UNDERGRADUATE LATINA/O/X STUDENT MOTIVATION: MODERATING INFLUENCES OF CULTURAL CAPITAL ON STEM PERSISTENCE AT A HISPANIC-SERVING INSTITUTION

by

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LIST OF ABBREVIATIONS

Abbreviation	**Description**
APA	American Psychological Association
APOC	Assistant professors of color
AspC	Aspirational capital
AttV	Attainment value
CCW	Community cultural wealth
CCWM	Community Cultural Wealth Model
CRT	Critical Race Theory
CURE	Course-based Undergraduate Research Experiences
DE	Developmental education
EFA	Exploratory factor analysis
EffC	Effort cost
ES	Expectancy of success
EV	Expectancy-value
EVT	Expectancy-value theory
FamC	Familial capital
GPA	Grade point average
HACU	Hispanic Association of Colleges and Universities
HBCU	Historically Black College and Universities

HSI	Hispanic-serving institution
IntV	Interest value
IRB	Institutional Review Board
ISE	Informal science education
ItP	Intention to persist
LMS	Learner management system
LS	Learning support
MOU	Memorandum of understanding
MR	Multiple regression
NavC	Navigational capital
NDCC	Non-dominant cultural capital
OppC	Opportunity cost
P-P	Predicted probability
POC	People of color
PsyC	Psychological cost
PWI	Predominantly White institution
R/E	Race/ethnicity
ResC	Resistant capital
RMSEA	Root mean square error of approximation
RQ	Research question
SAT	Scholastic Aptitude Test

SCU	South Central University, a pseudonym
SDT	Self-determination theory
SEM	Structural equation modeling
SES	Socioeconomic status
SEVT	Situated expectancy-value theory
SPSS	Statistical Package for Social Sciences
SRMR	Standardized root mean square residual
STEM	Science, Technology, Engineering, and Mathematics
STV	Subjective task value
TCU	Tribal Colleges and Universities
TIERA	Training in Environmental Research and Academic Success
URM	Underrepresented minority
UtV	Utility value
VIF	Variance inflation factors

GLOSSARY

Aspirational capital – “the ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers” (Yosso, 2005, p. 77); “resilience in the form of a disposition toward success” (Samuleson & Litzler, 2016, p. 97).

Attainment value – “the relative personal/identity-based importance attached by individuals to engage in various tasks or activities” (Eccles & Wigfield, 2020, p. 5)

CCW capitals – culturalized assets utilized by persons and communities of color to access and navigate social and academic environments.

Effort cost – “the perception of how much effort would need to be exerted to complete a task and whether it is worth doing so” (Eccles & Wigfield, 2020, p. 5)

Expectancy of success – “individuals’ beliefs about how well they will do on an upcoming task”; beliefs are “time- and task-specific” (Eccles & Wigfield, 2020, p. 5)

Familial capital – cultural knowledges nurtured among *familia* (kin) that carry a sense of community history, memory, and cultural intuition; a commitment to community well-being that occurs both within and between families as well as through church, sports, school, and social community settings (Yosso, 2005)

First-generation student – a student whose parents/guardians did not complete a college degree

Interest value – the enjoyment one gets when doing a task; "the anticipated enjoyment one expects to gain from doing a task" (Eccles & Wigfield, 2020, p. 4)

Hispanic-serving institution – an institution of higher education in which undergraduate enrollment is at least 25% Hispanic (U.S. Department of Education, 2016)

Navigational capital – skills in maneuvering through social institutions; agency even in the face of systemic constraints, especially through the utilization of social networks (Yosso, 2005)

Opportunity cost – "the extent to which doing one task takes away from one's ability or time to do other valued tasks" (Eccles & Wigfield, 2020, p. 5)

Persistence – an individual's continued engagement or participation in a task; continued enrollment at any institution

Psychological cost – "the emotional or psychological costs of pursuing the task, particularly anticipated anxiety, and the emotional and social costs of failure" (Eccles & Wigfield, 2020, p. 5)

Resistant capital – knowledges and skills which increase awareness of forms of oppression, and which foster oppositional behavior and thinking that challenge inequality (Yosso, 2005)

Retention – an institution's measure for continued enrollment within the same institution

Socioeconomic status – the subjective perception of social status or social class of an individual or group; often measured as a combination of education, income, and occupation (APA, 2020)

STEM major – a college major that is a science, technology, engineering, or mathematics discipline; includes health/medical sciences

Utility value – usefulness; “how well a particular task fits into an individual’s present or future plans” (Eccles & Wigfield, 2020, p. 5)

ABSTRACT

This dissertation is a quantitative correlational study that explored the associations between elements of expectancy-value theory of achievement choices and Latina/o/x students' intention to persist in their STEM major at a Hispanic-serving institution (HSI). The theoretical framework includes both expectancy-value theory (Eccles & Wigfield, 2020) and the Community Cultural Wealth Model (Yosso, 2005), positioning non-traditional types of cultural capital as variables which may moderate the influences that expectancy of success and subjective task value have on academic intentions to persist. Hierarchical multiple regression analyses revealed statistically significant interaction effects between expectancy and aspirational capital, value and aspirational capital, value and navigational capital, and value and resistant capital. Findings contribute to the gap in scholarly understandings of how culturalized assets operate within traditional theories of achievement motivation and suggest that Latina/o/x STEM major students may benefit from the purposeful validation of these assets.

