *STEM bachelor’s degree* is a bachelor’s degree in one of the following areas: (a) biological, agricultural, or environmental life sciences, (b) computer or mathematical sciences, (c) engineering or engineering technologies, or (d) physical sciences including chemistry, physics, astronomy, etc. These four areas, taken from Wang’s (2016a) Expanding STEM Talent Survey, are generally consistent with the Virginia Community College System’s transfer-oriented degree programs, transfer pathways, and the federal guidelines for STEM areas of study for veteran’s tuition reimbursement (U.S. Department of Veteran's Affairs, 2020).

*Persistence intentions* are defined, in accordance with the SCCT construct, as a subjective measure of an individual's perceived likelihood to continue to pursue a goal (Lent et al., 2003b; Lent et al., 2008; Lent et al., 2016).

*STEM Transfer persistence intentions* are a subjective measure of a community college student’s perceived likelihood to successfully complete a STEM bachelor’s degree and serves as a proxy for successful transfer.

*Perceived social and environmental supports for and barriers* to STEM transfer are examples of contextual supports and barriers, defined in SCCT as facilitative influences or obstacles that people anticipate will be encountered along the process of goal pursuit (Lent & Brown, 2006). This study used Lent et al.'s (2003b) Conceptual Supports and Barriers Scale to measure factors identified in the literature as especially important to first-generation college students, including family and peer support, availability of mentors, financial resources, and
perceptions of racial and gender discrimination (Cataldi et al., 2018; Davis, 2010; Engle & Tinto, 2008; Ishitani, 2006; Chen & Carroll, 2005; Pascarella et al., 2004).

Methodology

This project investigated how first-generation community college students compare to their continuing-generation peers in terms of persistence intentions and perceived supports and barriers related to the goal of STEM transfer. Contrasting but widely used definitions of first- and continuing-generation student were compared.

This section details the sample selection, instrumentation, data collection procedures, and data analysis procedures. An anonymous online survey was sent to qualifying students across seven Virginia community colleges during fall semester of 2021. Demographic survey items were used to determine first- or continuing-generation status. Students’ perceptions were measured quantitatively using Lent et al.’s (2003b) Contextual Supports and Barriers Scale and Persistence Intention’s Scale. Descriptive statistics were used to elaborate on the demographic and enrollment characteristics of the sample. Finally, hypotheses were tested using independent samples t-tests and one-way Analysis of Variance (ANOVA) tests.

Sample Selection

The research study took place across seven Virginia community colleges, selected for their demographic and geographic diversity, during the fall semester of 2021. These seven colleges have a combined population of about 10,000 students in STEM transfer-oriented degrees, not including health sciences. The 24 colleges of the Virginia Community College System (VCCS) have a combined headcount of around 160,000 students, with roughly 30% falling into the federal TRIO definition of first-generation, which includes students whose parents or single parent have not attained a bachelor’s degree (Higher Education Act of 1965,
The TRIO definition is analogous to this study’s first-generation “no bachelor’s” monolithic group. The combined racial/ethnic makeup of all colleges is 7.5% Asian, 17.5% Black or African American, 13.3% Hispanic/Latino, 56.5% White and non-responders, and about 5% other races including multiracial-Non-Hispanic (State Council of Higher Education for Virginia (SCHEV), 2020). About 60% of VCCS students are women. In the fall of 2021, there were around 140,000 students across all colleges, with 8,668 men and 5,561 women enrolled in a transfer-oriented STEM associate’s degree program (SCHEV, 2022).

Table 1

<table>
<thead>
<tr>
<th>Gender</th>
<th>Population Surveyed (~10,000)</th>
<th>All VCCS students (~140,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>34.98%</td>
<td>57%</td>
</tr>
<tr>
<td>Male</td>
<td>64.41%</td>
<td>43%</td>
</tr>
<tr>
<td>Transgender/Non-Binary/Other</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Unknown/Prefer not to answer</td>
<td>1.38%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: Internal VCCS database results; State Council of Higher Education for Virginia

Participants in this study were contacted via their community college email accounts with a recruitment email (see Appendix 10) and a link to an online survey. Participants eligible for this study were Virginia community college students aged 18 or over enrolled during the 2021 fall semester, who indicated on the survey that their primary goal for attending their community college is to transfer to a four-year college or university to attain a degree in one of four broad STEM major areas. Efforts to eliminate the possibility of responses from high school dual enrollment students included: the age restriction stated on the recruitment email; the age
restriction stated on the consent page; some participating colleges filtering for age when generating student email distribution lists; some participating colleges having survey existing exclusion filters for dual-enrollment students.

**Instrumentation**

The instrument chosen to quantitatively measure student perceived contextual supports and barriers is Lent et al.’s (2003b) Contextual Supports and Barriers Scale, comprising a 15-item perceived social and environmental supports scale, and a 21-item perceived social and environmental barriers scale. The instrument selected to quantify students’ subjective measure of their perceived likelihood to successfully transfer and complete their four-year STEM degree, their intention to persist, is Lent et al.’s (2003b) 4-item Persistence Intentions scale.

**Demographic and Enrollment Characteristics Survey**

A 7-item survey was used to record students’ race/ethnicity, gender, credit hours earned, STEM transfer major area, and parental education. The categorical variable *credit hours earned* were presented as a multiple-choice question with the following options: *None (this is my first semester); 3 to 6; 7 to 15; 16 to 30; 31 to 45; 46 or more.* The four STEM major fields were presented as a multiple-choice question with the following options: *biological, agricultural, or environmental life sciences; computer or mathematical sciences; engineering or engineering technologies; physical sciences including chemistry, physics, astronomy, etc.* A final option, *I do not plan to transfer or I do not plan to major in any of the above STEM areas* served as a final method to determine eligibility, and caused the survey to end if selected.
Contextual Supports and Barriers Scale

Perceived social and environmental supports for, and barriers to transfer were measured using Lent et al.'s (2003b) Contextual Supports and Barriers Scale. This 36-item instrument uses a Likert scale ranging from 1 (Not at all likely) to 5 (Very Likely) to measure perceived supports (15 items) and barriers (21 items) to college degree attainment. Although initially used to measure supports and barriers perceptions of engineering degree-seeking students, the scale and its individual subscales have also been used in the context of physical and biological science, computer science, and mathematics degree goals for undergraduate and high school students (Peña-Calvo, 2016; Garriot et al., 2013; Lent et al., 2008; Lent et al., 2003a, 2003b). Support items are divided into four conceptual clusters: (a) social support and encouragement; (b) instrumental assistance; (c) access to role models and mentors; (d) financial resources. Barrier items are divided into four conceptual clusters: (a) social or family influences; (b) financial constraints; (c) instructional barriers; (d) gender and race discrimination.

The original prompt for the instrument is During your time at this university pursuing an engineering degree, how likely will you be to... The modified prompt for the instrument for this study is: During your time at this college pursuing transfer to a four-year bachelor’s degree program in the STEM degree area you indicated in Question 2, how likely will you be to... Examples of support scale items include: Feel that your family members support this decision, and Have enough money saved up to be able to complete your education in this field. Examples of barrier scale items include Receive negative comments or discouragement about your major from family members, and Receive unfair treatment because of your racial or ethnic group.
Persistence Intentions Scale

Lent et al.'s (2003) Persistence Intentions scale was used to measure students’ intention to persist in STEM transfer. This four-item instrument uses a Likert scale ranging from 1 (Not at all likely) to 5 (Very Likely) to quantify a students’ subjective measure of their perceived likelihood to successfully complete a college degree (Lent et al., 2003b). The Persistence Intentions scale was initially used in the context of engineering degree persistence intentions. The scale has been adapted to multiple STEM majors including life sciences, physical sciences, computing, and mathematics (Peña-Calvo, 2016; Dutta et al., 2015; Lent et al., 2008).

The prompt for the Persistence Intentions scale is, Using the scale below, indicate your level of agreement with each of the following statements. The four original items are: I intend to major in an engineering field; I plan to remain enrolled in an engineering major over the next semester; I think that earning a bachelor’s degree in engineering is a realistic goal for me; I am fully committed to getting my college degree in engineering.

The prompt for the present study was adjusted to: Using the scale below, indicate your level of agreement with each of the following statements about the STEM major you indicated in Question 2. The response items were adjusted for this study as follows: I intend to major in my chosen STEM field; I plan to remain enrolled in my major, or transfer to four-year program in my major, over the next semester; I think that earning a bachelor’s degree in my chosen STEM field is a realistic goal for me; I am fully committed to getting my bachelor’s degree in my chosen STEM field.

Validity and Reliability of Instruments

The validity of an instrument refers to its ability to produce scores that are accurate, meaningful, reflect the true theoretical meaning of its construct, and allow the researcher to draw
good conclusions about the population being studied through the sample being measured (Creswell, 2008; Rovai et al., 2016). The evaluative judgement of validity should be supported by both theoretical rationale and empirical evidence (Messick, 1995). Reliability refers to the consistency and repeatability in scores across multiple administrations of an instrument (Creswell, 2008). The following sections explain evidence of different types of validity for each instrument, as well as reliability and potential limitations.

**Contextual Supports and Barriers Scale**

Content validity, or the extent to which an instrument’s items represent all aspects of a construct (Creswell, 2008), for the Contextual Supports and Barriers scales (Lent et al., 2003b) was established through review of the literature and existing instruments pertaining to career and educational barriers and supports, through expert review, and qualitative coding of interviews with two-year and four-year college students (Lent et al., 2001, 2002, 2003b). The conceptual clusters, confirmed factors, and individual items are all represented in the literature of college attrition and persistence, and are especially important to first-generation and community college students. These include the importance of mentors and role models (Deil-Amen, 2011; Engle & Tinto, 2008; Wallace et al., 2000), financial and work constraints (Cataldi et al., 2018; Ishitani, 2006), gender and racial discrimination (Fernández-García, 2019; Veelen et al., 2019), positive and negative family influences (Tate et al., 2015; Blackwell & Pinder, 2014; Archer et al., 2012;), peer interaction, support, and acceptance (Deil-Amen, 2011; Pascarella et al., 2004), and interaction with faculty and staff (Wang et al., 2017; Deil-Amen, 2011; Pascarella et al., 2004; Tinto, 1997).

Criterion validity, or the degree to which scores relate to an expected outcome or criterion (Creswell, 2008), of the Contextual Supports and Barriers scales and subscales has been
established through multiple SCCT studies in which greater barrier scores have correlated to lower academic self-efficacy and lower degree persistence intentions (Kim & Seo, 2014; Peña-Calvo et al., 2014; Lent et al., 2001, 2003b). The barrier scale has shown to correlate negatively, and the support scale positively, with barrier coping efficacy scales (Lent et al., 2001). These results are corroborated by SCCT studies (e.g. Turner et al., 2019; Fort & Murariu, 2018) that yield similar results using different instruments to measure barriers and supports, including those that use the Luzzo & McWhirter (2001) Perceptions of Barriers Scale, Zimet et al.'s (1988) Social Supports scale, and the revised Fennema-Sherman Math Attitudes Scale - Short Form (Fennema & Sherman, 1976; Turner et al., 2004).

The hypothesized relationships between perceived barriers and supports and persistence intentions have been observed in multiple studies using the full scales or (more commonly) the 9-item social supports and 5-item social barriers subscales. Although the 21-item full barriers scale failed to correlate with persistence intentions in the initial study of students in introductory psychology courses (Lent et al., 2001), subsequent studies have shown expected correlation from both scales. The full scales have shown to relate significantly to persistence intentions as hypothesized in studies of racially diverse engineering students (Lent et al., 2003b), Spanish university students across multiple STEM majors (Peña-Calvo et al., 2014), and South Korean undergraduate engineering students (Kim & Seo, 2014). The social barriers and social supports subscales of the instrument have related as hypothesized to persistence intentions among low-income prospective first-generation college students (Garriot et al., 2013), Hispanic male and female engineering students (Flores et al., 2017), and minority undergraduate students with disabilities (Dutta et al., 2015).
Construct validity was further established for the Contextual Supports and Barriers scales through exploratory and confirmatory factor analyses (Lent et al., 2005a). Results indicated two support subscales (Social and Financial) and three barrier subscales (Social, Instrumental, and Gender). Kim and Seo (2014) arrived at the same results through their confirmatory factor analysis of the instrument translated into Korean for their study of South Korean engineering students. Peña-Calvo et al. (2016) focused on the sources of supports and barriers, rather than the monolithic “social” subscales, represented by the instrument. In their exploratory factor analysis of responses from 811 STEM undergraduate university students in Spain, the researchers determined four factors for each scale: perceiving teaching staff supports/barriers; perceived peer supports/barriers; perceived family supports/barriers; perceived financial supports/barriers. Gender and racial discrimination did not score sufficiently high to be accepted as a latent factor, but this could be due to greater perception of racial homogeneity in the Spanish sample (Peña-Calvo et al., 2016).

Due to the strong relationship between social support and barrier factors and their corresponding full scale scores, Lent and colleagues used only the social conceptual cluster for further research, with similar results to the full scale studies (e.g. Lent et al., 2005a, 2008, 2010). Other SCCT researchers have used these subscales and corroborated the relationships between barriers and supports to persistence intentions (Navarro et al., 2019, 2014; Flores et al., 2017; Garriot et al., 2013). Although the social supports and social barriers subscales provide similar correlational results to the full 15- and 21-item scales, respectively, the present study relies on the full instrument to better characterize the range of experiences of first-generation college students.
The Contextual Supports and Barriers instrument has demonstrated reliability across multiple contexts. Lent and colleagues reported coefficient alpha values of .88 for the supports scale and .90 for the barriers scale in their 2001 study, and scores of .92 and .94 for supports and barriers, respectively, in their 2003 study of engineering students. Kim and Seo (2014) reported coefficient alpha values of .87 for the supports scale and .85 for the barriers scale in a study of 660 South Korean engineering students. The social supports and barriers subscales, widely used in place of the full instrument, reported coefficient alpha values of .90 for supports and .84 for barriers among engineering students in both historically Black and predominately White institutions (Lent et al., 2005a), .90 for supports and .76 for barriers among prospective first-generation college students (Garriot et al., 2013), and between .72 and .86 for Italian and Portuguese high school students (Lent et al., 2003a).

**Limitations.** The Contextual Barriers and Supports instrument does have several limitations. While the 9-item social supports and 5-item social barriers subscales have been widely used in SCCT research, the full scales have seen less utilization. More research is needed to better understand the types of barriers and supports faced by students, as well as determine how these may differ among minority, underserved, and first-generation populations (Lent & Brown, 2019; Peña-Calvo et al, 2016; Kim & Seo, 2014). Due to the scale’s focus on student perceptions, and without more longitudinal research, it is difficult to ascribe predictive validity beyond the scale’s correlation to SCCT factors. For this reason, although it can be said that higher barrier scores are predictors of lower persistence intentions, which have been shown in some studies to predict actual persistence (Lent et al., 2016; Lent et al., 2003b), it cannot be said generally that a higher score on the barriers scale predicts college dropout. Finally, there are instruments that explore more deeply individual constructs, such as the 12-item Parental
Encouragement Scale (Gloria, 2005) and Luzzo and McWhirter’s (2001) 33-item Perceptions of Barriers scale that addresses more fully racial and gender discrimination.

Despite its limitations, the Conceptual Supports and Barriers scale was used for this study because of its coverage of the major support and barrier factors identified in the literature as most salient to first-generation college students’ degree persistence, and its performance as predicted across multiple diverse samples. Although the full scale mean scores, which were used to answer RQ2, do not identify the types of supports and barriers a student faces, they are still suitable for determining whether the two first-generation student subgroups (no college versus no bachelor’s) perceive different overall amounts of supports and barriers.

**Persistence Intentions Scale**

Content validity for Lent et al.’s (2003b) Persistence Intentions Scale was established through review of the literature and existing instruments concerning goal choice and intentions, particularly Bandura’s (1986) social cognitive theory and Ajzen (1991) Theory of Planned Behavior (TPB). TPB has shown both theoretical and empirical support for strength of intention as a reliable indicator of eventual goal completion (Fichten et al., 2016a, 2016b; Witt et al., 2014). The persistence intention scale is conceptually similar to Ajzen and Fishbein’s (1980) TPB-based instrument but designed to be specific to degree completion (Lent et al., 2003b). The four items on the persistence intentions scale also accord with Malle and Knobe's (2001) philosophical and operational treatise on intentions, in which an intention comprises: (a) the decision to act on a goal; (b) practical reasoning about one's ability to achieve a goal; (c) both short-term commitment; (d) long-term commitment.

Predictive validity for the Persistence Intentions Scale has been established in longitudinal studies through its prediction of actual persistence among undergraduate
engineering students and its correlation to hypothesized social cognitive factors (Lent et al., 2016; Lent et al., 2003b). SCCT incorporates Bandura’s (1997) theory that perceived self-efficacy is a major determinant of intention (Lent & Brown, 2006). Multiple studies support this claim, with self-efficacy instruments correlating as hypothesized to persistence intentions (e.g. Garriot et al., 2017; Peña-Calvo et al., 2016; Dutta et al., 2015; Lent et al., 2005b). Structural equation modeling has shown persistence intentions, as hypothesized, are directly and indirectly affected by self-efficacy and directly affected by interests (Flores et al., 2017; Garriot et al., 2017; Dutta et al., 2015; Lent et al., 2008; 2005b). Accordingly, persistence intentions scale scores have correlated as predicted in SCCT theory-consistent manner with outcome expectations, interests, and perceived barriers and supports to STEM degree attainment (Flores et al., 2017; Garriot et al., 2017; Lent et al., 2016, 2015, 2010, 2005a, 2005b, 2003b; Navarro et al., 2019, 2014; Morris & Lent, 2019).

SCCT’s focus on persistence intentions is based on the evidence of strong associations between intentions and actual persistence revealed by college attrition and persistence research (e.g., Cabrera, 1992; Pascarella & Terenzini, 1980; Bean & Metzner, 1985). Lent et al.’s (2003b) persistence intentions scale has been shown to be predictive of actual persistence in undergraduate engineering students across as few as two and as many as six semesters (Lent et al., 2003b; 2016). Although structural equation modeling and path analyses in some studies have not always confirmed each hypothesized path in the SCCT choice model (Lent & Brown, 2019), the persistence intentions scale has demonstrated reliability and consistently related to perceived contextual barriers and supports across race, gender, country, and STEM degree area. Although the scale consists of only four items, each item operationalizes one of the four requirements for defining an intention according to Malle and Knobe’s (2001) monograph distinguishing intention
from desire. Conceptually similar to some TPB-based graduation intention instruments (e.g. Fichten et al.’s, 2014), Lent et al.’s instrument uses clear, unambiguous language that does not risk conflation of terms like “try” and “expect” with the word “intend.”

Coefficient alphas for the persistence intentions scale have ranged from .91 to .95 for samples of introductory engineering students (Lent et al. 2008, 2005a), .92 for Hispanic/Latino and White engineering students (Navarro et al, 2014), .79 for 1,208 computer science students, roughly half from historically Black colleges and universities and half from primarily White institutions (Lent et al., 2008), .72 for first-generation Hispanic/Latino and White engineering students (Garriott et al., 2017), and .92 for 115 underrepresented minority students with disabilities who expressed interest in STEM fields (Dutta et al., 2015).

Limitations. The persistence intentions scale is not without its limitations. There are few longitudinal SCCT studies that can attest to the scale’s ability to predict actual persistence toward a college degree. Most studies are cross-sectional and performed in four-year college and university settings, and there is a recognized need to investigate community college and first-generation college students (Lent & Brown, 2019; Garriot et al., 2017). Finally, it is doubtful that a quantitative measure, regardless of the quality of design and number of assessed dimensions, can ever capture the entirety of the abstract concept of “intention.” What it does offer is a way to quantitatively compare students’ perceptions of their own likelihood to transfer and complete their bachelor’s degree. Measuring and comparing those perceptions are important to the present study as well as informing further SCCT research.

Data Collection Procedures

Approval from the university Institutional Review Board was obtained before the research began. Approval from each participating community college’s Institutional Review
Board or office of institutional research was obtained the semester before the research began. The survey instrument for this study was hosted on the researcher’s Qualtrics online survey distribution account. The researcher emailed the recruitment letter content and survey links to each participating college’s office of institutional research or director of research. Each college emailed the survey link and recruitment information to eligible students. Three colleges sent emails only to students enrolled in STEM transfer programs (not including healthcare programs), comprising 91% of eligible students in the study and 51% of responses. Four colleges sent the email to all students aged 18 and over not enrolled in high school dual-enrollment programs, comprising 9% of eligible students and 49% of responses. Two colleges failed to send the follow-up email. Final response data was downloaded from Qualtrics into a Microsoft Excel spreadsheet and imported into the SPSS statistical analysis software.

Figure 1 shows a diagram of how each generation pair was created for hypothesis testing. For Definition #1, first-generation college students were defined as those with no parental college experience (FGCS-NC, n = 87); continuing-generation college students where thus defined as students whose parents have at least some college experience (CGCS-SC, n = 220). For Definition #2, first-generation college students were defined as those with no parental bachelor’s degree or higher (FGCS-NB, n = 155); continuing-generation college students were this defined as those with at least one parental bachelor’s degree or higher (FGCS-B+, n = 152).
Figure 1

Division of Generation Groups Based on Two Contrasting Definitions, Including Sample Sizes

Data Analysis Procedures

Data from the survey was input into IBM’s SPSS Statistics software application version 28 for statistical analysis. Measures of central tendency and variability were used to characterize first-generation students and continuing-generation students of all categories in terms of perceived supports, perceived barriers, and persistence intentions. To determine the existence of significant differences in perceived supports and barriers among generation types, the nine null hypotheses were tested using independent two-tailed t-tests and one-way Analysis of Variance (ANOVA) test. The following statistical tests were performed to test the hypotheses for the research question:
For Ho1, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-SC and FGCS-NC). The Dependent Variable was the mean score of the Contextual Supports and Barriers instrument’s 15-item supports scale.

For Ho2, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-B+ and FGCS-NB). The Dependent Variable was the score of the Contextual Supports and Barriers instrument’s 15-item supports scale.

For Ho3, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-SC and FGCS-NC). The Dependent Variable was the mean score of the Contextual Supports and Barriers instrument’s 21-item barriers scale.

For Ho4, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-B+ and FGCS-NB). The Dependent Variable was the mean score of the Contextual Supports and Barriers instrument’s 21-item barriers scale.

For Ho5, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-SC and FGCS-NC). The Dependent Variable was the mean score of the 4-item Persistence Intentions Scale.

For Ho6, an independent samples $t$-test was performed. The Independent Variable was student generation group (CGCS-B+ and FGCS-NB). The Dependent Variable was the mean score of the 4-item Persistence Intentions Scale.

For Ho7, a one-way ANOVA was performed to compare the effect of highest parental education on perceived supports for STEM transfer. The Independent Variable was highest parental education (No College, Some College No Bachelor’s, Bachelor’s+). The Dependent Variable was the mean score of the Contextual Supports and Barriers instrument’s 15-item supports scale.
For Ho8, a one-way ANOVA was performed to compare the effect of highest parental education on perceived supports for STEM transfer. The Independent Variable was highest parental education (No College, Some College No Bachelor’s, Bachelor’s+). The Dependent Variable was the mean score of the Contextual Supports and Barriers instrument’s 21-item barriers scale.

For Ho9, a one-way ANOVA was performed to compare the effect of highest parental education on perceived supports for STEM transfer. The Independent Variable was highest parental education (No College, Some College No Bachelor’s, Bachelor’s+). The Dependent Variable was the mean score of the 4-item Persistence Intentions Scale.

**Conclusion**

By using parametric methods to test hypotheses, this study attempts to answer the question of how first-generation community college students compare to their continuing-generation peers in terms of demographics, enrollment characteristics, persistence intentions, and perceived supports and barriers related to the goal of STEM transfer. Potential differences between the two first-generation groups (FGCS-NC vs. FGCS-NB) were tested and compared to their continuing-generation counterpart groups. Next, differences between students with no parental college, some parental college but no bachelor’s degree, and parental bachelor’s+ students were compared. The next section details the results of these analyses.

**Results**

This section details the results of the study. First, the sample of survey responders is described and compared against the population in terms of demographics and STEM major area. Next, the results of data analysis and summary of findings are presented. Demographic
information was compiled for the entire group of students as well as for each grouping of highest parental education.

**Demographic Characteristics of Respondents**

Demographic information gathered by this study included student gender, race/ethnicity, and parental education level. Enrollment characteristics included STEM major area and credit hours completed. Table 2 shows gender demographics for the surveyed population, all VCCS students, and survey sample (N = 307). Table 3 shows race/ethnicity demographics.

**Table 2**

*Gender Demographics for Surveyed Population, entire VCCS student body, and Survey Sample*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Population Surveyed (~10,000)</th>
<th>All VCCS students (~140,000)</th>
<th>Survey Responders (N = 307)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>3,242 (34.98%)</td>
<td>57%</td>
<td>149 (47.88%)</td>
</tr>
<tr>
<td>Male</td>
<td>5,970 (64.41%)</td>
<td>43%</td>
<td>147 (48.53%)</td>
</tr>
<tr>
<td>Transgender/Non-Binary/Other</td>
<td>N/A</td>
<td>N/A</td>
<td>9 (2.93%)</td>
</tr>
<tr>
<td>Unknown/Prefer not to answer</td>
<td>128 (1.38%)</td>
<td>N/A</td>
<td>2 (0.65%)</td>
</tr>
</tbody>
</table>
Table 3
Race/Ethnicity Demographics for Surveyed Population, entire VCCS student body, and Survey Sample

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Population Surveyed (~10,000)</th>
<th>All VCCS students (~140,000)</th>
<th>Survey Responders (N=307)</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian</td>
<td>180 (1.81%)</td>
<td>0.34%</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Asian</td>
<td>2,160 (21.74%)</td>
<td>7.98%</td>
<td>35 (11.40%)</td>
</tr>
<tr>
<td>Black</td>
<td>1,723 (17.34%)</td>
<td>17.43%</td>
<td>30 (9.77%)</td>
</tr>
<tr>
<td>Hispanic or Latino/a</td>
<td>1,390 (13.99%)</td>
<td>11.08%</td>
<td>41 (13.36%)</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>34 (0.34%)</td>
<td>0.25%</td>
<td>2 (0.65%)</td>
</tr>
<tr>
<td>White (Non-Hispanic)</td>
<td>3,652 (36.76%)</td>
<td>53.32%</td>
<td>189 (61.56%)</td>
</tr>
<tr>
<td>Other/Non specified</td>
<td>797 (8.02%)</td>
<td>9.6%</td>
<td>10 (3.26%)</td>
</tr>
</tbody>
</table>

Table 4
Gender by Highest Parental Education with Sample Size and Percentage.

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
<th>Transgender/Nonbinary/Other</th>
<th>Prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>147 (48.53%)</td>
<td>149 (48.5%)</td>
<td>9 (2.9%)</td>
<td>2 (0.7%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>58 (38.2%)</td>
<td>87 (57.2%)</td>
<td>6 (3.9%)</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>19 (65.6%)</td>
<td>9 (31%)</td>
<td>1 (3.4%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>24 (61.5%)</td>
<td>15 (38.5%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>46 (52.9%)</td>
<td>38 (43.7%)</td>
<td>2 (2.3%)</td>
<td>1 (1.1%)</td>
</tr>
</tbody>
</table>

Table 5 depicts the variable race/ethnicity highest parental education. The survey used the race/ethnicity categories used by the VCCS internal enrollment databases. As such, Hispanic/Latino ethnicity was included as a choice in the multiple-choice race/ethnicity question. The VCCS recently changed the student enrollment application to reflect Hispanic/Latino
ethnicity as separate from race. Future surveys should align with this change, as well as including a choice for “two or more races.” The researcher found no instances among the Qualtrics temporary store of incomplete surveys in which a survey taker stopped the survey on the race/ethnicity question (Question #3). There were no responses indicating American Indian or Alaskan Native ethnic identity.

Table 5

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total students</th>
<th>Asian</th>
<th>Black or African American</th>
<th>Hispanic/Latino</th>
<th>Native Hawaiian or other Pacific Islander</th>
<th>White (Non-Hispanic)</th>
<th>Prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>35 (11.4%)</td>
<td>30 (9.8%)</td>
<td>41 (13.4%)</td>
<td>2 (0.7%)</td>
<td>189 (61.6%)</td>
<td>10 (3.3%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>20 (13.2%)</td>
<td>17 (11.2%)</td>
<td>10 (6.6%)</td>
<td>2 (1.3%)</td>
<td>97 (63.8%)</td>
<td>6 (3.9%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>3 (10.3%)</td>
<td>2 (6.9%)</td>
<td>2 (6.9%)</td>
<td>0 (0%)</td>
<td>22 (75.9%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>1 (2.6%)</td>
<td>2 (5.1%)</td>
<td>7 (17.9%)</td>
<td>0 (0%)</td>
<td>28 (71.8%)</td>
<td>1 (2.6%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>11 (12.6%)</td>
<td>9 (10.3%)</td>
<td>22 (25.3%)</td>
<td>0 (0%)</td>
<td>42 (48.3%)</td>
<td>3 (3.4%)</td>
</tr>
</tbody>
</table>

Table 6 depicts the number and percentage of each parental education group enrolled across the four STEM major areas. Overall, STEM major areas were relatively evenly distributed among groups. Notably, for every STEM major area except engineering, there were more students with no parental bachelor’s degrees than students with parental bachelor’s or higher.
Table 6

STEM Major Area by College Generation Group

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total</th>
<th>Biological, agricultural, or environmental life sciences</th>
<th>Computer or mathematical sciences</th>
<th>Engineering or engineering technologies</th>
<th>Physical sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>94 (30.6%)</td>
<td>94 (30.6%)</td>
<td>91 (29.6%)</td>
<td>28 (9.1%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>41 (27%)</td>
<td>45 (29.6%)</td>
<td>54 (35.5%)</td>
<td>12 (7.9%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>9 (31%)</td>
<td>10 (34.5%)</td>
<td>8 (27.6%)</td>
<td>2 (6.9%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>14 (35.9%)</td>
<td>13 (33.3%)</td>
<td>7 (17.9%)</td>
<td>5 (12.8%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>30 (34.5%)</td>
<td>26 (29.9%)</td>
<td>22 (25.3%)</td>
<td>9 (10.3%)</td>
</tr>
</tbody>
</table>

The next section presents the results of data analysis and hypothesis testing to answer the study’s research question.

Results of Data Analysis

The data compiled from the online survey were analyzed to determine how first-generation community college students compare to their continuing-generation peers in terms of demographics, enrollment characteristics, persistence intentions, and perceived supports and barriers related to the goal of STEM transfer. Along with the demographic survey questions, responses to Lent et al.’s (2003b) 36-item Contextual Supports and Barriers Scale and 4-item Persistence Intentions Scale were analyzed to test each hypothesis.

The Contextual Supports subscale score was calculated by dividing all item scores (totaling between 15 and 75) by the number of questions (15) to produce a mean score between 1 and 5. This mean score was used for testing hypotheses Ho1 and Ho2. The following groups were assigned: For Ho1, the FGCS-NC group \((n = 87)\) contained all students whose parents had no college experience, and the CGCS-SC \((n = 220)\) group contained all other students, whose
parents had at least some college. For Ho2, the FGCS-NB group \((n = 152)\) contained all students whose parents had less than a bachelor’s degree, including an associate’s degree, some college but no degree, and those with no college; the CGCS-B+ group \((n = 155)\) contained only students who had one or more parent with at least a bachelor’s degree.

Table 7

*Contextual Supports Subscale Mean Scores for Each Generation Group*

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>(n)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>3.22</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>3.27</td>
<td>0.65</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>3.07</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>3.30</td>
<td>0.65</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>3.13</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The Contextual Barriers subscale score was calculated by dividing all item scores (totaling between 21 and 105) by the number of questions (21) to produce a mean score between 1 and 5. This mean score was used for testing hypotheses Ho3 and Ho4. The same groups were used from the previous hypothesis tests. Table 8 shows contextual barriers scores for each generation group.
Table 8  
*Contextual Barriers Subscale Mean Scores for Each Generation Group*

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>2.33</td>
<td>0.67</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>2.30</td>
<td>0.63</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>2.42</td>
<td>0.63</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>2.29</td>
<td>0.61</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>2.37</td>
<td>0.72</td>
</tr>
</tbody>
</table>

The Persistence Intentions Scale score was calculated by dividing all item scores (totaling between 4 and 20) by the number of questions (4) to produce a mean score between 1 and 5. This mean score was used for testing hypotheses Ho5 and Ho6. Table 9 shows persistence intentions scores for each group.

Table 9  
*Persistence Intentions Scores for Each Generation Group*

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>4.43</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>4.47</td>
<td>0.71</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>4.33</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>4.48</td>
<td>0.72</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>4.38</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Table 10 shows Cronbach’s alpha scores calculated for each scale for each group.

Cronbach’s alpha provides an indication of internal consistency or the strength of correlation among all items in a scale (Rovai et al., 2014), with a recommended minimum of at least .7 representing high reliability (Hinkle et al. 1998). Overall, the scales showed strong reliability, with scores ranging from .77 to .92.

Table 10

*Cronbach’s Alpha Scores for Each Scale by Generation Group*

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>n</th>
<th>Supports</th>
<th>Barriers</th>
<th>Persistence Intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>0.85</td>
<td>0.89</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>0.86</td>
<td>0.88</td>
<td>0.79</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>0.86</td>
<td>0.92</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>0.86</td>
<td>0.87</td>
<td>0.80</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>0.86</td>
<td>0.91</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table 11 shows contextual supports subscale conceptual cluster mean scores for all students and each generation group. Regardless of definition, first-generation students reported lower average levels of supports on the full scale. Especially notable are the overall similar scores for the perception of role models and mentors for all groups, ranging from 2.83 to 2.90. These scores indicate that all community college students perceive that they are slightly less than “moderately likely” (3 on the instrument’s Likert-style scale) to have access to mentors or role models. First-generation students scored noticeably lower on perceived financial supports compared to their continuing-generation counterparts. All students scored below “moderately likely” with an average of 2.48. Given these results, it is reasonable to suspect that the supports
scale’s financial resources items contributed to much of the statistical difference between first- and continuing-generation support scores found during hypothesis testing.

Table 12 shows contextual barriers subscale conceptual cluster mean scores for all students and each generation group. Full scale scores increase based on parental education, from 2.29 for the CGCS-B+ group (lowest perceived barriers) to 2.42 for the FGCS-NC group (highest perceived barriers). First-generation students reported higher perceived barriers in all clusters except for instructional barriers, for which they reported slightly fewer barriers.

Table 11
Mean Scores for Contextual Supports Conceptual Clusters by Generation Group

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>Full scale</th>
<th>Social supports</th>
<th>Instrumental assistance</th>
<th>Role models and mentors</th>
<th>Financial resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>3.22</td>
<td>3.82</td>
<td>3.21</td>
<td>2.86</td>
<td>2.48</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>3.27</td>
<td>3.87</td>
<td>3.24</td>
<td>2.86</td>
<td>2.60</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>3.07</td>
<td>3.70</td>
<td>3.15</td>
<td>2.88</td>
<td>2.19</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>3.30</td>
<td>3.90</td>
<td>3.19</td>
<td>2.90</td>
<td>2.69</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>3.13</td>
<td>3.75</td>
<td>3.24</td>
<td>2.83</td>
<td>2.28</td>
</tr>
</tbody>
</table>
Table 12

Mean Scores for Contextual Barriers Conceptual Clusters by Generation Group

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>Full scale</th>
<th>Social and family influences</th>
<th>Financial constraints</th>
<th>Instructional barriers</th>
<th>Gender and race discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>2.33</td>
<td>2.32</td>
<td>3.02</td>
<td>2.34</td>
<td>1.67</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>2.30</td>
<td>2.26</td>
<td>2.96</td>
<td>2.34</td>
<td>1.66</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>2.42</td>
<td>2.46</td>
<td>3.17</td>
<td>2.23</td>
<td>1.71</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>2.29</td>
<td>2.27</td>
<td>2.88</td>
<td>2.38</td>
<td>1.64</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>2.37</td>
<td>2.36</td>
<td>3.16</td>
<td>2.30</td>
<td>1.70</td>
</tr>
</tbody>
</table>

Hypothesis Testing

To test null hypotheses Ho1 through Ho6, independent samples t-tests were used. To test null hypotheses Ho7 through Ho9, ANOVA (Analysis of Variance) tests were used. One of the assumptions of such parametric techniques is that samples have normally distributed scores (Pagano, 2004). Normal distributions are often not possible in social science research, however, especially when using self-reporting instruments and surveys (Pallant, 2020). Fortunately, with sample sizes over 30, t-tests and ANOVA are usually robust enough with respect to non-normal distributions (Glass & Hopkins, 1996). Although barrier scores for some groups in this study did not pass the Kolmogorov-Smirnov test for normality, sample sizes for each group in this study ranged from 87 (FGCS-NC) to 220 (CGCS-SC). The persistence intentions scale scores were especially skewed, with most respondents choosing all 5s (Strongly Agree) for each of the four items. Following the recommendation of Lent et al. (2018), these scores were transformed using rank case transformation into normalized z-scores. The result was a slightly more normalized
score variable, which still failed the Kolmogorov-Smirnov test for normality (p < .001). The limitations of this instrument were discussed in an earlier section. Figure 2 shows the frequency histogram of the Kolmogorov-Smirnov test for normality of the raw persistence intention scores. Figure 3 shows the results for the transformed z-score persistence intentions.

Figure 2. Kolmogorov-Smirnov test for normality for persistence intentions scores for all students
Figure 3. Kolmogorov-Smirnov test for normality for transformed persistence intentions scores for all students

Table 13 summarizes the results of \( t \)-tests between the CGCS-SC and FGCS-NC groups (Ho1, Ho3, and Ho5). Table 14 shows the results of \( t \)-tests between the CGCS-B+ and FGCS-NB groups (Ho2, Ho4, and Ho6). Cohen (1988) interprets a Cohen’s \( d \) effect size value of .2 to represent a small effect, .5 to represent a medium effect, and .8 to represent a large effect. These recommendations were used to interpret the effect sizes for \( t \)-tests.

Table 15 shows the results of one-way ANOVA tests (Ho7, Ho8, and Ho9) for each measure between three groups: continuing-generation students with a parental bachelor’s degree or higher; first-generation students with some parental college but no bachelor’s degree or higher; first-generation students with no parental college experience. Eta squared effect sizes
were calculated for each ANOVA. Cohen (1988) interprets an eta squared value of .01 as a small effect, .06 as a medium effect, and .14 as a large effect. These recommendations were used to interpret the effect sizes for ANOVA tests.

Table 13

*Continuing-Generation (Some college) and First-Generation (No college) STEM Transfer Perceptions*

<table>
<thead>
<tr>
<th>Scale</th>
<th>CGCS-SC (n = 220)</th>
<th>FGCS-NC (n = 87)</th>
<th>t(305)</th>
<th>p</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports</td>
<td>3.27</td>
<td>0.65</td>
<td>3.08</td>
<td>0.66</td>
<td>2.38</td>
</tr>
<tr>
<td>Barriers</td>
<td>2.30</td>
<td>0.63</td>
<td>2.42</td>
<td>0.75</td>
<td>-1.46</td>
</tr>
<tr>
<td>Persistence Intentions</td>
<td>4.47</td>
<td>0.71</td>
<td>4.33</td>
<td>0.81</td>
<td>1.45</td>
</tr>
<tr>
<td>Persistence Intentions – Transformed</td>
<td>-.005</td>
<td>.85</td>
<td>-.16</td>
<td>.90</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Table 14

*Continuing-Generation (Bachelor’s+) and First-Generation (No bachelor’s) STEM Transfer Perceptions*

<table>
<thead>
<tr>
<th>Scale</th>
<th>CGCS-B+ (n = 152)</th>
<th>FGCS-NB (n = 155)</th>
<th>t(305)</th>
<th>p</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports</td>
<td>3.30</td>
<td>0.66</td>
<td>3.13</td>
<td>0.65</td>
<td>2.83</td>
</tr>
<tr>
<td>Barriers</td>
<td>2.29</td>
<td>0.61</td>
<td>2.37</td>
<td>0.72</td>
<td>-1.62</td>
</tr>
<tr>
<td>Persistence Intentions</td>
<td>4.48</td>
<td>0.72</td>
<td>4.38</td>
<td>0.75</td>
<td>0.67</td>
</tr>
<tr>
<td>Persistence Intentions – Transformed</td>
<td>0.02</td>
<td>0.84</td>
<td>-0.12</td>
<td>0.90</td>
<td>1.30</td>
</tr>
</tbody>
</table>
Table 15

One-Way ANOVA Comparing STEM Transfer Perceptions Across Parental Education Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bachelor’s+</th>
<th>Some college, no bachelor’s</th>
<th>No College</th>
<th>df</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
</tr>
<tr>
<td>Supports</td>
<td>152</td>
<td>3.30</td>
<td>0.65</td>
<td>68</td>
<td>3.21</td>
<td>0.63</td>
<td>87</td>
</tr>
<tr>
<td>Barriers</td>
<td>152</td>
<td>2.29</td>
<td>0.62</td>
<td>68</td>
<td>2.31</td>
<td>0.68</td>
<td>87</td>
</tr>
<tr>
<td>Persistence Intentions</td>
<td>152</td>
<td>4.48</td>
<td>0.72</td>
<td>68</td>
<td>4.44</td>
<td>0.67</td>
<td>87</td>
</tr>
<tr>
<td>Persistence Intentions - Transformed</td>
<td>152</td>
<td>0.02</td>
<td>0.84</td>
<td>68</td>
<td>-.05</td>
<td>0.88</td>
<td>87</td>
</tr>
</tbody>
</table>

**Ho1: Supports – CGCS-SC Group and FGCS-NC Group**

An independent t-test was conducted to evaluate the null hypothesis (Ho1) that there was no significant difference in perceived supports for STEM transfer between continuing-generation students with at least some parental college experience (CGCS-SC, n = 220) and first-generation community college students defined as those with no parental college experience (FGCS-NC, n = 87). The assumption of normality of scores were confirmed using the Kolmogorov-Smirnov test for both groups, p > .05. The assumption of homogeneity of variance was evaluated using Levene’s F Test for Equality of Variance and was found tenable, p > .05.