1. INTRODUCTION

Degree attainment is arguably the central goal of institutions of higher education as it represents the fulfillment of student learning and mastery of content. Over the last several decades, there has been increased attention placed on both access to higher education and degree attainment for students of color in the continued pursuit of equity and social justice. Although higher education can broadly be positioned as a field of service, when disparities persist among populations regarding both access to higher education as well as completion, the conceptualization and operationalization of service must be examined because the work of social justice and equity is clearly not finished. Representation disparities in STEM fields (science, technology, engineering, and mathematics) are of particular concern leading to a closer examination of STEM workforce preparation in postsecondary education. Through this study, I focused on one influencing aspect of postsecondary STEM education for the underrepresented Latina/o/x population. Specifically, I examined how aspects of achievement motivation influence intent to persist in a STEM major at a Hispanic-serving institution (HSI) and how cultural capital moderated this influence.

The Importance of Diversity in the STEM Workforce

Diversity in the STEM workforce varies by the nature of STEM-related occupations. A 2018 Pew Research Center report (Funk & Parker, 2018) indicated that women represented approximately 50% of the total STEM workforce, but this is more heavily concentrated in healthcare professions and less so in computer jobs and engineering jobs. In fact, there has been a seven-percentage point drop in female representation in computer-related fields over the last 30 years. Additionally, STEM representation by ethnicity in the United States is still disproportionate to the overall population (see Table 1.1). The percentage of Black individuals in the U.S. workforce is 11% but only 9% in STEM jobs. The Hispanic population makes up 16% of the U.S. workforce, but Hispanic workers occupy only 7% of all STEM jobs. The percentages of Black and Hispanic workers in STEM jobs are even lower when comparing employed adults with a bachelor's degree. The White and Asian populations in the U.S. are disproportionally represented in the STEM workforce, especially among workers with college degrees. Asian workers comprise approximately 6% of the overall U.S. workforce, but 13% of the STEM workforce. White workers comprise 65% of the overall workforce and 69% of the STEM workforce.

Why does representation matter? I discuss two significant reasons here. One is that diverse population representation brings multiple perspectives which can contribute to the overall success of a company or organization. Without sufficiently diverse representation, unique problems may go undetected and unaddressed, which can then lead to marginalization of unique populations. Doherty et al. (2017) found that an increasing number of Americans believed that a more diverse national composition makes the country a better place to live. Approximately 60% of the Hispanic population believed that racial and ethnic diversity in the workforce is "extremely/very" important, regardless of whether the job is STEM-related, with the majority of Hispanic persons (68%) employed in STEM jobs believing that their workplace pays about the right amount of attention to increasing racial and ethnic diversity.

Table 1.1

Percent Employed in Each Group, by Highest Level of Education

Job Type	Demographic Group			
	White	Asian	Black	Hispanic
All employed	65	6	11	16
STEM jobs	69	13	9	7
Among those with high school or less education				
All employed	55	4	12	27
STEM jobs	63	4	16	15
Among those with some college education				
All employed	67	4	13	13
STEM jobs	72	4	12	9
Among those with a bachelor's degree				
All employed	73	8	8	8
STEM jobs	70	14	7	6
Among those with a postgraduate degree				
All employed	72	11	8	6
STEM jobs	66	21	6	5

Note. Recreated from Pew Center Research analysis of 2014-2016 American Community Survey (Funk & Parker, 2018). Based on employed adults ages 25 and older. Whites, Blacks, and Asians include only non-Hispanics. Hispanics are of any race. "Some college" includes those with an associate degree and those who attended college but did not obtain a degree.

The other reason representation matters is an economic one. STEM workers who also have a STEM major may earn 15% more than STEM workers without a STEM major (Day & Martinez, 2021). Additionally, in general, a typical STEM worker could annually earn twice as much as a non-STEM worker (U.S. Bureau of Labor Statistics, 2021). However, adding a layer of complexity to this difference is that in spite of higher overall STEM-job earnings, the gender wage gap is *greater* in STEM jobs than non-STEM jobs, partially due to the cluster of women employed in lower-paying health care-related positions, a wage gap that also holds true for the Black and Hispanic populations. Within the array of health care STEM jobs, Black and Hispanic workers are clustered more around licensed practical, vocational, and technical jobs such as licensed vocational nurse or laboratory technician than they are around jobs with advanced degrees (e.g., pharmacist, veterinarian). Similarly, among physical sciences and mathematics, Black and Hispanic workers are more likely to hold technical jobs such as chemical technician and operations analyst than professional jobs such as physicist or actuary (Funk & Parker, 2018).