The results of the independent t-test provided evidence that the difference in perceived supports for STEM transfer between the CGCS-SC group (M = 3.27, SD = .65) and the FGCS-NC group (M = 3.08, SD = .66) was statistically significant, t(305) = 2.38, p = .018. Cohen’s $d$ was .02, indicating a small effect size.
Based on their responses, continuing-generation community college students with at least some parental college experience perceive significantly more contextual supports for STEM transfer than first-generation community college students with no parental college experience.

**Ho2: Supports – CGCS-B+ Group and FGCS-NB Group**

An independent $t$-test was conducted to evaluate the null hypothesis (Ho2) that there was no difference in perceived supports for STEM transfer between continuing-generation college students with at least one parental bachelor’s degree or higher (CGCS-B+, $n = 152$) and first-generation community college students defined as those with no parental college degree (FGCS-NB, $n = 155$).

The results of the independent $t$-test provided evidence that the difference in perceived supports for STEM transfer between the CGCS-B+ group ($M = 3.30$, $SD = .65$) and the FGCS-NB group ($M = 3.13$, $SD = .65$) was statistically significant, $t(305) = 2.23$, $p = .027$. Cohen’s $d$ was .25, indicating a small effect size.

Based on their responses, continuing-generation community college students with a parental bachelor’s degree or higher perceive significantly more contextual supports for STEM transfer than first-generation community college students with no parental bachelor’s degree or higher.

**Ho3: Barriers – CGCS-SC Group and FGCS-NC Group**

An independent $t$-test was conducted to evaluate the null hypothesis (Ho3) that there was no difference in perceived barriers to STEM transfer between continuing-generation college students with at least some parental college experience (CGCS-SC, $n = 220$) and first-generation community college students defined as those with no parental college experience (FGCS-NC, $n =
The assumption of normality of scores were confirmed using the Kolmogorov-Smirnov test for the CGCS-SC group, $p > .05$, but not for the FGCS-NC group, $p < .05$. The assumption of homogeneity of variance was evaluated using Levene’s F Test for Equality of Variance and was found untenable, $p < .05$; results for unequal variances were used.

The results of the independent $t$-test provided evidence that the difference in perceived barriers to STEM transfer between the CGCS-SC group ($M = 2.30, SD = .63$) and the FGCS-NC group ($M = 2.42, SD = .75$) was not statistically significant, $t(305) = -1.36, p = .176$.

Based on their responses, continuing-generation community college students with at least some parental college experience do not perceive significantly different amounts of contextual barriers to STEM transfer than first-generation community college students with no parental college experience.

**Ho4: Barriers – CGCS-B+ Group and FGCS-NB Group**

An independent $t$-test was conducted to evaluate the null hypothesis (Ho4) that there was no difference in perceived barriers to STEM transfer between continuing-generation college students with at least one parental bachelor’s degree or higher (CGCS-B+, $n = 152$) and first-generation community college students defined as those with no parental college degree (FGCS-NB, $n = 155$). The assumption of normality of scores were confirmed using the Kolmogorov-Smirnov test for the CGCS-B+ group, $p > .05$, but not for the FGCS-NB group, $p < .05$. The assumption of homogeneity of variance was evaluated using Levene’s F Test for Equality of Variance and was found untenable, $p < .05$; results for unequal variances were used.

The results of the independent $t$-test provided evidence that the difference in perceived barriers to STEM transfer between the CGCS-B+ group ($M = 2.29, SD = .61$) and the FGCS-NB group ($M = 2.37, SD = .72$) was not statistically significant, $t(305) = -1.05, p = .295$. 

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Based on their responses, continuing-generation community college students with at least one parental bachelor’s degree or higher do not perceive significantly different amounts of contextual barriers to STEM transfer than first-generation community college students with no parental bachelor’s degree or higher.

**Ho5: Persistence Intentions – CGCS-SC Group and FGCS-NC Group**

An independent t-test was conducted to evaluate the null hypothesis (Ho5) that there was no difference in STEM transfer persistence intentions between continuing-generation college students with at least some parental college experience (CGCS-SC, n = 220) and first-generation community college students defined as those with no parental college experience (FGCS-NC, n = 87). The assumption of normality of scores were rejected using the Kolmogorov-Smirnov test for both the CGCS-SC and FGCS-NC group, $p > .05$. The assumption of homogeneity of variance was evaluated using Levene’s F Test for Equality of Variance and was found tenable, $p > .05$.

The results of the independent t-test provided evidence that the difference in STEM transfer persistence intentions between the CGCS-SC group (M = 4.47, SD = .71) and the FGCS-NC group (M = 4.33, SD = .81) was not statistically significant, $t(305) = 1.43, p = .154$.

Based on their responses, continuing-generation community college with at least some college experience do not perceive significantly different amounts of STEM transfer persistence intentions than first-generation community college students defined as those with no parental college experience.

**Ho6: Persistence Intentions – CGCS-B+ Group and FGCS-NB Group**

An independent t-test was conducted to evaluate the null hypothesis (Ho6) that there was no difference in STEM transfer persistence intentions between continuing-generation college
students with at least one parental bachelor’s degree or higher (CGCS-B+, \( n = 152 \)) and first-generation community college students defined as those with no parental college degree (FGCS-NB, \( n = 155 \)). The assumption of normality of scores were rejected using the Kolmogorov-Smirnov test for both groups, \( p > .05 \). The assumption of homogeneity of variance was evaluated using Levene’s F Test for Equality of Variance and was found tenable, \( p > .05 \).

The results of the independent \( t \)-test provided evidence that the difference in STEM transfer persistence intentions between the CGCS-B+ group (\( M = 4.48, SD = .72 \)) and the FGCS-NB group (\( M = 4.38, SD = .75 \)) was not statistically significant, \( t(305) = 1.20, p = .231 \).

Based on their responses, continuing-generation community college students with at least one parental bachelor’s degree or higher do not perceive significantly different amounts of STEM transfer persistence intentions than first-generation community college students with no parental bachelor’s degree or higher.

**Ho7: Supports Compared Between Parental Education Groups**

A one-way ANOVA was performed to evaluate the null hypothesis (Ho7) that there was no significant difference in perceived supports for STEM transfer based on highest parental education, with the following groups: No College (\( n = 87 \)), Some College, No Bachelor’s (\( n = 68 \)), Bachelor’s+ (\( n = 152 \)). There was a statistically significant difference at the \( p < .05 \) level: \( F(2, 304) = 3.29, p = .039 \). Post-hoc comparisons using Tukey’s HSD test indicated that the mean score for the No College group (\( M = 3.08, SD = .66 \)) was significantly lower the Bachelor’s+ group (\( M = 3.30, SD = .65 \)). The effect size, calculated using eta squared, was .03, signifying a small effect size.

Based on their responses, continuing-generation community college students whose parents have a bachelor’s or higher perceive significantly more supports for STEM transfer than
first-generation students with no parental college experience, but about the same level of supports compared to first-generation students with at least some parental college experience.

**Ho8: Barriers Compared Between Parental Education Groups**

A one-way ANOVA was performed to evaluate the null hypothesis (Ho8) that there was no significant difference in perceived barriers to STEM transfer based on highest parental education, with the following groups: No College (n = 87), Some College, No Bachelor’s (n = 68), Bachelor’s+ (n = 152). There was no statistically significant difference at the p < .05 level: F(2, 304) = 1.08, p = .341.

Based on their responses community college students do not perceive significantly different levels of barriers to STEM transfer based on highest parental education.

**Ho9: Persistence Intentions Between Parental Education Groups**

A one-way ANOVA was performed to evaluate the null hypothesis (Ho9) that there was no significant difference in STEM transfer persistence intentions based on highest parental education, with the following groups: No College (n = 87), Some College, No Bachelor’s (n = 68), Bachelor’s+ (n = 152). There was no statistically significant difference at the p < .05 level: F(2, 304) = 1.01, p = .335. A second ANOVA using the transformed z-scores for persistence intentions corroborated that there were no statistically significantly differences at the p < .05 level: F(2, 304) = 1.2, p = .305.

Based on their responses community college students do not perceive significantly different levels of STEM transfer persistence intentions based on highest parental education.
Summary of Results

The results of the Contextual Supports and Barriers Scale and Persistence Intentions Scale showed little difference between first- and continuing-generation students in terms of supports, and no difference in barriers or persistence intentions. The perceptions of lower financial supports by first-generation students – especially those with no parental college experience – were the major factor in the small but statistically significant difference in supports. The results of ANOVA testing corroborated this conclusion by revealing that the only significant difference in variable scores between students based on their parental education (bachelor’s+, some college but no bachelor’s, and no college) was a small difference in perceived supports between students with no parental college and students with a parental bachelor’s or higher.

Discussion

Community college students pursuing STEM transfer appear to have similar perceptions of the supports and barriers they will encounter during their experience, as well as similar beliefs about their likelihood of successfully transferring. When they do differ, it is primarily due to the lower perceived financial supports of students with no parental college experience. However, compared separately, first-generation students with at least some parental college experience are more like their continuing-generation peers. In short, first-generation status in this study was only identifiable in students whose parents have no college experience; all other students were not significantly different. It is important to remember that this study only measured perceptions and did not include other metrics such as actual persistence, GPA, socioeconomic status, work obligations, age, or transfer-related interactions with faculty and advisors.

The financial disparities between first-generation and continuing-generation college students are well established (Cataldi et al., 2018; Engle & Tinto, 2008; Pascarella et al., 2004).
Despite some arguments (e.g., Davis, 2010) and implicit assumptions that all students who do not have a parent with a bachelor’s degree or higher should be considered interchangeable to define first-generation status, the data suggest otherwise. Students with no parental college experience are known to have lower high school GPAs, fewer Advanced Placement course credits, and considerably lower household incomes compared to students whose parents have some college but no bachelor’s degree (Cataldi et al., 2018). This study corroborates the financial gulf between the two contrasting definitions of first-generation student. The more significant findings of this research are the similarities among the entire sample of community college students, regardless of parental education.

In one of the few studies comparing subgroups of first-generation students, Kim et al. (2020) found that FGCS-NB university students with a sibling who had attended college had equal parental, peer, and institutional support and academic success to their continuing-generation peers. However, those first-generation students without a sibling in college scored significantly lower on each of these measures. Some first-generation students in the present study likely have siblings who attend(ed) college. These family members' social support and capital could have translated into statistically similar scores to continuing-generation students. Raque-Bogdan and Lucas (2016) also found no differences between first-generation and continuing-generation university students regarding career-related parental support, college self-efficacy, college outcome expectations, their self-efficacy for coping with barriers, and career aspirations. First-generation students did, however, report significantly higher scores for perceived educational, financial, and discrimination barriers, a finding that the present study does not support. The authors postulated that the similarities in support might be because first-generation
students had already overcome the barrier to admission to a selective college. SES, they posited, may play a more significant role than first-generation status in differentiating students.

The present study’s quantitative findings support the similarities in social supports between generation groups found in qualitative research. Martin et al. (2020) found that first-generation (“no bachelor’s”) university engineering students expressed similar social capital sources (e.g., parents, peers, faculty, advisors) relative to engineering career choice compared to their continuing-generation peers. The only differences found were when social influence for choice of major began; parents of continuing-generation engineering majors encouraged them into engineering fields pre-college, while first-generation students experienced general social supports pre-college and engineering major supports after being admitted. Social capital and perceptions may be associated with college success, but they are not the same as college success. Vuong et al. (2010) found that even though first-generation (“no bachelor’s”) university students had similar levels of college self-efficacy to their continuing-generation peers, first-generation status was associated with lower GPA. The possible divergence between pre-transfer perceptions and post-transfer persistence is fertile ground for future research.

The literature reiterates that first-generation students often feel that they do not belong in the university setting, feel alienated by cultural barriers, and suffer from less academic engagement resulting in weaker degree attainment (Jury et al., 2018; Laanan & Jain, 2016; Jehangir, 2009). The absence of significant differences in the present study’s sample could be due to the nature of the community college, a non-residential school with students from more similar financial and educational backgrounds. According to Wells (2008), community colleges may be more meritocratic. Wells found that community college students who reported lower social capital sources (e.g., parental education, financial resources, friends in college) were more
likely to transition from first to second year than students in four-year schools who reported similar social capital.

Perhaps the most important finding of this study was the near-identical perception of access to mentors and role models across all groups. Regardless of parental education, community college students perceive that they are slightly less than “moderately likely” to have access to mentors in their field and role models who can advise them during their pursuit of STEM transfer. This is especially alarming considering the evidence that mentorships and guided research experiences help influence community college student transfer intent and transfer success (Pawloski & Shabram, 2019; Dinh & Zhang, 2021; Nerio et al., 2019).

According to Bandura’s (1986) social cognitive theory, upon which SCCT is based, role models and mentors are sources of vicarious learning, one of four sources of self-efficacy. Potential first-generation students in high school perceive a lack of positive role models, and even the presence of negative ones, as a barrier to attending college (Gibbons & Borders, 2010). Pascarella et al. (2004) found that first-generation students are less inclined to participate in extracurricular activities that might bring them into contact with potential role models because of work and other life commitments. Community college students, even continuing-generation students, are more likely to be working at least part-time and have family commitments (Juszkiewicz, 2020), which could explain to some extent why all groups had nearly identical perceptions of mentor availability.

Implications and Recommendations

Although first-generation students of both definitions had lower social supports and higher social and family barriers as predicted, differences were small. One of the most notable similarities is community college students’ perception of being less than moderately likely to
have access to mentors and role models. Community colleges should investigate innovative methods of providing mentoring and research relationships for all STEM transfer-seeking students. No matter how innovative the program, students will only benefit if they show up. Community college students, especially first-generation students, work more hours and take fewer credits per semester on average than university students. As a result, these students are less able to take advantage of extracurricular activities that increase institutional attachment (Pascarella et al., 2004; Fischer, 2007). Fortunately, active learning and collaborative pedagogies in the community college classroom have resulted in increased student engagement (Tinto, 1997), institutional attachment (Braxton et al., 2008), and STEM transfer intent (Wang et al., 2017). Research, mentoring, and transfer capital experiences therefore need to also take place within the classroom to engage all community college students. Pawloski and Shabram (2019) detail the initial success of a community college geosciences “career course”, a three-credit hour course in which students are introduced to research opportunities, internship opportunities, transfer requirements, and field trips as part of a larger National Science Foundation-funded endeavor that includes opportunities for mentorship. Students taking the career course have shown increased interest in pursuing geoscience-driven internships and have successfully transferred to geoscience-based baccalaureate programs. Focusing these experiences into a mandatory course means that all students have the opportunity to develop transfer capital. Creating new classes may not be feasible, especially for those colleges who have articulation agreements with four-year schools that require specific courses to be completed. Because of this limitation, faculty and administration should consider integrating active-learning and mentoring opportunities in existing required courses.
Many transfer degrees across the VCCS require students to take a Student Development (SDV) course their first semester, one of which is oriented toward STEM students. These courses focus on study skills, advising, career planning, and “topical areas which are applicable to their particular discipline (VCCS, 2022).” Although SDV courses are typically one semester hour, they could still be used to introduce students to research and collaboration opportunities available the next semester, discuss the requirements and procedures for transfer, require students to map the transferable courses they need to a four-year institution, and introduce different voices from industry, academia, and of students who successfully transferred.

The dataset from this study can be used for further research into community college students in STEM transfer programs. Although demographic information was used solely to describe the sample, multiple ANOVA tests could be used to determine any significant differences in perceptions between groups based on gender, race/ethnicity, credit hours attained, and STEM major area. Further research could obtain larger datasets to determine support and barrier perceptions of marginalized populations and the intersection of race/ethnicity and gender. Researchers should consider integrating institutional data, such as overall GPA, math/science major GPA, and credit hours per semester with survey data to determine links between student beliefs, performance, and persistence. Qualitative and mixed-methods research could investigate how first-generation students understand the roles and availability of resources, including mentors and family support. Given the recent evidence that first-generation students are more susceptible to abuse, homelessness, and food insecurity during the COVID-19 pandemic (Soria et al., 2021), and the dramatic decline in first-generation enrollment during the 2021 academic year (internal VCCS communication and database results), more research is needed to determine the range and acuteness of obstacles faced and how they affect transfer success.
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CHAPTER 4: Social and Environmental Influences on STEM Transfer Intentions

Abstract

This study examined the social and environmental supports and barriers that community college students perceive during their pursuit of transfer to a four-year college or university for the purpose of completing a bachelor’s degree in a STEM (Science Technology Engineering Math) major, and how these factors relate to their perceived likelihood of degree attainment. A total of 307 students across seven Virginia community colleges responded to an online survey including validated instruments for measuring perceived supports, barriers, and persistence intentions. Statistical analyses explored differences between first-generation and continuing-generation student perceptions based on two widely used but contrasting definitions of first-generation college student. The study explored the relationship between student support and barrier perceptions and their persistence intentions, or perceived likelihood of successfully completing their degree. The entire sample of community college students demonstrated theory-consistent correlations. However, contrary to most published research that has taken place in the four-year setting, results for first- and continuing-generation subgroups were inconsistent. This study serves as a foundation for further research performed at the community college, where results may vary compared to four-year contexts.

Introduction

Every year, educational researchers publish findings about the successes and impediments community college students experience after transferring to a four-year college or university. These students, many of whom are the first in their family to attend college, often face transfer credit loss, increased family and work obligations, and campus culture shock while pursuing a bachelor’s degree (Davis, 2010; Chen & Carrol, 2005; Pascarella et al. 2004). Social
and cultural differences between transfer and non-transfer university students have been studied, including quality of effort and general perceptions of courses, activities, and transfer process (Laanan, 2004). Unfortunately, there is far less published research performed at the community college level, while students are pursuing transfer. As a result of these gaps in the research, less is known about the perceptions of transfer-seeking community college students. Accordingly, transfer research at the four-year college and university level excludes all community college students who failed to transfer.

The gap in transfer research exists even as nearly 40% of all undergraduate students in the United States are attending one of 936 public community colleges (National Center for Education Statistics [NCES], 2021). While four-year college performance metrics are often compared, especially between first-generation and continuing-generation college students, there is a general lack of inquiry into the beliefs and perceptions of community college students in transfer programs (Laanan & Jain, 2016; Wang, 2012). There is also general disagreement in the literature as to who should be considered a first-generation college student. While the prevailing definition is a student who does not have at least one parent or guardian with a bachelor’s degree (Ives & Castillo-Montoya, 2020), other research defines first-generation college student as one whose parents or guardians have no postsecondary experience whatsoever (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al., 2004). Depending on as many as seven contrasting definitions, anywhere from 22% to 77% of students may be defined and first-generation (Toutkoushian et al., 2018), making research into this subpopulation difficult to compare and interpret (LeBouef & Dworkin, 2021). Some argue that the students making up the prevailing definitions of first-generation are effectively interchangeable (e.g., Davis, 2010); this appears to be the implicit assumption of many researchers. However, there is some evidence that
first-generation students with no parental college experience are less academically prepared and have fewer financial resources than those whose parents have completed some college (Redford & Hoyer, 2017; American College Testing, 2016; Nomi, 2005). Exposing any differences in these subpopulations would inform future research as well as help community college administration, staff, and faculty better understand and serve students.

This study examined the social and environmental supports and barriers that community college students perceive during their pursuit of transfer to a four-year college or university for the purpose of completing a bachelor’s degree in a STEM (Science Technology Engineering Math) major, and how these factors relate to their perceived likelihood of degree attainment. Special attention is paid to the differences in responses from two prevailing definitions of first- and continuing-generation college student. A previous article focused solely on differences in supports and barriers scale scores between continuing-generation and first-generation students. This article extends that project by examining the statistical relationships between students’ perceived supports and barriers and their perceived likelihood of transferring successfully and earning a bachelor’s degree.

The theoretical framework for this research is social cognitive career theory (SCCT, Lent et al., 1994), which proposes a model for investigating career choice and academic persistence through the interplay of demographic characteristics, beliefs, interests, expectations, and external social and environmental factors. Recently, researchers have used SCCT variables to predict first-generation college students' interest and persistence in math, science, and engineering bachelor's degree programs (Navarro et al., 2019; Garriot et al., 2017, 2015, 2013). In SCCT, the subjective measure of one’s likelihood to pursue and achieve a goal is referred to as persistence intentions (Lent et al., 1994). A person’s belief about their likelihood of successfully completing
a degree program, and the actual successful completion, are directly and indirectly influenced by social, financial, and external environmental supports and barriers. Persistence intentions have been shown to predict actual semester-to-semester persistence in longitudinal studies (Lent et al., 2003b) and have been correlated with supports and barriers in undergraduate university students in various STEM majors (Peña-Calvo, 2016; Garriot et al., 2013; Lent et al., 2008; Lent et al., 2003a, 2003b). However, there have been no published studies comparing these variables among community college transfer-bound students, or first-generation and continuing-generation community college students. This study was guided by SCCT’s emphasis on the importance of contextual influences (e.g., family, peers, finances) on degree persistence and Wang’s (2016a) SCCT-based STEM Transfer Model, which situates transfer research within the community college context.

An anonymous survey was emailed to students across seven Virginia community colleges during the fall semester of 2021. The survey included two validated scales from Lent et al.’s (2003b) battery of SCCT instruments along with demographic and parental education questions. A total of 307 students completed the survey, a roughly 3% response rate. Depending on definition, students ranged from 87 first-generation (“no college”) and 220 continuing generation (some parental college to bachelor’s degree or higher), to 155 first-generation (“no bachelor’s”) and 152 continuing-generation (“bachelor’s or higher”).

**Literature Review**

The literature on first-generation college students presents several obstacles. Not only do different studies use contrasting definitions of "first-generation" (Ives & Castillo-Montoya, 2020; Nguyen & Nguyen, 2018; Davis, 2010), but so do different federal agencies (see Cataldi et al., 2018; Engle & Tinto, 2008). Usually defined as a student whose parents do not hold a bachelor's
degree (Ives & Castillo-Montoya, 2020), and less often as a student whose parents have no college experience (Ives & Castillo-Montoya, 2020; Davis, 2010; Pascarella et al. 2004), the contrary definitions are almost never compared in the literature. The implications of using one definition over the other are acute. These are distinctly different interpretations, each with its own assumptions about who should and should not be counted as first-generation (LeBouef & Dworkin, 2021; Toutkoushian et al., 2018). The prevailing "no bachelor's" definition implicitly assumes that experiences, beliefs, and performance metrics relevant to degree completion are roughly equivalent among students whose parents have never attended college and those who have attended but did not attain a bachelor's degree. Others, such as Davis (2010) explicitly state that both groups are effectively identical because they have similar competence and comfort navigating the higher-education landscape, and thus the "no bachelor's" definition is most useful.

Although the "no bachelor's" definition appears to be the most adopted in the literature, there are a handful of studies that show significant differences between the two definitions. Cataldi et al. (2018) found that high school students with no parental college experience dropped out more often at 33% than those who had some parental college but no bachelor's, at 26%. Those with at least one parent with a bachelor's degree dropped out at only 14%. In their analysis of the NCES Longitudinal Study of 2002 through 2012, Redford and Hoyer (2017) found high school sophomore students with no parental postsecondary education were more than twice as likely to live in a household with a 2002 income of $20,000 or less compared to their peers with some parental postsecondary education (27% versus 12%). Only 6% of students with at least one parent with a bachelor’s degree fell into this low-income category. While 13% of first-generation ("no college") and 16% of first-generation ("no bachelor’s") high school sophomores had a GPA of 3.50 and above, 29% of continuing-generation students met the same achievement. There
were fewer differences in reasons for leaving college without first obtaining a credential, but one notable difference is 31% of first-generation ("no college") students chose *Conflicts with demands at home*, versus 23% of first-generation ("no bachelor’s") students. Throughout 2012-2015, the percent of high school graduates meeting three or more ACT exam college readiness benchmarks (English, reading, mathematics, and science) averaged 18% for the “no college” group, 30% for the “some college, no bachelor's” group, and 50% for the “one or more bachelor’s” group (American College Testing, 2016, p. 10).

Most published first-generation college student research takes place at the four-year college and university level. This is especially problematic because roughly 40% of undergraduates in the United States are attending a community college (NCES, 2021). Noomi (2005) reported that for community college students, the barriers experienced due to personal finances, cost of computers, and family responsibilities were more frequent and more urgent for first-generation students with no parental college compared to those defined as having no parental bachelor’s degree. Reasons for attending a community college were similar for both groups, except for the purpose of transfer, where the "some college, no bachelors" group was roughly 48% versus about 35% for the "no college" group. Collectively, these findings illustrate that two of the prevailing definitions of first-generation college student are not effectively interchangeable.

Regardless of demographic or definition, first-generation students are more likely than continuing-generation peers to be lower income, non-traditional aged, more than twice as likely to leave before degree completion, have lower high school GPAs, require remedial coursework in college, lack basic knowledge about applying to college and degree requirements once in college, and express a lack of mentors and role models (Cataldi et al., 2018; Engle & Tinto,
These disadvantages are exacerbated by racial and gender discrimination, including stereotypes promulgated by parents, educators, peers, and co-workers (Fernández-García, 2019; Veelen, 2019). Those who do persist to degree completion are more often those who have frequent interactions with faculty and advisors, access to mentors, support from family, and greater ability to cope with social and environmental barriers (Heller & Cassady, 2017; Wang, Lee, & Prevost, 2017; Packard et al., 2011). This study focused on the perceptions of STEM transfer supports and barriers and how they relate to transfer persistence intentions. The theoretical framework for measuring and interpreting these variables in Lent et al.’s (1994) social cognitive career theory (SCCT).

**Social Cognitive Career Theory**

SCCT is primarily concerned with career and academic choice and development, and the role self-efficacy, outcome expectations, and career/academic interests play in goal choice and goal achievement (Lent et al., 1994). Self-efficacy beliefs refer to “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986, p. 391).” Self-efficacy beliefs are the major determinants of thought and action in social cognitive theory (Lent & Brown, 2006). Outcome expectations are "beliefs about the consequences or outcomes of performing particular behaviors (p. 17)," and together with self-efficacy, assert influence over interests, choice goals, and choice actions. Choice goals in SCCT are “an individual’s intention to engage in a particular activity or to produce a particular outcome, addressing questions such as, how much and how well do I want to do this?” (Lent, 2005a, p. 105).
Figure 1 shows the SCCT choice model, with shaded boxes representing the model variables measured in most studies, according to the results of a meta-analysis of 143 SCCT studies over a thirty-year period (Lent et al., 2018).

**Figure 1**


Note. Shaded boxes represent the most common constructs measured in research. Used with permission of Robert Lent.

When the choice goal of a particular study is completing a degree, the variable studied is often referred to as *persistence intentions*. Persistence intentions are defined, in accordance with the SCCT construct, as a subjective measure of an individual's perceived likelihood to continue to pursue a goal (Lent et al., 2003b; Lent et al., 2008; Lent et al., 2016). Unlike performance metrics, persistence intentions reflect individual student beliefs about how *likely* they are to succeed.

**The Theoretical Basis for Persistence Intentions**

Ajzen (n.d. b) defines intent as "an indication of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior." Malle and Knobe
(2001) illustrated three requirements for differentiating an intention from a desire. An intention must be something a person can make happen for themselves, not a wish for an outcome. Second, an intention requires practical reasoning to determine whether one can perform an action and whether other desires outweigh the desire to perform the action. Third, an intention requires some degree of commitment, including early investment in resources to accomplish the goal, accepting opportunity costs of not pursuing a different goal, and acceptance of the possible results of not achieving the goal.

An example that accords with Malle and Knobe's (2001) model is the student who wants to earn a bachelor's degree in computer science. If he simply sits at home and wishes he had a degree, it is not an intention but a desire. If he realizes that he must act and enroll in college, he is beginning to form an intention. Determining whether he has the time, funds, and ability is a practical reasoning process. Assuming he decides he is capable, he weighs the opportunity costs of not expending financial and mental resources in college and instead working a low-paying job with few responsibilities, against spending four or more years in college working toward a degree that will lead to financial and social rewards. At this point, the prospective student must make some sort of material commitment to turn this desire into an intention. Enrolling in a community college as a computer science transfer major is an example of early investment in the goal. It is then the degree of goal commitment that determines whether the intent to attain a computer science degree leads to goal attainment.

The Theory of Planned Behavior (TPB: Ajzen, 1991) posits that intention is a product of attitudes toward an intended behavior and the perceived social pressure to engage (or not engage) in that behavior. These two influences are moderated by perceptions of one's ability to perform the behavior. TPB has shown both theoretical and empirical support for strength of intention as a
reliable indicator of eventual goal completion (Fichten, Amsel et al., 2016; Witt et al., 2014). Using Ajzen's (n.d. a) guide to developing TPB instruments, Fichten et al. (2014) developed a TPB Postsecondary Graduation Questionnaire that included a five-item intention scale. Example intention scale items include *I intend to complete my program of studies*, *I will try to complete my program of studies*, and *All things considered, it's possible that I might not complete my program of study*. In a longitudinal study of 123 Canadian college students, the instrument correctly classified 83% of the entire sample, predicting 74% of premature leavers and 86% of graduates based on strength of intent scale scores (Fichten, Amsel et al., 2016). In a longitudinal study of 175 university students and 75 community college students, the instrument correctly classified 74% of graduates/transfers and premature leavers. The method of determination was to divide the mean of the intention scores into the binary variable for weak and strong intention (Fichten, Heiman et al., 2016). A potential problem with this instrument, despite its predictive ability, is the wording of the items. First-generation community college students, especially those whose first language is not English, may not understand the distinctions among the items beginning with "I intend", "I will try", "I expect", and "I am determined". Lent et al. (1994), in their social cognitive career theory also describe an intention as an antecedent to actual behavior, and in accordance with Bandura's (1986) social cognitive theory, use the term *choice goal* to represent an intention to engage in a particular activity or to produce a particular outcome.

Lent et al. (2003b) developed a four-item Persistence Intentions Scale, conceptually similar to Ajzen's (n.d. a) TPB behavioral measures, to measure intent to persist in engineering degree programs. Unlike Fichten et al.'s (2014) survey items, the Persistence Intentions Scale has distinct items with clear wording. The four items are *I intend to major in an engineering field*, *I plan to remain enrolled in an engineering major over the next semester*, *I think that a bachelor's
degree in engineering is a realistic goal for me, and I am fully committed to completing my engineering degree. These items generally match with Malle and Knobe's (2001) requirements of decision to act, practical reasoning about ability to achieve a goal, and both short-term and long-term commitment. Persistence intentions scores have been positively correlated with actual persistence in engineering degree-seekers, and in SCCT theory-consistent manner with self-efficacy, outcome expectations, interests, contextual barriers and contextual supports (Lent et al., 2003). Coefficient alphas for the Persistence Intentions Scale have ranged from .91 to .95 for samples of introductory engineering students (Lent et al. 2005a; Lent et al., 2008), .92 for Hispanic/Latino and White engineering students (Navarro et al, 2014), .79 for 1,208 computer science students, roughly half from historically Black colleges and universities and half from primarily white institutions (Lent et al., 2008), .72 for first-generation Hispanic/Latino and White engineering students (Garriott et al., 2017), and .92 for 115 underrepresented minority students with disabilities who expressed interest in STEM fields (Dutta et al., 2015).

**Contextual Supports and Barriers**

In SCCT, the social, cultural, and environmental influences fall into two categories – distal (background) contextual affordances and proximal environmental influences. Distal contextual affordances help shape social cognition and interest, and include influences such as skill development, cultural and gender role socialization, parental status, and work hours (Lent et al., 2001; Wang, 2016a). Proximal environmental influences, which actuate at critical choice junctures, include emotional and financial support, job availability, perceived social barriers and supports, and organizational policy and practices (Lent et al., 2001; Wang, 2016a). These contextual factors can directly and indirectly affect both ability and willingness to transform interest into goals and goals into actions/attainment. Beneficial environmental conditions (such
as access to supportive family and access to mentors) aid in navigating the path to goal achievement, while detrimental conditions (such as a culture that does not prize education or an environment of racial discrimination) hinder the process (Lent et al., 2002).

In SCCT research, perceived social and environmental supports and barriers are often measured using Lent et al.’s (2003b) Contextual Supports and Barriers Scale. This 36-item instrument uses a Likert scale ranging from 1 (Not at all likely) to 5 (Very Likely) to measure perceived supports (15 items) and barriers (21 items) to college degree attainment. Although initially designed for engineering degree-seeking students, the scale and its individual subscales have also been used in the context of physical and biological science, computer science, and mathematics degree goals for undergraduate and high school students (Peña-Calvo, 2016; Garriot et al., 2013; Lent et al., 2008; Lent et al., 2003a, 2003b). Support items are divided into four conceptual clusters: (a) social support and encouragement; (b) instrumental assistance; (c) access to role models and mentors; (d) financial resources. Barrier items are divided into four conceptual clusters: (a) social or family influences; (b) financial constraints; (c) instructional barriers; (d) gender and race discrimination.

The conceptual clusters, confirmed factors, and individual items of the Contextual Supports and Barriers Scale are all represented in the literature of college attrition and persistence, and are especially important to first-generation and community college students. These include the importance of mentors and role models (Deil-Amen, 2011; Engle & Tinto, 2008; Wallace et al., 2000), financial and work constraints (Cataldi et al., 2018; Ishitani, 2006), gender and racial discrimination (Fernández-García, 2019; Veelen et al., 2019), positive and negative family influences (Tate et al, 2015; Blackwell & Pinder, 2014; Archer et al., 2012;), peer interaction, support, and acceptance (Deil-Amen, 2011; Pascarella et al., 2004), and
interaction with faculty and staff (Wang et al., 2017; Deil-Amen, 2011; Pascarella et al., 2004; Tinto, 1997). This study examines the relationship between these support and barrier scores and persistence intentions, as they relate to STEM transfer for both continuing-generation and first-generation community college students.

**Research Question**

The research question explored in this study was, what is the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students?

Ten hypotheses were tested to answer the research question:

Ho1: There is no relationship between perceived supports for STEM transfer and STEM transfer persistence intentions for community college students.

Ho2: There is no relationship between perceived barriers to STEM transfer and STEM transfer persistence intentions for community college students.

Ho3: There is no relationship between perceived supports for STEM transfer and STEM transfer persistence intentions for first-generation college students with no parental college experience (FGCS-NC)

Ho4: There is no relationship between perceived barriers to STEM transfer and STEM transfer persistence intentions for first-generation college students with no parental college experience (FGCS-NC)

Ho5: There is no relationship between perceived supports for STEM transfer and STEM transfer persistence intentions for continuing-generation community college students with at least some parental college experience (CGCS-SC)
Ho6: There is no relationship between perceived barriers to STEM transfer and STEM transfer persistence intentions for continuing-generation community college students with at least some parental college experience (CGCS-SC)

Ho7: There is no relationship between perceived supports for STEM transfer and STEM transfer persistence intentions for first-generation college students with no parental bachelor's degree or higher (FGCS-NB)

Ho8: There is no relationship between perceived barriers to STEM transfer and STEM transfer persistence intentions for first-generation college students with no parental bachelor's degree or higher (FGCS-NB)

Ho9: There is no relationship between perceived supports for STEM transfer and STEM transfer persistence intentions for continuing-generation community college students with at least one parental bachelor's degree or higher (CGCS-B+)

Ho10: There is no relationship between perceived barriers to STEM transfer and STEM transfer persistence intentions for continuing-generation community college students with at least one parental bachelor's degree or higher (CGCS-B+)

**Theoretical Framework**

Four major elements comprise the theoretical framework for this study. First, the research into first-generation community college students, and their quantitatively and qualitatively different experiences compared to continuing-generation students. Second, the evidence against the notion, implicit or explicit, that first-generation students whose parents have no postsecondary experience are effectively indistinguishable from those whose parents have postsecondary experience but no bachelor’s degree (e.g. Davis, 2010). Third, Lent et al.’s (1994) Social Cognitive Career Theory (SCCT) of educational and career choice, which hypothesizes
the effects of social and environmental influences on career goals and the strength of intention to persist in accomplishing those goals. Fourth, Wang’s (2016a) SCCT-based STEM Transfer Model, which situates the goal of transfer itself as the central phenomenon to be studied, separately from four-year degree attainments.

Definitions

First-generation college students are defined in this study in two ways. First-generation ("no bachelor’s") refers to all students whose parent or parents have not attained a bachelor’s degree or higher. This definition is consistent with the federal TRIO program’s definition of first-generation college student (Higher Education Act of 1965, 1998). First-generation ("no college") refers to students whose parent or parents have no postsecondary experience.

Continuing-generation students are defined based on the corresponding first-generation definition. When using the first-generation ("no bachelor’s") definition, continuing-generation ("bachelor’s+") refers to students who have one or more parent or guardian with at least a bachelor’s degree. When using the first-generation ("no college") definition, continuing-generation ("some college") refers to students who have one or more parent with at least some college experience, which could include no degree, an associate’s degree, or a bachelor’s degree or higher.

For the purposes of this study, a STEM bachelor’s degree is a bachelor’s degree in one of the following areas: (a) biological, agricultural, or environmental life sciences, (b) computer or mathematical sciences, (c) engineering or engineering technologies, or (d) physical sciences including chemistry, physics, astronomy, etc. These four areas, taken from Wang’s (2016a) Expanding STEM Talent Survey, are generally consistent with the Virginia Community College System’s transfer-oriented degree programs, transfer pathways, and the federal guidelines for
STEM areas of study for veteran’s tuition reimbursement (U.S. Department of Veteran's Affairs, 2020).

Persistence intentions are defined, in accordance with the SCCT construct, as a subjective measure of an individual's perceived likelihood to continue to pursue a goal (Lent et al., 2003b; Lent et al., 2008; Lent et al., 2016). In this study, the goal referenced by the measured persistence intentions is successful transfer to and completion of a STEM bachelor’s degree.

STEM transfer persistence intentions are a subjective measure of a community college student’s perceived likelihood to successfully complete a STEM bachelor’s degree and serves as a proxy for successful transfer.

Perceived social and environmental supports for and barriers to STEM transfer are examples of contextual supports and barriers, defined in SCCT as facilitative influences or obstacles that people anticipate will be encountered along the process of goal pursuit (Lent & Brown, 2006). This study used Lent et al.'s (2003b) Conceptual Supports and Barriers Scale to measure factors identified in the literature as especially important to first-generation college students, including family and peer support, availability of mentors, financial resources, and perceptions of racial and gender discrimination (Cataldi et al., 2018; Davis, 2010; Engle & Tinto, 2008; Ishitani, 2006; Chen & Carroll, 2005; Pascarella et al., 2004).

Methodology

This project investigated the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students. This section details the sample selection, instrumentation, data collection procedures, and data analysis procedures. An anonymous online survey was sent to qualifying students across seven Virginia community colleges. Demographic
survey items were used to determine first- or continuing-generation status. Students’ perceptions were measured quantitatively using Lent et al.’s (2003b) Contextual Supports and Barriers Scale and Persistence Intention’s Scale. Descriptive statistics were used to elaborate on the demographic and enrollment characteristics of the sample. Finally, hypotheses were tested using Pearson correlation coefficient tests to determine the existence and strength of relationships.

**Sample Selection**

The research study took place across seven Virginia community colleges, selected for their demographic and geographic diversity, during fall semester 2021. These seven colleges have a combined population of about 10,000 students in STEM transfer-oriented degrees, not including health sciences. The 24 colleges of the Virginia Community College System (VCCS) have a combined headcount of around 160,000 students, with roughly 30% falling into the federal TRIO definition of first-generation, which includes students whose parents or single parent have not attained a bachelor’s degree (Higher Education Act of 1965, 1998). The combined racial/ethnic makeup of all colleges is 7.5% Asian, 17.5% Black or African American, 13.3% Hispanic/Latino, 56.5% White and non-responders, and about 5% other races including multiracial-Non-Hispanic (State Council of Higher Education for Virginia (SCHEV), 2020). About 60% of VCCS students are women (SCHEV, 2020). In the fall of 2021, there were 8,668 men and 5,561 women enrolled in a transfer-oriented STEM associate’s degree program (SCHEV, 2022). Table 1 summarizes the gender demographics of the population surveyed and the entire VCCS.
Participants in this study were contacted via their community college email accounts with a recruitment email (see Appendix 10) and a link to an online survey. Participants eligible for this study were Virginia community college students aged 18 or over enrolled during the 2021 fall semester, who indicated on the survey that their primary goal for attending their community college is to transfer to a four-year college or university to attain a degree in one of four broad STEM major areas. Efforts to eliminate the possibility of responses from high school dual enrollment students included: the age restriction stated on the recruitment email; the age restriction stated on the consent page; participating colleges filtering for age when generating student email distribution lists.

**Criteria for Participation**

This study compares community college students who intend to transfer to a four-year degree program in a STEM field. The primary focus is on differences between first-generation and continuing-generation community college students. Participants eligible for thus study were currently enrolled, credit-seeking students aged 18 or over, who indicated that their primary goal for attending their community college is to transfer to a four-year college or university to attain a degree in a STEM field.
Instrumentation

The instrument chosen to quantitatively measure student perceived contextual supports and barriers is Lent et al.’s (2003b) Contextual Supports and Barriers Scale, comprising a 15-item perceived social and environmental supports scale, and a 21-item perceived social and environmental barriers scale. The instrument selected to quantify students’ subjective measure of their perceived likelihood to successfully transfer and complete their four-year STEM degree, their intention to persist, is Lent et al.’s (2003b) 4-item Persistence Intentions scale.

Demographic and Enrollment Characteristics Survey

A 7-item survey was used to record students’ race/ethnicity, gender, credit hours earned, STEM transfer major area, and parental education. The categorical variable credit hours earned were presented as a multiple-choice question with the following options: None (this is my first semester); 3 to 6; 7 to 15; 16 to 30; 31 to 45; 46 or more. The four STEM major fields were presented as a multiple-choice question with the following options: biological, agricultural, or environmental life sciences; computer or mathematical sciences; engineering or engineering technologies; physical sciences including chemistry, physics, astronomy, etc. A final option, I do not plan to transfer or I do not plan to major in any of the above STEM areas served as a final method to determine eligibility, and caused the survey to end if selected.

Contextual Supports and Barriers Scale

Perceived social and environmental supports for, and barriers to transfer were measured using Lent et al.'s (2003b) Contextual Supports and Barriers Scale. This 36-item instrument uses a Likert scale ranging from 1 (Not at all likely) to 5 (Very Likely) to measure perceived supports (15 items) and barriers (21 items) to college degree attainment. Although initially used to
measure supports and barriers perceptions of engineering degree-seeking students, the scale and its individual subscales have also been used in the context of physical and biological science, computer science, and mathematics degree goals for undergraduate and high school students (Peña-Calvo, 2016; Garriot et al., 2013; Lent et al., 2008; Lent et al., 2003a, 2003b). Support items are divided into four conceptual clusters: (a) social support and encouragement; (b) instrumental assistance; (c) access to role models and mentors; (d) financial resources. Barrier items are divided into four conceptual clusters: (a) social or family influences; (b) financial constraints; (c) instructional barriers; (d) gender and race discrimination.

The original prompt for the instrument is *During your time at this university pursuing an engineering degree, how likely will you be to...* The modified prompt for the instrument for this study is: *During your time at this college pursuing transfer to a four-year bachelor’s degree program in the STEM degree area you indicated in Question 2, how likely will you be to...*

Examples of support scale items include: *Feel that your family members support this decision,* and *Have enough money saved up to be able to complete your education in this field.* Examples of barrier scale items include *Receive negative comments or discouragement about your major from family members,* and *Receive unfair treatment because of your racial or ethnic group.*

**Persistence Intentions scale**

Lent et al.’s (2003b) Persistence Intentions scale was used to measure students’ intention to persist in STEM transfer. This four-item instrument uses a Likert scale ranging from 1 (*Not at all likely*) to 5 (*Very Likely*) to quantify a students’ subjective measure of their perceived likelihood to successfully complete a college degree (Lent et al., 2003b). The Persistence Intentions scale was initially used in the context of engineering degree persistence intentions.
The scale has been adapted to multiple STEM majors including life sciences, physical sciences, computing, and mathematics (Peña-Calvo, 2016; Dutta et al., 2015; Lent et al., 2008).

The prompt for the Persistence Intentions scale is, *Using the scale below, indicate your level of agreement with each of the following statements.* The four original items are: *I intend to major in an engineering field; I plan to remain enrolled in an engineering major over the next semester; I think that earning a bachelor’s degree in engineering is a realistic goal for me; I am fully committed to getting my college degree in engineering.*

The prompt for the present study was adjusted to: *Using the scale below, indicate your level of agreement with each of the following statements about the STEM major you indicated in Question 2.* The response items were adjusted for this study as follows: *I intend to major in my chosen STEM field; I plan to remain enrolled in my major, or transfer to four-year program in my major, over the next semester; I think that earning a bachelor’s degree in my chosen STEM field is a realistic goal for me; I am fully committed to getting my bachelor’s degree in my chosen STEM field.*

**Validity and Reliability of Instruments**

The validity of an instrument refers to its ability to produce scores that are accurate, meaningful, reflect the true theoretical meaning of its construct, and allow the researcher to draw good conclusions about the population being studied through the sample being measured (Creswell, 2008; Rovai et al., 2016). The evaluative judgement of validity should be supported by both theoretical rationale and empirical evidence (Messick, 1995). Reliability refers to the consistency and repeatability in scores across multiple administrations of an instrument (Creswell, 2008). The following sections explain evidence of different types of validity for each instrument, as well as reliability and potential limitations.
Content validity, or the extent to which an instrument’s items represent all aspects of a construct (Creswell, 2008), for the Contextual Supports and Barriers scales (Lent et al., 2003b) was established through review of the literature and existing instruments pertaining to career and educational barriers and supports, through expert review, and qualitative coding of interviews with two-year and four-year college students (Lent et al., 2001, 2002, 2003b). The conceptual clusters, confirmed factors, and individual items are all represented in the literature of college attrition and persistence, and are especially important to first-generation and community college students. These include the importance of mentors and role models (Deil-Amen, 2011; Engle & Tinto, 2008; Wallace et al., 2000), financial and work constraints (Cataldi et al., 2018; Ishitani, 2006), gender and racial discrimination (Fernández-García, 2019; Veelen et al., 2019), positive and negative family influences (Tate et al, 2015; Blackwell & Pinder, 2014; Archer et al., 2012;), peer interaction, support, and acceptance (Deil-Amen, 2011; Pascarella et al., 2004), and interaction with faculty and staff (Wang et al., 2017; Deil-Amen, 2011; Pascarella et al., 2004; Tinto, 1997).

Criterion validity, or the degree to which scores relate to an expected outcome or criterion (Creswell, 2008), of the Contextual Supports and Barriers scales and subscales has been established through multiple SCCT studies in which greater barrier scores have correlated to lower academic self-efficacy and lower degree persistence intentions (Kim & Seo, 2014; Peña-Calvo et al., 2014; Lent et al., 2001, 2003b). The barrier scale has shown to correlate negatively, and the support scale positively, with barrier coping efficacy scales (Lent et al., 2001). These results are corroborated by SCCT studies (e.g., Turner et al., 2019; Fort & Murariu, 2018) that yield similar results using different instruments to measure barriers and supports, including those...
that use the Luzzo & McWhirter (2001) Perceptions of Barriers Scale, Zimet et al.'s (1988) Social Supports scale, and the revised Fennema-Sherman Math Attitudes Scale - Short Form (Fennema & Sherman, 1976; Turner et al., 2004).

The hypothesized relationships between perceived barriers and supports and persistence intentions have been observed in multiple studies using the full scales or (more commonly) the 9-item social supports and 5-item social barriers subscales. Although the 21-item full barriers scale failed to correlate with persistence intentions in the initial study of students in introductory psychology courses (Lent et al., 2001), subsequent studies have shown expected correlation from both scales. The full scales have shown to relate significantly to persistence intentions as hypothesized in studies of racially diverse engineering students (Lent et al., 2003b), Spanish university students across multiple STEM majors (Peña-Calvo et al., 2014), and South Korean undergraduate engineering students (Kim & Seo, 2014). The social barriers and social supports subscales of the instrument have related as hypothesized to persistence intentions among low-income prospective first-generation college students (Garriot et al., 2013), Hispanic male and female engineering students (Flores et al., 2017), and minority undergraduate students with disabilities (Dutta et al., 2015).

Construct validity was further established for the Contextual Supports and Barriers scales through exploratory and confirmatory factor analyses (Lent et al., 2005a). Results indicated two support subscales (Social and Financial) and three barrier subscales (Social, Instrumental, and Gender). Kim and Seo (2014) arrived at the same results through their confirmatory factor analysis of the instrument translated into Korean for their study of South Korean engineering students. Peña-Calvo et al. (2016) focused on the sources of supports and barriers, rather than the monolithic “social” subscales, represented by the instrument. In their exploratory factor analysis
of responses from 811 STEM undergraduate university students in Spain, the researchers determined four factors for each scale: perceiving teaching staff supports/barriers; perceived peer supports/barriers; perceived family supports/barriers; perceived financial supports/barriers. Gender and racial discrimination did not score sufficiently high to be accepted as a latent factor, but this could be due to greater perception of racial homogeneity in the Spanish sample (Peña-Calvo et al., 2016).

Due to the strong relationship between social support and barrier factors and their corresponding full scale scores, Lent and colleagues used only the social conceptual cluster for further research, with similar results to the full scale studies (e.g. Lent et al., 2005a, 2008, 2010). Other SCCT researchers have used these subscales and corroborated the relationships between barriers and supports to persistence intentions (Navarro et al., 2019, 2014; Flores et al., 2017; Garriot et al., 2013). Although the social supports and social barriers subscales provide similar correlational results to the full 15- and 21-item scales, respectively, the present study relies on the full instrument to better characterize the range of experiences of first-generation college students.

The Contextual Supports and Barriers instrument has demonstrated reliability across multiple contexts. Lent and colleagues reported coefficient alpha values of .88 for the supports scale and .90 for the barriers scale in their 2001 study, and scores of .92 and .94 for supports and barriers, respectively, in their 2003 study of engineering students. Kim and Seo (2014) reported coefficient alpha values of .87 for the supports scale and .85 for the barriers scale in a study of 660 South Korean engineering students. The social supports and barriers subscales, widely used in place of the full instrument, reported coefficient alpha values of .90 for supports and .84 for barriers among engineering students in both historically Black and predominately White
Limitations. The Contextual Barriers and Supports instrument does have several limitations. While the 9-item social supports and 5-item social barriers subscales have been widely used in SCCT research, the full scales have seen less utilization. More research is needed to better understand the types of barriers and supports faced by students, as well as determine how these may differ among minority, underserved, and first-generation populations (Lent & Brown, 2019; Peña-Calvo et al, 2016; Kim & Seo, 2014). Due to the scale’s focus on student perceptions, and without more longitudinal research, it is difficult to ascribe predictive validity beyond the scale’s correlation to SCCT factors. For this reason, although it can be said that higher barrier scores are predictors of lower persistence intentions, which have been shown in some studies to predict actual persistence (Lent et al., 2016; Lent et al., 2003b), it cannot be said generally that a higher score on the barriers scale predicts college dropout. Finally, there are instruments that explore more deeply individual constructs, such as the 12-item Parental Encouragement Scale (Gloria, 2005) and Luzzo and McWhirter’s (2001) 33-item Perceptions of Barriers scale that addresses more fully racial and gender discrimination.

Despite its limitations, the Conceptual Supports and Barriers scale was used for this study because of its coverage of the major support and barrier factors identified in the literature as most salient to first-generation college students’ degree persistence, and its performance as predicted across multiple diverse samples. Although the full scale mean scores, which were used to answer RQ2, do not identify the types of supports and barriers a student faces, they are still suitable for
determining whether the two first-generation student subgroups (no college versus no bachelor’s) perceive different overall amounts of supports and barriers.

**Persistence Intentions Scale**

Content validity for Lent et al.’s (2003b) Persistence Intentions Scale was established through review of the literature and existing instruments concerning goal choice and intentions, particularly Bandura’s (1986) social cognitive theory and Ajzen (1991) Theory of Planned Behavior (TPB). TPB has shown both theoretical and empirical support for strength of intention as a reliable indicator of eventual goal completion (Fichten et al., 2016; Witt et al., 2014). The persistence intention scale is conceptually similar to Ajzen and Fishbein’s (1980) TPB-based instrument but designed to be specific to degree completion (Lent et al., 2003b). The four items on the persistence intentions scale also accord with Malle and Knobe’s (2001) philosophical and operational treatise on intentions, in which an intention comprises: (a) the decision to act on a goal; (b) practical reasoning about one's ability to achieve a goal; (c) both short-term commitment; (d) long-term commitment.

Predictive validity for the Persistence Intentions Scale has been established in longitudinal studies through its prediction of actual persistence among undergraduate engineering students and its correlation to hypothesized social cognitive factors (Lent et al., 2016; Lent et al., 2003b). SCCT incorporates Bandura’s (1997) theory that perceived self-efficacy is a major determinant of intention (Lent & Brown, 2006). Multiple studies support this claim, with self-efficacy instruments correlating as hypothesized to persistence intentions (e.g., Garriot et al., 2017; Peña-Calvo et al., 2016; Dutta et al., 2015; Lent et al., 2005b). Structural equation modeling has shown persistence intentions, as hypothesized, are directly and indirectly affected by self-efficacy and directly affected by interests (Flores et al., 2017; Garriot et al.,
Accordingly, persistence intentions scale scores have correlated as predicted in SCCT theory-consistent manner with outcome expectations, interests, and perceived barriers and supports to STEM degree attainment (Flores et al., 2017; Garriot et al., 2017; Lent et al., 2016, 2015, 2010, 2005a, 2005b, 2003b; Navarro et al., 2019, 2014; Morris & Lent, 2019).

SCCT’s focus on persistence intentions is based on the evidence of strong associations between intentions and actual persistence revealed by college attrition and persistence research (e.g., Cabrera, 1992; Pascarella & Terenzini, 1980; Bean & Metzner, 1985). Lent et al.’s (2003b) persistence intentions scale has been shown to be predictive of actual persistence in undergraduate engineering students across as few as two and as many as six semesters (Lent et al., 2003b; 2016). Although structural equation modeling and path analyses in some studies have not always confirmed each hypothesized path in the SCCT choice model (Lent & Brown, 2019), the persistence intentions scale has demonstrated reliability and consistently related to perceived contextual barriers and supports across race, gender, country, and STEM degree area. Although the scale consists of only four items, each item operationalizes one of the four requirements for defining an intention according to Malle and Knobe’s (2001) monograph distinguishing intention from desire. Conceptually similar to some TPB-based graduation intention instruments (e.g., Fichten et al.’s, 2014), Lent et al.’s (2003b) instrument uses clear, unambiguous language that does not risk conflation of terms like “try” and “expect” with the word “intend.”

Coefficient alphas for the persistence intentions scale have ranged from .91 to .95 for samples of introductory engineering students (Lent et al. 2008, 2005a), .92 for Hispanic/Latino and White engineering students (Navarro et al, 2014), .79 for 1,208 computer science students, roughly half from historically Black colleges and universities and half from primarily White
institutions (Lent et al., 2008), .72 for first-generation Hispanic/Latino and White engineering students (Garriott et al., 2017), and .92 for 115 underrepresented minority students with disabilities who expressed interest in STEM fields (Dutta et al., 2015).

**Limitations.** The persistence intentions scale is not without its limitations. There are few longitudinal SCCT studies that can attest to the scale’s ability to predict actual persistence toward a college degree. Most studies are cross-sectional and performed in four-year college and university settings, and there is a recognized need to investigate community college and first-generation college students (Lent & Brown, 2019; Garriot et al., 2017). Finally, it is doubtful that a quantitative measure, regardless of the quality of design and number of assessed dimensions, can ever capture the entirety of the abstract concept of “intention.” What it does offer is a way to quantitatively compare students’ perceptions of their own likelihood to transfer and complete their bachelor’s degree. Measuring and comparing those perceptions are important to the present study as well as informing further SCCT research.

**Data Collection Procedures**

Approval from the university Institutional Review Board was obtained before the research began. Approval from each participating community college’s Institutional Review Board or office of institutional research was obtained the semester before the research began. The survey instrument for this study was hosted on the researcher’s Qualtrics online survey distribution software system. The researcher emailed the recruitment letter content and survey links to each participating college’s office of institutional research or director of research. Each college emailed the survey link and recruitment information to eligible students. Three colleges sent emails only to students enrolled in STEM transfer programs (not including healthcare programs), comprising 91% of eligible students in the study and 51% of responses. Four colleges
sent the email to all students aged 18 and over not enrolled in high school dual-enrollment programs, comprising 9% of eligible students and 49% of responses. Two colleges failed to send the follow-up email. Final response data was downloaded from Qualtrics into a Microsoft Excel spreadsheet. First-generation and continuing-generation groups were created according to the definitions outlined above.

Figure 2 shows a diagram of how each generation pair was created for hypothesis testing. For Definition #1, first-generation college students were defined as those with no parental college experience (FGCS-NC, n = 87); continuing-generation college students where thus defined as students whose parents have at least some college experience (CGCS-SC, n = 220). For Definition #2, first-generation college students were defined as those with no parental bachelor’s degree or higher (FGCS-NB, n = 155); continuing-generation college students were this defined as those with at least one parental bachelor’s degree or higher (FGCS-B+, n = 152).
Data Analysis Procedures

Data from the survey was input into SPSS for statistical analysis. Measures of central tendency and variability were used to characterize continuing-generation students and first-generation students of all categories in terms of contextual supports, contextual barriers, and persistence intentions. The following statistical analyses were performed to test the hypotheses for the research question:

For Ho1, a Pearson correlation test was performed for all community college students. The Independent Variable was the group’s mean score on the 15-item supports subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.
For Ho2, a Pearson correlation test was performed for all community college students. The Independent Variable was the group’s mean score on the 21-item barriers subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho3, a Pearson correlation test was performed for first-generation students with no parental college experience (FGCS-NC). The Independent Variable was the group’s mean score on the 15-item supports subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho4, a Pearson correlation test was performed for first-generation students with no parental college experience (FGCS-NC). The Independent Variable was the group’s mean score on the 21-item barriers subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho5, a Pearson correlation test was performed for continuing-generation community college students with at least some parental college experience (CGCS-SC). The Independent Variable was the group’s mean score on the 15-item supports subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho6, a Pearson correlation test was performed for continuing-generation community college students with at least some parental college experience (CGCS-SC). The Independent Variable was the group’s mean score on the 21-item barriers subscale of Lent et al.’s (2003b)
Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho7, a Pearson correlation test was performed for first-generation college students with no parental bachelor's degree or higher (FGCS-NB). The Independent Variable was the group’s mean score on the 15-item supports subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho8, a Pearson correlation test was performed for first-generation college students with no parental bachelor's degree or higher (FGCS-NB). The Independent Variable was the group’s mean score on the 21-item barriers subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho9, a Pearson correlation test was performed for continuing-generation community college students with at least some parental college experience (CGCS-B+). The Independent Variable was the group’s mean score on the 15-item supports subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.

For Ho10, a Pearson correlation test was performed for continuing-generation community college students with at least some parental college experience (CGCS-B+). The Independent Variable was the group’s mean score on the 21-item barriers subscale of Lent et al.’s (2003b) Contextual Supports and Barriers Scale. The Dependent Variable was the group’s mean score on Lent et al.’s (2003b) 4-item Persistence Intentions Scale.
Conclusion

By using Pearson correlation to test hypotheses, this study attempted to answer the question: what is the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students? After first determining correlation results for the entire sample of 307 community college students, tests were conducted for each generation group. The next section details the results of these tests.

Results

This section details the results of the study. First, the sample of survey responders is described and compared against the population in terms of demographics and STEM major area. Next, the results of data analysis and summary of findings as presented. Generation types were based on the two definitions of first-generation college student are: (a) first-generation college students with no parental college experience (FGCS-NC); (b) continuing-generation college student, defined as having at least some parental college experience (CGCS-SC); (c) first-generation college student with no parental bachelor’s degree (FGCS-NB); (d) continuing-generation college student, defined as having at least one parent with a bachelor’s degree or higher (CGCS-B+);

Demographic Characteristics of Respondents

Demographic information gathered by this study included student gender, race/ethnicity, and parental education level. Enrollment characteristics included STEM major area and credit hours completed. Table 2 shows gender demographics for the surveyed population, all VCCS students, and survey sample (N = 307). Table 3 shows race/ethnicity demographics.
Table 2

*Gender Demographics for Surveyed Population, Entire VCCS Student Body, and Survey Sample*

<table>
<thead>
<tr>
<th>Gender</th>
<th>Population Surveyed (~10,000)</th>
<th>All VCCS students (~140,000)</th>
<th>Survey Responders (N = 307)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>3,242 (34.98%)</td>
<td>57%</td>
<td>149 (47.88%)</td>
</tr>
<tr>
<td>Male</td>
<td>5,970 (64.41%)</td>
<td>43%</td>
<td>147 (48.53%)</td>
</tr>
<tr>
<td>Transgender/Non-Binary/Other</td>
<td>N/A</td>
<td>N/A</td>
<td>9 (2.93%)</td>
</tr>
<tr>
<td>Unknown/Prefer not to answer</td>
<td>128 (1.38%)</td>
<td>N/A</td>
<td>2 (0.65%)</td>
</tr>
</tbody>
</table>

Table 3

*Race/Ethnicity Demographics for Surveyed Population, Entire VCCS Student Body, and Survey Sample*

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Population Surveyed (~10,000)</th>
<th>All VCCS students (~140,000)</th>
<th>Survey Responders (N=307)</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian</td>
<td>180 (1.81%)</td>
<td>0.34%</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Asian</td>
<td>2,160 (21.74%)</td>
<td>7.98%</td>
<td>35 (11.40%)</td>
</tr>
<tr>
<td>Black</td>
<td>1,723 (17.34%)</td>
<td>17.43%</td>
<td>30 (9.77%)</td>
</tr>
<tr>
<td>Hispanic or Latino/a</td>
<td>1,390 (13.99%)</td>
<td>11.08%</td>
<td>41 (13.36%)</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>34 (0.34%)</td>
<td>0.25%</td>
<td>2 (0.65%)</td>
</tr>
<tr>
<td>White (Non-Hispanic)</td>
<td>3,652 (36.76%)</td>
<td>53.32%</td>
<td>189 (61.56%)</td>
</tr>
<tr>
<td>Other/Non specified</td>
<td>797 (8.02%)</td>
<td>9.6%</td>
<td>10 (3.26%)</td>
</tr>
</tbody>
</table>
Table 4

*Gender by Highest Parental Education with Sample Size and Percentage.*

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
<th>Transgender/Nonbinary/Other</th>
<th>Prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>147</td>
<td>149</td>
<td>9 (2.9%)</td>
<td>2 (0.7%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>58</td>
<td>87</td>
<td>6 (3.9%)</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>19</td>
<td>9</td>
<td>1 (3.4%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>24</td>
<td>15</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>46</td>
<td>38</td>
<td>2 (2.3%)</td>
<td>1 (1.1%)</td>
</tr>
</tbody>
</table>

Table 5 depicts the variable race/ethnicity highest parental education. The survey used the race/ethnicity categories used by the VCCS internal enrollment databases. As such, Hispanic/Latino ethnicity was included as a choice in the multiple-choice race/ethnicity question. The VCCS recently changed the student enrollment application to reflect Hispanic/Latino ethnicity as separate from race. Future surveys should align with this change, as well as including a choice for “two or more races.” The researcher found no instances among the Qualtrics temporary store of incomplete surveys in which a survey taker stopped the survey on the race/ethnicity question (Question #3). There were no responses indicating American Indian or Alaskan Native racial identity.
Table 5

Race/Ethnicity by Highest Parental Education with Sample Size and Percentage.

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total students</th>
<th>Asian</th>
<th>Black or African American</th>
<th>Hispanic/Latino</th>
<th>Native Hawaiian or other Pacific Islander</th>
<th>White (Non-Hispanic)</th>
<th>Prefer not to answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>35 (11.4%)</td>
<td>30 (9.8%)</td>
<td>41 (13.4%)</td>
<td>2 (0.7%)</td>
<td>189 (61.6%)</td>
<td>10 (3.3%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>20 (13.2%)</td>
<td>17 (11.2%)</td>
<td>10 (6.6%)</td>
<td>2 (1.3%)</td>
<td>97 (63.8%)</td>
<td>6 (3.9%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>3 (10.3%)</td>
<td>2 (6.9%)</td>
<td>2 (6.9%)</td>
<td>0 (0%)</td>
<td>22 (75.9%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>1 (2.6%)</td>
<td>2 (5.1%)</td>
<td>7 (17.9%)</td>
<td>0 (0%)</td>
<td>28 (71.8%)</td>
<td>1 (2.6%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>11 (12.6%)</td>
<td>9 (10.3%)</td>
<td>22 (25.3%)</td>
<td>0 (0%)</td>
<td>42 (48.3%)</td>
<td>3 (3.4%)</td>
</tr>
</tbody>
</table>

Table 6 depicts the number and percentage of each parental education group enrolled across the four STEM major areas. Overall, STEM major areas were relatively evenly distributed among groups. Notably, for every STEM major area except engineering, there were more students with no parental bachelor’s degrees than students with parental bachelor’s or higher.

Table 6

STEM Major Area by College Generation Group

<table>
<thead>
<tr>
<th>Highest Parental Education</th>
<th>Total</th>
<th>Biological, agricultural, or environmental life sciences</th>
<th>Computer or mathematical sciences</th>
<th>Engineering or engineering technologies</th>
<th>Physical sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>94 (30.6%)</td>
<td>94 (30.6%)</td>
<td>91 (29.6%)</td>
<td>28 (9.1%)</td>
</tr>
<tr>
<td>Bachelor’s+</td>
<td>152</td>
<td>41 (27%)</td>
<td>45 (29.6%)</td>
<td>54 (35.5%)</td>
<td>12 (7.9%)</td>
</tr>
<tr>
<td>Associate’s</td>
<td>29</td>
<td>9 (31%)</td>
<td>10 (34.5%)</td>
<td>8 (27.6%)</td>
<td>2 (6.9%)</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>39</td>
<td>14 (35.9%)</td>
<td>13 (33.3%)</td>
<td>7 (17.9%)</td>
<td>5 (12.8%)</td>
</tr>
<tr>
<td>No college</td>
<td>87</td>
<td>30 (34.5%)</td>
<td>26 (29.9%)</td>
<td>22 (25.3%)</td>
<td>9 (10.3%)</td>
</tr>
</tbody>
</table>
The next section presents the results of data analysis and hypothesis testing to answer the study’s research question.

**Results of Data Analysis**

The data compiled from the online survey were analyzed to determine the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students. Along with the demographic survey questions, responses to Lent et al.’s (2003b) 36-item Contextual Supports and Barriers Scale and 4-item Persistence Intentions Scale were analyzed to test each hypothesis.

Table 7 shows Cronbach’s alpha scores calculated for each scale for each group. Cronbach’s alpha provides an indication of the strength of correlation among all items in a scale, with a recommended minimum of at least .7 (Pallant, 2020). Overall, the scales showed strong reliability, with scores ranging from .77 to .92. Scores for individual conceptual clusters of each instrument are discussed in a following article.

### Table 7

**Contextual Supports Subscale Mean Scores for Each Generation Group**

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>3.22</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Definition #1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>3.27</td>
<td>0.65</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>3.07</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Definition #2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>3.30</td>
<td>0.65</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>3.13</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Hypothesis Testing

The fourteen hypotheses for this study were tested using Pearson product-moment correlation tests. Table 8 shows the results of Pearson correlations between perceived supports and persistence intentions, by generation group. Table 9 shows the results of Pearson correlations between perceived barriers and persistence intentions, by generation group.

Table 8

Pearson Correlation Coefficient Scores for Perceived Supports and Persistence Intentions, by Generation Group

<table>
<thead>
<tr>
<th>Generation Group</th>
<th>n</th>
<th>p</th>
<th>Pearson correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>307</td>
<td>&lt; .001</td>
<td>.20*</td>
</tr>
<tr>
<td>Definition #1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-SC</td>
<td>220</td>
<td>.005</td>
<td>.19*</td>
</tr>
<tr>
<td>FGCS-NC</td>
<td>87</td>
<td>.058</td>
<td>.20</td>
</tr>
<tr>
<td>Definition #2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGCS-B+</td>
<td>152</td>
<td>.123</td>
<td>.13</td>
</tr>
<tr>
<td>FGCS-NB</td>
<td>155</td>
<td>.001</td>
<td>.26*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the .01 level (2-tailed)
An assumption of Pearson correlation is that both variables are normally distributed. In the case of the persistence intentions scale, however, normality was not met due to heavily skewed data, with most students choosing all 5s (the highest score) for the four-item scale. Lent et al. (2018) addressed this problem by rank case transformation of the scale to normalized z-scores. This study used the same method, resulting in a slightly more normalized, but still heavily skewed non-normal distribution. Figure 3 shows the frequency histogram of the Kolmogorov-Smirnov test for normality of the raw persistence intention scores. Figure 4 shows the results for the transformed z-score persistence intentions. According to Field (2000), the Pearson correlation coefficient test is robust to violations of normality. It is with this understanding that the following correlation tests were performed. Cohen (1988) interprets a Pearson $r$ value below .30 to represent a small relationship, .30 to .49 to represent a medium relationship, and .50 and above to represent a large relationship. These recommendations were used to interpret the strength of relationships in each test.
Figure 3. Kolmogorov-Smirnov test for normality for persistence intentions scores for all students.
Figure 4. Kolmogorov-Smirnov test for normality for transformed persistence intentions scores for all students.

**Ho1: All Community College Students’ Perceived Supports and Persistence Intentions**

The relationship between perceived supports for STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived supports was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was a small correlation at the .001 level between the two variables, $r = .20$, $n = 307$, $p < .001$, with higher levels of perceived supports associated with higher levels of persistence intentions.
Ho2: All Community College Students’ Perceived Barriers and Persistence Intentions

The relationship between perceived barriers to STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived barriers was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was a small correlation at the .001 level between the two variables, $r = -.18$, $n = 307$, $p = .002$, with higher levels of perceived barriers associated with lower levels of persistence intentions.

Ho3: FGCS-NC Perceived Supports and Persistence Intentions

The relationship between perceived supports for STEM transfer and persistence intentions for first-generation community college students with no parental college experience (FGCS-NC, $n = 87$) was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived supports was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was no significant correlation, $r = .20$, $n = 87$, $p = .058$.

Ho4: FGCS-NC Perceived Barriers and Persistence Intentions

The relationship between perceived barriers to STEM transfer and persistence intentions for first-generation community college students with no parental college experience (FGCS-NC, $n = 87$) was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Both perceived barriers and persistence intentions were non-normal, $p < .05$. There was no significant correlation, $r = .20$, $n = 87$, $p = .058$. 
**Ho5: CGCS-SC Perceived Supports and Persistence Intentions**

The relationship between perceived supports for STEM transfer and persistence intentions for continuing-generation community college students with some parental college experience to bachelor’s+ (CGCS-SC, $n = 220$) was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived supports was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was a small correlation between the two variables at the .01 level of significance, $r = .19$, $n = 152$, $p = .005$, with higher levels of perceived supports associated with higher levels of persistence intentions.

**Ho6: CGCS-SC Perceived Barriers and Persistence Intentions**

The relationship between perceived barriers to STEM transfer and persistence intentions for continuing-generation community college students with some parental college experience to bachelor’s+ (CGCS-SC, $n = 220$) was investigated using a Pearson product-moment correlation coefficient. The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived barriers was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was a small correlation between the two variables at the .01 level of significance, $r = -.15$, $n = 220$, $p = .022$, with higher levels of perceived barriers associated with lower levels of persistence intentions.

**Ho7: FGCS-NB Perceived Supports and Persistence Intentions**

The relationship between perceived supports for STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient for first-generation college students with no parental bachelor’s degree or higher (FGCS-NB, $n = 155$).
The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived supports was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was a small correlation at the .001 level of significance between the two variables, $r = .26$, $n = 155$, $p = .001$, with higher levels of perceived supports associated with higher levels of persistence intentions.

**H08: FGCS-NB Perceived Barriers and Persistence Intentions**

The relationship between perceived barriers to STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient for first-generation college students with no parental bachelor’s degree or higher (FGCS-NB, $n = 155$). The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Both perceived barriers and persistence intentions were non-normal, $p < .05$. There was a small correlation between the two variables, $r = -.21$, $n = 155$, $p = .010$, with higher levels of perceived barriers associated with lower levels of persistence intentions.

**H09: CGCS-B+ Perceived Supports and Persistence Intentions**

The relationship between perceived supports for STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient for continuing-generation college students with a parental bachelor’s degree or higher (CGCS-D3, $n = 152$). The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived supports was found tenable, $p > .05$, but persistence intentions were non-normal, $p < .05$. There was no statistically significant correlation, $r = .13$, $n = 152$, $p = .123$. 
Ho10: CGCS-B+ Perceived Supports and Persistence Intentions

The relationship between perceived barriers to STEM transfer and persistence intentions was investigated using a Pearson product-moment correlation coefficient for continuing-generation college students with a parental bachelor’s degree or higher (CGCS-B+, n = 152). The assumption of normality of each variable was evaluated using the Kolmogorov-Smirnov test. Normality of perceived barriers was found tenable, \( p > .05 \), but persistence intentions were non-normal, \( p < .05 \). There was no statistically significant correlation, \( r = -.14, n = 152, p = .085 \).

Summary of findings

For perceived supports, there were small-to-medium correlations with persistence intentions for the entire group of community college students, the FGCS-NC group, and the FGCS-NB group. There was no significant correlation for the CGCS-SC and FGCS-NC groups. For perceived barriers, there were small correlations with persistence intentions for the entire group of community college students, the FGCS-NB group, and the FGCS-NC group. There was no signification correlation for the CGCS-B+ group and FGCS-NB group.

Overall, the supports and barriers scores of the monolithic “no bachelor’s” group of first-generation students (FGCS-NB, \( n = 155 \)) were correlated to persistence intentions, while continuing-generation college students (CGCS-B+, \( n = 152 \)) showed no correlation between supports or barriers to persistence intentions.

For all groups, supports scores had a significant negative correlation to barrier scores, as predicted by Lent et al. (2018), at the .01 level of significance. Effect sizes ranged from \(-.578\) (FGCS-NC group) to \(-.674\) (FGCS-NB), suggesting large associations between variables. Overall, students who perceived fewer supports perceived more barriers, and those who
perceived more supports perceived fewer barriers. The next section discusses these findings and provides implications for practice and research.

**Discussion**

The entire sample of community college students (N = 307) reported supports and barriers scores that correlated as expected with persistence intentions based on the SCCT hypothesis. These results were consistent with the full supports and barriers instrument’s correlation to persistence intentions of university engineering students (Lent et al., 2003b) as well as math and science course-taking intentions of undergraduate university students across multiple STEM majors in the US and abroad (Lent et al., 2018; Peña-Calvo et al., 2016). The results were also consistent with the shorter instrument’s performance with students at predominately white institutions (PWI) and historically black colleges and universities (HBCU) in engineering (Lent et al., 2005a; 2015; 2016) and computing sciences (Lent et al., 2008). For this study’s entire sample, supports correlation coefficient was .20, while barriers correlation coefficient was -.18 (significant at the .01 level). The average effect sizes for supports and barriers calculated from a meta-analysis of 143 SCCT studies were .36 and -.22, respectively (Lent et al., 2018). These results have implications for practice; providing community college students with resources to increase their perceived supports while addressing their perceived barriers may help to bolster their persistence intentions. However, when the sample was divided into groups based on first- and continuing-generation students, or highest parental education level, support and barrier scores did not reliably correlate to persistence intentions.

Supports and barriers were associated with persistence intentions as expected for two out of four generation groups. For the CGCS-SC group (from some parental college to bachelor’s degree or higher) and FGCS-NB group (no parental bachelor’s degree), small but significant
correlations were reported for both supports and barriers. For the FGCS-NC (no parental college) group, only barriers were correlated to persistence intentions. For the CGCS-B+ (parental bachelor’s or higher) group, neither supports nor barriers correlated to persistence intentions. This is an especially important finding because the CGCS-B+ definition is one of the most widely used in defining first- versus continuing-generation college students. Using this definition, it could be argued that continuing-generation students’ perceived STEM transfer supports and barriers do not influence their belief about how likely they are to successfully transfer.

The lack of correlation for Bachelor’s+ continuing-generation students is a unique finding; there appears to be no published study in which both contextual supports and barriers have no correlational relationship to persistence intentions for such a large sample (n = 155). Lent et al. (2008), using the 14-item short version of the Contextual Supports and Barriers scale, found barrier scores among Black and African American students (n = 575) at both a private and a state university were not correlated with engineering persistence intentions, but social supports were. In a follow-up study, perceived barriers for engineering students at two HBCUs (n = 116) were not correlated to persistence intentions during their first semester but were by the end of their second (Lent et al., 2010), indicating the possibility that a longitudinal study might yield different results. Garriot et al. (2017) found no significant correlation between first-generation (first to attend college) undergraduate students’ (n = 130) engineering persistence intentions and a 10-item parental supports instrument; other support types or barriers were not measured.

The most surprising result of this study was the lack of any correlation for continuing generation community college students with at least a parental bachelor’s degree. This group also had the highest supports scores and lowest barrier scores. The different outcomes may be due to
some fundamental difference between community college and four-year populations, some aspect of the instruments, or both. Students already pursuing a STEM baccalaureate degree are familiar with the four-year school setting and the rigor involved. Community college students may have less-informed notions of what to expect after transfer and how their experiences, good and bad, may affect their likelihood of degree completion.

Implications and Recommendations

Whatever the reasons, it is evident that community college students perceive their STEM transfer supports, barriers, and persistence intentions differently from four-year college and university students. More research is needed not only to determine why these differences exist but how they relate to and possibly affect actual persistence. Future research should compare students at community colleges with students in their first two years of baccalaureate degree programs to determine differences in perceptions and persistence. Longitudinal studies could help determine if persistence intentions change over time and whether they predict actual semester-to-semester persistence and degree completion. In time, such research could yield a more accurate understanding of first-generation community college students instead of relying on data derived almost exclusively from research conducted at four-year colleges and universities.

This study has several limitations. It cannot be directly compared to most SCCT-based studies because it uses the full 36-item Contextual Supports and Barriers Scale, which may yield different results from the more widely used 14-item version. This study could be expanded by analyzing only those 14 items, all of which are part of the 36-item scale and comparing the community college sample results to the many four-year college and university studies. Another important limitation is that only perceptions were measured, not performance or actual
persistence. Those wishing to perform similar research would benefit from matched institutional data and more sociodemographic survey information. Institutional data including GPA, major-related GPA, and developmental course history are associated with persistence (Crisp & Delgado, 2014). Sociodemographic information, such as income, weekly work hours, and dependents are, also associated with persistence, are known to be greater persistence barriers for first-generation, female, and underrepresented minority students (Engle & Tinto, 2008; Chen & Carrol, 2005). For future SCCT-based research into community college STEM transfer, Wang’s (2016) STEM Transfer Model focuses specifically on transfer intent (as a binary variable) and incorporates transfer-related interactions, student transcripts, and other administrative data into the various SCCT variables. Wang and Lee’s (2018) survey instrument measures transfer-related interactions with faculty, advisors, and peers as well as active learning in STEM classes, both of which have been shown to increase transfer success.
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https://doi.org/10.2307/1170245


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Chapter 5: Conclusions and Recommendations

Community college students, many of whom are the first in their families to attend college, make up around 40% of America's undergraduate population (National Science Board [NSB], 2020). The country's 936 public community colleges, with their open enrollment policies, lower annual tuition rates, and broad geographic distribution enable lower-income and less academically prepared students to access affordable higher education without relocating. Community colleges are also a significant component in many students' baccalaureate degree completion by offering transfer opportunities to four-year programs. As the demand for a qualified science, technology, engineering, and mathematics (STEM) workforce increases (NSB, 2018), community college students have become a critical resource for addressing the "leaky" STEM employment pipeline (Zhang, 2021). In fact, around one-half of all recent science and engineering bachelor's degree recipients began their education at a community college (NSB, 2020).

Despite the crucial role of two-year colleges, most higher education research, including transfer and STEM education research, occurs within the four-year college and university context (Dinh & Zhang, 2021; Wang & Wickersham, 2018). Adding to the gaps in the research is the lack of agreement on who should be considered first-generation. In a meta-analysis of first-generation college student studies, Toutkoushian et al. (2018) found that as few as 22% and as many as 77% of students would be considered first-generation depending on which of eight conflicting definitions were used. The two prevailing yet contradictory definitions of a first-generation student, both used by federal and state governments, are: (1) a student who does not have a parent or guardian with any postsecondary education; (2) a student who does not have a parent or guardian with a bachelor's degree or higher. The first definition does not include those
whose parents may have attended but dropped out of college as early as the second semester. The second definition does not include parents who may have attained associate's degrees, which implies that community college terminal associate's degrees do not count as "college." Not only does this widely used definition implicitly exclude community colleges, but most first-generation student research is performed at four-year colleges and universities; the data does not reflect the actual population (Ives & Castillo-Montoya, 2020).

With these limitations in mind, it is evident that community college transfer students, especially those who fall into one or more categories of first-generation status, are an understudied population despite being vital to the STEM workforce.

This study addresses gaps in the literature by looking closely at the perceptions of community college students pursuing STEM transfer. Through the lens of social cognitive career theory (SCCT), this study asks community college STEM transfer-intending students about the social and environmental supports and barriers they face while pursuing STEM transfer at the community college. SCCT provides a framework for investigating career choice and academic persistence through the interplay of demographic characteristics, beliefs, interests, expectations, and external factors (Lent et al., 1994). Although SCCT relies on Bandura’s (1986) self-efficacy theory as a central component, the present study investigates a narrower aspect of the model: the association between social and environmental factors and a student’s perceived likelihood of successful degree completion (persistence intentions). As such, this investigation is among the first to apply this aspect of SCCT to a community college population, and to compare different definitions of first-generation and continuing-generation college students.
Background of Population

The participants in this study were STEM transfer-seeking students from six geographically and demographically diverse Virginia community colleges, who chose to complete an anonymous survey. A total of 307 students out of an estimated 10,000 eligible students responded. Of these students, 147 were female, 149 were male, 9 identified as transgender/non-binary/other and 2 preferred not to answer. Two contrasting definitions of first-generation, and their continuing-generation counterparts, were used. Using the first definition, the 307 responders were divided into first-generation students whose parents have no college experience (FGCS-NC) totaling 87 and all other continuing-generation students with some college (CGCS-SC) totaling 220. Using the second definition, the 307 responders were divided into first-generation students whose parents have some college but no bachelor’s degree (FGCS-NB) totaling 152 and continuing-generation students with at least one parent with a bachelor’s degree or higher (CGCS-B+) totaling 155.

Discussion of Findings

The first research question explored in this study was, how do first-generation community college students compare to their continuing-generation peers in terms of perceived supports, barriers, and persistence intentions related to the goal of STEM transfer? The results of this study demonstrate that community college students pursuing STEM transfer appear to have similar perceptions of the supports and barriers they will encounter during their experience, as well as similar beliefs about their likelihood of successfully transferring. When they do differ, it is primarily due to the lower perceived financial supports of students with no parental college experience. However, compared separately, first-generation students with at least some parental college experience are more like their continuing-generation peers. In short, first-generation
status in this study was only identifiable in students whose parents have no college experience; all other students were not significantly different. It is important to remember that this study only measured perceptions and did not include other metrics such as actual persistence, GPA, socioeconomic status, work obligations, age, or transfer-related interactions with faculty and advisors.

The financial disparities between first-generation and continuing-generation college students are well established (Engle & Tinto, 2008; Pascarella et al., 2004). Despite some arguments (e.g., Davis, 2010) and implicit assumptions that all students who do not have a parent with a bachelor’s degree or higher should be considered interchangeable to define first-generation status, the data suggest otherwise. Students with no parental college experience are known to have lower high school GPAs, fewer Advanced Placement course credits, and considerably lower household incomes compared to students whose parents have some college but no bachelor’s degree (Cataldi et al., 2018). This study corroborates the financial gulf between the two contrasting definitions of first-generation student. The more significant findings of this research are the similarities among the entire sample of community college students, regardless of parental education.

In one of the few studies comparing subgroups of first-generation students, Kim et al. (2020) found that first-generation (“no bachelor’s”) university students with a sibling who had attended college had equal parental, peer, and institutional support and academic success to their continuing-generation peers. However, those first-generation students without a sibling in college scored significantly lower on each of these measures. Some first-generation students in the present study likely have siblings who attend(ed) college. These family members’ social support and capital could have translated into statistically similar scores to continuing-generation
students. Raque-Bogdan and Lucas (2016) also found no differences between first-generation and continuing-generation university students regarding career-related parental support, college self-efficacy, college outcome expectations, their self-efficacy for coping with barriers, and career aspirations. First-generation students did, however, report significantly higher scores for perceived educational and discrimination barriers, a finding that the present study does not support. The authors postulated that the similarities in support might be because first-generation students had already overcome the barrier to admission to a selective college. Socioeconomic status, they posited, may play a more significant role than first-generation status in differentiating students.

The present study’s quantitative findings support the similarities in social supports between generation groups found in qualitative research. Martin et al. (2020) found that first-generation (“no bachelor’s”) university engineering students expressed similar social capital sources (e.g., parents, peers, faculty, advisors) relative to engineering career choice compared to their continuing-generation peers. The only differences found were when social influence for choice of major began; parents of continuing-generation engineering majors encouraged them into engineering fields pre-college, while first-generation experienced general social supports pre-college and engineering major supports after being admitted. Social capital and perceptions may be associated with college success, but they are not the same as college success. Vuong et al. (2010) found that even though first-generation (“no bachelor’s”) university students had similar levels of college self-efficacy to their continuing-generation peers, first-generation status was associated with lower GPA. The possible divergence between pre-transfer perceptions and post-transfer persistence is fertile ground for future research.
The literature reiterates that first-generation students often feel that they do not belong in the university setting, feel alienated by cultural barriers, and suffer from less academic engagement resulting in weaker degree attainment (Jury et al., 2017; Laanan & Jain, 2016; Jehangir, 2009). The absence of significant differences in the present study’s sample could be due to the nature of the community college, a non-residential school with students from more similar financial and educational backgrounds. According to Wells (2008), community colleges may be more meritocratic. Wells found that community college students who reported lower social capital sources (e.g., parental education, financial resources, friends in college) were more likely to transition from first to second year than students in four-year schools who reported similar social capital.

Perhaps the most important finding of this study was the near-identical perception of access to mentors and role models across all groups. Regardless of parental education, community college students perceive that they are slightly less than “moderately likely” to have access to mentors in their field and role models who can advise them during their pursuit of STEM transfer. This is especially alarming considering the evidence that mentorships and guided research experiences help influence community college student transfer intent and transfer success (Pawloski & Shabram, 2019; Dinh & Zhang, 2021; Nerio et al., 2019).

According to Bandura’s (1986) social cognitive theory, upon which SCCT is based, role models and mentors are sources of vicarious learning, one of four sources of self-efficacy. Potential first-generation students in high school perceive a lack of positive role models, and even the presence of negative ones, as a barrier to attending college (Gibbons & Borders, 2010). Pascarella et al. (2004) found that first-generation students are less inclined to participate in extracurricular activities that might bring them into contact with potential role models because of
work and other life commitments. Community college students, even continuing-generation students, are more likely to be working at least part-time and have family commitments (AACC, 2022, NCES 2020), which could explain to some extent why all groups had nearly identical perceptions of mentor availability.

The second research question explored in this study was, what is the relationship between perceived STEM transfer-related supports and barriers and STEM persistence intentions for continuing-generation and first-generation community college students?

The entire sample of community college students (N = 307) reported supports and barriers scores that correlated as expected with persistence intentions based on the SCCT hypothesis. These results were consistent with the full supports and barriers instrument’s correlation to persistence intentions of university engineering students (Lent et al., 2003b) as well as math and science course-taking intentions of undergraduate university students across multiple STEM majors in the United States and abroad (Lent et al., 2019; Sheu & Bordon, 2017; Peña-Calvo et al., 2016). The results were also consistent with the shorter instrument’s performance with students at predominately white institutions (PWI) and historically black colleges and universities (HBCU) in engineering (Lent et al., 2005a; 2015; 2016) and computing sciences (Lent et al., 2008). For this study’s entire sample, supports correlation coefficient was .20, while barriers correlation coefficient was -.18 (significant at the .01 level). The average effect sizes for supports and barriers calculated from a meta-analysis of 143 SCCT studies were .36 and -.22, respectively (Lent et al., 2018). However, when the sample was divided into groups based on first- and continuing-generation students, or highest parental education level, support and barrier scores did not consistently correlate to persistence intentions.
Supports and barriers were associated with persistence intentions as expected for two out of four generation groups. For the CGCS-SC group (from some parental college to bachelor’s degree+) and FGCS-NB group (no parental bachelor’s degree), small but significant correlations were reported for both supports and barriers. For the FGCS-NC (no parental college) group, only barriers were correlated to persistence intentions. For the CGCS-B+ (parental bachelor’s or higher) group, neither supports nor barriers correlated to persistence intentions. This is an especially important finding because the CGCS-B+ definition is one of the most widely used in defining first- versus continuing-generation college students. Using this definition, it could be argued that continuing-generation students’ perceived STEM transfer supports and barriers do not influence their belief about how likely they are to successfully transfer.

The lack of correlation for Bachelor’s+ continuing-generation students is a unique finding; there appears to be no published study in which both contextual supports and barriers have no correlational relationship to persistence intentions for such a large sample ($n = 155$). Lent et al. (2008), using the 14-item short version of the Contextual Supports and Barriers scale, found barrier scores among Black and African American students ($n = 575$) at both a private and a state university were not correlated with engineering persistence intentions, but social supports were. In a follow-up study, perceived barriers for engineering students at two HBCUs ($n = 116$) were not correlated to persistence intentions during their first semester but were by the end of their second (Lent et al., 2010), indicating the possibility that a longitudinal study might yield different results. Garriot et al. (2017) found no significant correlation between first-generation (first to attend college) undergraduate students’ ($N = 130$) engineering persistence intentions and a 10-item parental supports instrument; other support types or barriers were not measured.
The most surprising result of this part of the study was the lack of any correlation for continuing generation community college students with at least a parental bachelor’s degree. This group also had the highest supports scores and lowest barrier scores. The different outcomes may be due to some fundamental difference between community college and four-year populations, some aspect of the instruments, or both. Students already pursuing a STEM baccalaureate degree are familiar with the four-year school setting, the rigor involved, and have more access to tutoring, peer, research, and mentoring resources (Laanan & Jain, 2016; Engle & Tinto, 2008; Pascarella et al., 2004) while also facing greater tuition expenses. Community college students may have less-informed notions of what to expect after transfer and how their experiences, good and bad, may affect their likelihood of degree completion.

**Limitations**

There are several notable limitations of this study concerning design, implementation, instrumentation, sample selection, and analysis. A cross-sectional survey design was employed to capture a snapshot of student perceptions across the VCCS during fall semester of 2021. The survey was voluntary and, as there was no matched institutional data, all data was self-reported. To reduce the number of survey items and increase the likelihood of completion, questions about otherwise important factors such grade point average, work obligations, and remedial course participation were omitted. The other instruments in the usual battery of SCCT survey instruments were also omitted, meaning the entire SCCT model could not be scrutinized.

The study was designed to incorporate both geographically and demographically diverse students across the VCCS. To accomplish this, twelve of the twenty-three VCCS colleges were approached by the researcher, and seven gave permission to conduct survey research. Two of these colleges did not disseminate the follow-up survey. One of these did not respond to multiple
requests, while the other canceled the follow-up email due to a mid-semester moratorium on surveying students. Several colleges reported a reluctance to participate due to the increasing number of surveys sent to students during the academic year. This reluctance to allow survey dissemination, however justified, presents limitations for future research.

According to internal VCCS database queries, there were approximately 10,000 STEM transfer-seeking students across the seven participating colleges. The survey response rate was roughly 3%. Responses reflected disproportionately more White students compared to the population (61.6% vs 36.7%) and disproportionately fewer Black students (9.8% vs 17.3%) and Asian (11.4% vs 21.7%) students. Female responders were over-represented at 48.5% compared to the population’s 35%, while male responders were underrepresented at 47.9% versus the population’s 64.5%. Transgender students totaled 2.9% of survey responders compared to the VCCS’s “unknown or prefer not to answer” category with 1.4%. Due to the small sample sizes of minority students, it was not feasible to perform statistical analysis at the intersections of race and/or gender with generation type or STEM major area. A larger, more representative sample size may have revealed statistically significant differences in perceptions scores that corroborate existing research on underrepresented minorities and the intersection of race and gender. Another limitation concerning underrepresented minority students is the use of Hispanic/Latino as a race category instead of a separate ethnicity question. While this usage was consistent with existing VCCS and National Center for Educational Statistics (NCES) demographic data available at the time, new VCCS students enrolling for the first time are given the option of choosing more than one race and, separately, identifying Hispanic/Latino ethnicity. This usage aligns with the United States Census Bureau’s (USCB, 2021) guidelines for survey questions on race and ethnicity.
Future researchers should align with these guidelines and prepare for the logistical and technical challenges of survey construction and statistical analysis.

The responses to the Persistence Intentions Scale resulted in non-normal, skewed results. As a result, there were no statistically significant differences in persistence intentions scores between any generation group. Although the kurtotic results were expected and transformed according to Lent et al.’s (2005a) recommendations, there was very little variation. Most students chose the highest rating (5 or Strongly Agree) for all four items.

The data gathered for this study were cross-sectional and self-reported, and thus cannot be used to draw causal conclusions. There are also methodological considerations when comparing groups of students. Ives and Castillo-Montoya (2020) warn in their study of first-generation college students:

While using comparison groups can generate valuable knowledge, when research compares a subpopulation of students to a control population of ostensibly “average” students whose lived experiences may greatly differ, it limits understanding of the subpopulation. Therefore, prior to any analysis, the data are already marked with underlying beliefs and values that successful college students should think and behave in particular, normative ways, as comparison was embedded in the purpose of the studies that used those instruments (p. 11).

Comparing first-generation students “against” continuing-generation students in this study risks normalizing the continuing-generation student experience. Care should be taken to look beyond the deficit-only mindset that first-generation student research often incorporates (Martin et al., 2020; Garriot, 2019). Although this study compares perceived disadvantages (barriers) between continuing-generation and first-generation students, it also considers
advantages (supports). As such, the study makes a significant contribution to the research by illustrating no differences in perceived barriers and only major differences in perceived financial supports between generation groups.

**Considering COVID-19**

The effects of the COVID-19 pandemic cannot be ignored in interpreting the data of this study. For many students in this survey, the fall 2021 semester was their first in college after at least one fully online year of high school. For many who had accumulated course credits, it was their first time on campus after taking one or more semesters fully online. In both quantitative and qualitative studies, first-generation students at universities reported higher levels of stress, financial anxiety, mental health issues, and food insecurity (Scharp et al., 2022; Jeong et al., 2021; Soria et al., 2020). Students in the Virginia Community College System reported similar barriers, with 57% of first-generation students (defined as no parental college experience) reporting basic needs insecurity, and 50% of other students (many who would be included in the “no bachelor’s” definition of first-generation student) reporting needs insecurity (The Hope Center, 2021). The instruments used in this study did not measure perceptions of anxiety, stress, or mental health issues, all of which may have yielded significant differences. First-generation students not only experienced more hardship, the also left college at higher rates. According to internal data, during system-wide enrollment drop of fall semester 2021, the VCCS reported a system-wide reduction of over 10,000 first-generation (“no parental college”) students. This study had more first-generation (monolithic definition) students than continuing-generation but may have had fewer students with no parental college experience than if it were carried out before the pandemic enrollment drop.
**Recommendations**

Recommendations for research include further SCCT-based inquiry into first-generation community college students, the use of different instruments for persistence intentions, incorporation of institutional data with student surveys, longitudinal research to track transfer success, mixed-methods approaches, and consideration of alternatives to the classification of first-generation students. Recommendations for practice include building mentoring and active learning experiences into the classroom setting and proactive approaches to helping community college transfer-seeking students identify supports, barriers, and coping mechanisms.

**Recommendations for Research**

This study investigated two variables of the SCC model on choice goals (persistence intentions): contextual supports and contextual barriers. Lent et al. (2018) stress the need for further multivariate testing of the model, including the variables for self-efficacy, outcome expectations, and career interests. Multivariate analysis would reveal the effects of all the theory’s components on persistence intentions and reduce the possibility of misestimating the relationships between any two variables. For example, although the correlations between supports, barriers, and persistence intentions in this study had small effect sizes similar to previous SCCT research, they may affect intentions indirectly through other variables. Standardized parameter estimates for the SCCT variables based on a meta-analysis of multiple studies showed supports having moderate effects on self-efficacy (.40) and outcome expectations (.32) which, through career interest, are significant predictors of persistence (Lent et al. 2018, Sheu & Bordon, 2017). Lent and Brown (2019) suggest that the roles of supports and barriers may be "heightened in contexts where people are most likely to encounter social or financial challenges to their persistence (p. 11)," including first-generation students. There was no
indication of this in the present study. A complete SCCT-based research design could reveal indirect, moderating effects of supports and barriers on persistence intentions, as well as science and math self-efficacy and outcome expectations, which are known to be predictive of persistence intentions (Lent et al., 2005a).

The dataset from this study can be used for further research into community college students in STEM transfer programs. Although demographic information was used solely to describe the sample, multiple ANOVA tests could be used to determine any significant differences in perceptions between groups based on gender, race/ethnicity, credit hours attained, and STEM major area. Further research could obtain larger datasets to determine support and barrier perceptions of marginalized populations and the intersection of race/ethnicity and gender. Researchers should consider integrating institutional data, such as overall GPA, math/science major GPA, and credit hours per semester with survey data to determine links between student beliefs, performance, and persistence. Qualitative and mixed-methods research could investigate how first-generation students understand the roles and availability of resources, including mentors and family support. Given the recent evidence that first-generation students are more susceptible to abuse, homelessness, and food insecurity during the COVID-19 pandemic (Soria et al., 2021), and the dramatic decline in first-generation enrollment during the 2021 academic year (internal VCCS communication and database results), more research is needed to determine the range and acuteness of obstacles faced and how they affect transfer success. As one of the few recent studies to use the full Contextual Supports and Barriers Scale, this research provides a rich dataset for further analysis. Peña-Calvo et al. (2016) performed factor analysis to test the conceptual clusters of the full Contextual Barriers and Supports Scale between gender and STEM major for 811 Spanish university students; each cluster was significantly related to
persistence intention goals as predicted. The present study’s data could be similarly used for cluster factor analysis and to determine whether statistically significant differences exist between groups based on individual factors.

Wang (2016a) expresses the importance of system-wide survey-based research using matched performance data for a holistic understanding of community college students and STEM transfer. Those wishing to perform similar research would benefit from matched institutional data and more sociodemographic survey information. Institutional data including GPA, major-related GPA, and developmental course history are associated with persistence (Crisp & Delgado, 2014). Sociodemographic information, such as income, weekly work hours, and dependents are also associated with persistence, and are known to be greater persistence barriers for first-generation, female, and underrepresented minority students (Engle & Tinto, 2008; Chen & Carrol, 2005). For future SCCT-based research into community college STEM transfer, Wang’s (2016a) STEM Transfer Model focuses specifically on transfer intent and incorporates transfer-related interactions, student transcripts, and other administrative data into the various SCCT variables. Wang and Lee’s (2018) survey instrument measures transfer-related interactions with faculty, advisors, and peers as well as active learning in STEM classes, both of which have been shown to increase persistence and transfer success.

Whatever the reasons, it is evident that community college students perceive their STEM transfer supports, barriers, and persistence intentions differently from four-year college and university students. More research is needed not only to determine why these differences exist but how they relate to and possibly affect actual persistence. Future research should compare students at community colleges with students in their first two years of baccalaureate degree programs to determine differences in perceptions and persistence. Longitudinal studies could
help determine if persistence intentions change over time and whether they predict actual semester-to-semester persistence and degree completion. In time, such research could yield a more accurate understanding of first-generation community college students instead of relying on data derived almost exclusively from research conducted at four-year colleges and universities.

**Recommendations for Practice**

This first part of this study found more similarities between first-generation and continuing-generation community college students than differences. Although first-generation students of both definitions had lower social supports and higher social and family barriers as predicted, differences were small. One of the most notable similarities is community college students’ perception of being less than moderately likely to have access to mentors and role models. Community colleges should investigate innovative methods of providing mentoring and research relationships for all STEM transfer-seeking students. No matter how innovative the program, students will only benefit if they show up. Community college students, especially first-generation students, work more hours and take fewer credits per semester on average than university students. As a result, these students are less able to take advantage of extracurricular activities that increase institutional attachment (Pascarella et al., 2004; Fischer, 2007). Fortunately, active learning and collaborative pedagogies in the community college classroom have resulted in increased student engagement (Tinto, 1997), institutional attachment (Braxton et al., 2008), and STEM transfer intent (Wang et al., 2017). Research, mentoring, and transfer capital experiences therefore need to also take place within the classroom to engage all community college students. Accordingly, this approach represents a cost-saving opportunity compared to differentiated instruction and generation-centric outreach.
Pawloski and Shabram (2019) detail the initial success of a community college geosciences “career course”, a three-credit hour course in which students are introduced to research opportunities, internship opportunities, transfer requirements, and field trips as part of a larger National Science Foundation-funded endeavor that includes opportunities for mentorship. Students taking the career course have shown increased interest in pursuing geoscience-driven internships and have successfully transferred to geoscience-based baccalaureate programs. Focusing these experiences into a mandatory course means that all students have the opportunity to develop transfer capital. Creating new classes may not be feasible, especially for those colleges who have articulation agreements with four-year schools that require specific courses to be completed. Because of this limitation, faculty and administration should consider integrating active-learning and mentoring opportunities into existing required courses.

Many transfer degrees across the VCCS require students to take a Student Development (SDV) course their first semester, one of which is oriented toward STEM students. These courses focus on study skills, advising, career planning, and “topical areas which are applicable to their particular discipline (VCCS, 2022).” Although SDV courses are typically one semester hour, they could still be used to introduce students to research and collaboration opportunities available the next semester, discuss the requirements and procedures for transfer, require students to map the transferable courses they need to a four-year institution, and introduce different voices from industry, academia, and of students who successfully transferred.

This study’s entire sample, representing community college STEM-transfer seeking students, demonstrated overall expected correlation between contextual factors and persistence intentions. These results have implications for practice; providing community college students with resources to increase their perception of social and environmental supports while addressing
their perception of barriers may help to bolster their persistence intentions. College counselors and advisors could adopt a proactive approach to helping students understand the importance of developing relationships with peers and faculty, as well as how to address potentially adverse family and peer influences. College counselors who frequently interact with students may also have a more comprehensive view of how social supports and barriers are understood through the lens of generation status, socioeconomic status, race/ethnicity, and gender. This study’s findings provide evidence that all community college students perceive similar obstacles and affordances concerning STEM transfer. Colleges should seek to enhance outreach and advising by exploring the different ways in which students conceptualize and deal with these factors.

**Conclusion**

The problem this study addresses is the lack of knowledge about community college students’ perceptions of social and environmental supports and barriers associated with successful transfer to a four-year STEM degree program, and how these perceptions differ between first-generation and continuing-generation students. To accomplish this, the study: (1) described first-generation community college students in terms of demographics, persistence intentions, and perceived supports and barriers pertaining to the goal of STEM transfer; (2) determined significant differences in these factors between first-generation students whose parents have no college experience, first-generation students whose parents have some college but no bachelor’s degree, and continuing-generation students; (3) determined the relationships between perceived supports and barriers and persistence intentions for STEM transfer among all students and generation groups.

Each definition of first-generation college student reported significantly lower perceived supports for STEM transfer compared to their continuing-generation counterparts. There were no
significant differences in perceived barriers or persistence intentions between any group. The
deciding factor in first-generation lower support scores was the lower financial supports reported
by first-generation students with no parental college experience. All students, regardless of
generation status, had moderately low perceptions of financial resources and access to STEM
mentors and role models. Although supports and barriers correlated to persistence intentions for
the entire sample of community college students as expected, findings based on generation status
were inconsistent. For first-generation students whose parents have no college experience,
supports did not correlate to persistence intentions. For continuing-generation students with at
least one parent with a bachelor’s degree or higher, neither supports nor barriers correlated to
persistence intentions. One especially salient finding of this study is that all community college
students reported nearly identically low levels of access to STEM role models and mentors.

Overall, the results of this study contradict many of the findings of research on first-
generation college students, which takes place mostly at four-year colleges and universities.
Several of the findings from the correlation study also contradict findings of social cognitive
career theory studies of university STEM degree-seeking students. This study contributes to the
body of research in several ways. A close examination of survey results reiterated the importance
of providing mentoring opportunities during pursuit of STEM transfer for all students. By
capturing responses that were in notable contrast to most studies, this study helps advance the
argument that more research into first-generation college students needs to take place at the
community college, where results and their implications could differ considerably from what has
become established knowledge.
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Appendix 1 - Virginia Tech IRB Exemption Approval

MEMORANDUM

DATE: February 16, 2021
TO: Bradley Bowen, William Robert Oliver II
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 29, 2024)

PROTOCOL TITLE: Barriers to, and supports for transfer to a STEM bachelor’s degree among continuing-generation and first-generation community college students.

IRB NUMBER: 20-998

Effective February 16, 2021, the Virginia Tech Human Research Protection Program (HRPP) determined that this protocol meets the criteria for exemption from IRB review under 45 CFR 46.104 (d) category(ies) 2(i).

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit an amendment to the HRPP for a determination.

This exempt determination does not apply to any collaborating institution(s). The Virginia Tech HRPP and IRB cannot provide an exemption that overrides the jurisdiction of a local IRB or other institutional mechanism for determining exemptions.

All investigators (listed above) are required to comply with the researcher requirements outlined at:
https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Determined As: Exempt, under 45 CFR 46.104(d) category(ies) 2(i)
Protocol Determination Date: February 16, 2021

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.
Appendix 2 - Blue Ridge Community College IRB Approval

RRC Summary Form

Date submitted to OIRE: 2/17/21
Date reviewed by RRC: 3/19/21

After review, the RRC finds that the submitted project does not meet federal guidelines. (If the submitted project does not meet the federal guidelines please outline reasons below)

Additional concerns/comments: Appreciate the addendum to be able to disaggregate by college; will be interesting data.
The only item of concern is the description of how he was going to use the data in the future after his dissertation or how if he was going to destroy his records or data afterwards. He talks about locking it up but after one year what happens to the data?
The invitation will be forwarded to students by OIRE and will include a link to the survey itself. Mr. Oliver will work with OIRE to determine the parameters for the students who are to be invited.

The RRC recommends does not recommend the approval of this project.

RRC Chairperson

Date

The Vice President recommends does not recommend the approval of this project.

Vice President of Instruction and Student Services

Date

Date investigator informed of final action:

Protocol Number: 21-7 Oliver
RE: Dissertation research inquiry from VCCS faculty member

Ogden, Kristin <ogdenk@centralvirginia.edu>
To: Robert Oliver

Okay – we will honor this request under an exemption since you have VT IRB approval. Your survey looks great! I’ll be interested to see your results as well. I will get you a formal letter next week.

I am able to send emails, but I’ll have to check with my colleagues on the Canvas post. What is your timeline to send out the survey [and my apologies if that is included in your materials].

Kris

From: Robert Oliver <OliverR@bcoc.edu>
Sent: Thursday, February 25, 2021 3:49 PM
To: Ogden, Kristin <ogdenk@centralvirginia.edu>
Subject: Re: Dissertation research inquiry from VCCS faculty member

No problem! Yes, I would request that someone from CVCC send the email/post. I won’t have access to actual student email addresses and they won’t be associated with the survey.

Thank you!
Robert

From: "Ogden, Kristin" <ogdenk@centralvirginia.edu>
Date: Thursday, February 25, 2021 at 3:44 PM
To: Robert Oliver <OliverR@bcoc.edu>
Subject: RE: Dissertation research inquiry from VCCS faculty member

Thank you for your patience, Robert and for this additional information.

I do chair our IRB and you have provided all of the required information. Will you be dependent upon someone at CVCC to post the survey in Canvas AND to send an email or is it just one or the other?

Thank you,

Kris Ogden, Ed.D
Dean, Institutional Effectiveness and Strategic Planning
Central Virginia Community College
3506 Wards Road
Lynchburg, VA 24502
434-832-7918
Yes, I will provide initial approval for this survey to be distributed during Fall 2021.

From: Robert Oliver <OliverR@brcc.edu>
Sent: Monday, March 8, 2021 11:21 AM
To: David M. deMedicis <DdeMedicis@germanna.edu>
Subject: Re: Survey request for Fall 2021

David,

Please see the attached updated proposal summary, with the included paragraph outlining intent to share the individual college's results along with the aggregate results:

The investigators will provide a final report summarizing the responses from all students (across all colleges) who participate in the survey, as well as a report of that individual participating college's student responses. Responses will be categorized by generation type, as a whole, by gender, by race, and by STEM major area. Colleges may also request a copy of the dissertation manuscript articles and their final analyses.

Let me know if you need anything else, and thanks again for your consideration!

Robert
RE: Dissertation research

John H. Milam <JMilam@lfcc.edu>  
To: Robert Oliver; Cc: Caroline Wood

Tuesday, February 23, 2021 at 5:14 PM

Robert,

I am please to let you know that LFCC has approved participation in your survey research for your dissertation.

When we get closer to next fall and the first email to all enrolled, credit students, give me a reminder.

I am cc’ing Caroline Wood, our associate vice president who will probably be the person to send this out. Caroline – Robert’s research involves an online survey of students about first generation transfer to four-year STEM. The first and second waves of the survey go to the entire student body in the fall.

Thanks and good luck,
John
March 17, 2021

Mr. Robert Oliver
Professor of Information Systems Technology
Blue Ridge Community College
1 College Lane
Weyers Cave, VA 24486

Dear Mr. Oliver,

Your Virginia Tech doctoral research proposal titled, Barriers to and Supports for Transfer to a STEM Bachelor's Degree Among Continuing-Generation and First-Generation Community College Students, has been approved. Participation in any research project is purely voluntary. Please ensure the participants are aware of their options. You agreed to provide us research findings once complete.

Please feel free to contact me if you have any questions.

Sincerely,

Sharon Karkehabadi
Associate Vice President of Academic Assessment
Office of Institutional Effectiveness and Student Success
Northern Virginia Community College
3924 Pender Drive Suite 113
Fairfax, VA 22030
(703) 323-3129

Cc: Dr. Chad Knights
RE: IRB process for survey research

Robert,  

Your proposal has been approved. We are currently in the first week of classes. I would suggest waiting another week or two before sending the survey. Please let me know your timetable. I can generate the list of students and send the email out to them.

Thanks,
Robert
Appendix 8 - Virginia Western Community College IRB Approval

April 23, 2021

Robert Oliver
wroliver@vt.edu
540 453 2364

IRB #: 21-020

Protocol Title: Barriers to and supports for transfer to a STEM bachelor's degree among continuing-generation and first-generation community college students

Dear Mr. Oliver:

I am pleased to notify you that the Virginia Western Institutional Review Board (IRB) has granted approval to the captioned research project. This approval provides permission to begin the research activities outlined in the IRB-approved application and supporting documents.

Approved as: Expedited, modified board review under 45 CFR 46.110
This expedited approval was possible because the protocol was previously approved by the IRB at Virginia Tech.

Approval Date: April 23, 2021
Expiration Date: April 22, 2022
Continuing Review Due Date*: February 22, 2022 (60 days prior to the expiration date)
*A continuing review request for this project must be submitted if activities covered under this protocol, including data analysis, are to continue beyond the expiration date listed above.

This approval is contingent upon the research survey being conducted online through the Institutional Effectiveness Office, with demographic information collected separately from the rest of the research survey items.

All investigators are required to comply with the researcher requirements outlined at: https://dev.virginiawestern.edu/ie/irb.php. Please review these responsibilities before the commencement of your research.

Other Conditions and Instructions:
This letter conveys IRB approval and separate arrangements must be made with the appropriate academic division, department or program.

Changes in Protocol:
Plans to deviate from the approved protocol and/or supporting documents must be approved by the IRB prior to the implementation of any changes.

Unplanned variance in protocol that could adversely affect the safety or welfare of subjects must be reported to the IRB within 10 days of discovering the variance.

Close Out Report:
Appendix 9 - Survey Consent Form and Information Sheet
Information Sheet for Participation in a Research Study

Principal Investigator: Dr. Bradley Bowen, (540) 231-5915, bowenb@vt.edu
Co-Investigator: William Oliver, (540) 453-2364, wroliver@vt.edu

IRB# and Title of Study: #20-998, Barriers to and supports for transfer to a STEM bachelor’s degree program among continuing-generation and first-generation community college students.

You are invited to participate in a research study. This form includes information about the study and contact information if you have any questions.

I (William Oliver) am a graduate student at Virginia Tech, and I am conducting this research as part of my course work.

➤ WHAT SHOULD I KNOW?

If you decide to participate in this study, you will complete an anonymous online survey. As part of the study, you will be directed to the only survey web site where you will answer questions about the types of obstacles and supports you will experience while in
Appendix 10 – Study Recruitment Email

IRB# 20-998 – Recruitment Email/Canvas Post

Subject line: Transferring to a science, technology, engineering, or math program? We want your input!

Body:
If you are 18 or older and plan to transfer to a bachelor’s degree program in a STEM (Science, Technology, Engineering, Math) field, we would like your input for a Virginia Tech research study (IRB #20-998). Eligible participants will complete a single anonymous survey that should take no longer than 15 minutes.

The purpose of this research is to learn about the barriers and supports community college students face while pursuing transfer to a four-year STEM degree program. Unfortunately, very little is known about this important subject, and your voice is important to us.

If you have any questions or concerns about the research, please feel free to contact Dr. Bradley Bowen, (540) 231-5915, bowenb@vt.edu.

Remember, this is completely voluntary. If you would like more information or if you would like to take the survey, please click here for more information.

Thank you and good luck!

The “please click here for more information” link directed to the survey’s landing page, which displayed the content of the Information Sheet for Participation in a Research Study (Appendix A).
Appendix 11 - Follow-Up Recruitment Email

**Subject line:** Last chance for STEM transfer survey. We still want your input!

**Body:**

If you have already taken part in the Virginia Tech research survey (IRB# 20-998) for STEM transfer-seeking students, please disregard this email.

If you are 18 or older and plan to transfer to a bachelor’s degree program in a STEM (Science, Technology, Engineering, Math) field, there’s still time to participate in a fifteen-minute survey about the barriers and supports you’re experiencing while pursuing transfer. The survey will be available for one more week.

If you have any questions or concerns about the research, please feel free to contact Dr. Bradley Bowen, (540) 231-5915, Bowenb@vt.edu.

Remember, this is completely voluntary. If you would like more information or if you would like to take the survey, please click here for more information.

Thank you and good luck!

The “please click here for more information” link directed to the survey’s landing page, which displayed the content of the Information Sheet for Participation in a Research Study (Appendix A).
**Appendix 12 - Demographic and Enrollment Characteristics Survey**

We would like to know a little about you and your educational goals. The following questions will help us learn more about you as a unique individual.

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Question</th>
<th>Possible Responses</th>
</tr>
</thead>
</table>
| 1           | Which one of the following four areas of study do you intend to pursue when you transfer to a four-year college or university? If you have chosen more than one program of study, please only check the one that most closely represents your primary interest.  
  - Biological, agricultural, or environmental life sciences  
  - Computer or mathematical sciences  
  - Engineering or engineering technologies  
  - Physical sciences including chemistry, physics, astronomy, etc.  
  - I do not plan to transfer or to major in any of the above STEM fields. | 1. Biological, agricultural, or environmental life sciences  
  2. Computer or mathematical sciences  
  3. Engineering or engineering technologies  
  4. Physical sciences including chemistry, physics, astronomy, etc.  
  5. I do not plan to transfer or to major in any of the above STEM fields. (Ends survey. See End of Survey Text below) |
| 2           | What is your gender?                                                                                                                     | 1. Female  
  2. Male  
  3. Transgender/non-binary/other  
  4. Prefer not to answer                                                                                                                   |
| 3           | Which of the following best describes your race/ethnicity?  
  1. American Indian or Alaskan Native  
  2. Asian  
  3. Black or African American  
  4. Hispanic/Latino  
  5. Native Hawaiian or other Pacific Islander  
  6. White (Non-Hispanic)  
  7. Prefer not to answer                                                                                                                   |                                                                                                                                                        |
| 4           | Not including the current semester, about how many course credit hours have you completed at this community college? Use your best estimate if you are not sure. | 1. None (this is my first semester)  
  2. 3 to 6  
  3. 7 to 15  
  4. 16 to 30  
  5. 31 to 45  
  6. 46 or more                                                                                                                             |
| 5           | What best describes your parent(s) highest level of education? Parent #1  
  7. Did not finish high school  
  8. Graduated from high school or received a GED  
  9. Attended college but did not earn a degree  
  10. Earned an associate’s (2-year) degree  
  11. Earned a bachelor’s (4-year) degree  
  12. Earned a Master’s degree                                                                                                               |
| 6 | What best describes your parent(s) highest level of education? Parent #2 | 13. Earned a Doctorate (Ph.D., MD, DDS, J.D., etc.)  
14. Unknown (or this parent did not raise me)  
1. Did not finish high school  
2. Graduated from high school or received a GED  
3. Attended college but did not earn a degree  
4. Earned an associate's (2-year) degree  
5. Earned a bachelor's (4-year) degree  
6. Earned a Master's degree  
7. Earned a Doctorate (Ph.D., MD, DDS, J.D., etc.)  
Unknown (or this parent did not raise me) |

**End of Survey Text**

Thank you very much for your participation in this research! Your participation is now complete, and you will not be required to do anything further. We believe your participation will help to expand and improve knowledge about community college students’ experiences and needs.

We wish you the best of luck with your educational and career endeavors!
Appendix 13 - Contextual Supports and Barriers Scale (Lent et al., 2003) Excerpt

The prompt below was used for the full 36-item Conceptual Supports and Barriers Scale. Excerpt of four example questions follow.

People face a variety of factors that may support or hinder their college and career plans. We are interested in knowing about the situations, either helpful or unhelpful, you believe you might experience in relation to one particular choice option: the decision to transfer from your community college to a four-year college or university to pursue a bachelor’s degree in a STEM field.

During your time at this community college pursuing transfer to a four-year bachelor's degree program in your chosen STEM field, how likely will you be to:

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all likely 1</th>
<th>A little likely 2</th>
<th>Somewhat likely 3</th>
<th>Very likely 4</th>
<th>Extremely likely 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel accepted by your classmates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have access to a &quot;role model&quot; in this field (i.e. someone you can look up to and learn from by observing)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Be able to afford the extra cost of advanced training in this field</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Feel that your education/career options are limited by financial concerns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feel pressure from parents or other important people to change your major to some other field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 14 - Persistence Intentions Scale (Lent et al., 2003)

Using the scale below, indicate your level of agreement with each of the following statements about the STEM degree major you indicated earlier:

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree 1</th>
<th>Disagree somewhat 2</th>
<th>Neither agree nor disagree 3</th>
<th>Agree somewhat 4</th>
<th>Strongly agree 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I intend to major in my chosen STEM field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I plan to remain enrolled in my major, or transfer to a bachelor’s degree program, over the next semester</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>I think that earning a bachelor’s degree in my chosen STEM field is a realistic goal for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am fully committed to getting my bachelor’s degree in my chosen STEM field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>