Access to higher paying STEM positions, which reduces the overall earnings gap, requires higher levels of educational attainment. However, only a fraction of college graduates with STEM degrees actually move into a STEM job (Day & Martinez, 2021) signaling a concern regarding the pipeline between STEM training and STEM degree attainment to actual employment in a STEM job.

Persistence in the Representation Gap

Despite the appeal of higher pay and prestige in STEM jobs, the representation gap persists. One reason may be due to how different populations perceive STEM fields. The 2018 Pew Research Center report revealed that although about half of the American public believed that STEM jobs pay better, attract the brightest young people, and are more highly respected, half of the American public also believed that STEM jobs are difficult to get into. Further, less than 20% of Americans believed that STEM jobs have more flexibility than other jobs for balancing work life and family life, a significant determining factor for whether or not to pursue a STEM job, both for men and women. The two strongest beliefs of reasons for the representation gap of Blacks and Hispanics in STEM jobs by workers who were currently in STEM positions were less access to quality education and not being encouraged to pursue STEM at a young age. Also cited as major reasons for the STEM representation gap by one third or more of STEM workers were that Blacks and Hispanics believed they would be unsuccessful in STEM fields, may face discrimination in recruitment, hiring, and promotions, and lack Black and Hispanic role models in these fields. One 48-year-old Hispanic physician research participant elaborated that "Hispanics are looked down upon as stupid," and a 60-year-old Hispanic physical scientist research participant shared that "opportunities are usually offered to my white counterparts before they are offered to me" (Funk & Parker, 2018, section 4, pp. 80–81).

Perceptions about The Contributions (or lack of) in U.S. Education to STEM

As noted above, lack of access to high quality education was a reason cited to explain the representation gap in the STEM workforce for the Black and Hispanic populations. In the same Pew report (Funk & Parker, 2018), 61% of all U.S. adults and 73% of public-school parents reported believing that their local K–12 (kindergarten through 12^{th} grade) public schools were doing a "good" to "excellent" job. Perceptions were less positive, though, for how K–12 schools were faring in teaching critical thinking and problem-solving skills, both key contributors to success in STEM fields. Further, when asked to compare U.S. STEM education to that of other developed nations, 73% of Americans rated the U.S. K–12 public schools as average to below average. At the postsecondary level, American perceptions of STEM education were slightly more favorable with approximately 40% of college graduates indicating that graduate-level STEM education in the U.S. is above average compared to other countries.

A variety of reasons were given for problems in U.S. STEM education with no shortage of blame to go around. U.S. adults doled out similar shares of blame to parents not supporting schools, students not willing to work hard enough, teachers not emphasizing the practical uses of STEM topics, teachers overemphasizing standardized testing, and teachers not using appropriate methods for developing critical thinking and problem solving.

Attitudes Toward STEM Education

Most Americans enjoyed math and science in grade school. Funk and Parker (2018) found that nearly 75% of respondents indicated that they liked science classes, partly due to the labs and activities. Even workers in non-STEM occupations noted that they were once interested in a STEM-related area, but the high cost of specialized education and the number of years required in school were both major reasons for taking a different career path. About 68% of respondents indicated that interest in science was a reason they liked science classes, as opposed to liking the class for other reasons, such as having a good teacher. Of those who disliked science classes, close to half of respondents said that it was due to the high level of difficulty and nearly one third of respondents did not easily see how the subject would be useful in the future. Nearly 60% of respondents also said they enjoyed math classes in K–12. Men were more likely than women to say they liked both math and science. Regarding ethnicity, Whites, Blacks, and Hispanics were all similar in likelihood to say that they enjoyed both math and science classes in grade school, with no statistically significant differences by age. Still, at the undergraduate level, in 2016, Hispanic students earned just under 14% of science degrees and 10% of engineering degrees (National Science Foundation, 2019) despite being just over 20% of the undergraduate student population (Bauman, 2017).

Although a large percentage of respondents enjoyed science classes in grade school (the 75% mentioned above), there are clearly other factors contributing to the pursuit of a STEM degree in college as STEM majors do not represent 75% of all college degrees. In other words, interest alone does not result in pursuit. About 41% of respondents said that they began to seriously consider a STEM field while in high school, college, or in their twenties. In addition to perceived costs of time and money for pursuing a STEM degree, other dissuading reasons included changes in interests, difficulty in STEM classes, perceived gender obstacles, and family or personal circumstances.

Connecting Expectancy-Value Theory with Cultural Capital Within the STEM Pipeline

The responses indicated above regarding STEM attitudes are collectively represented as constructs in the expectancy-value theory (EVT) of achievement motivation (Eccles et al., 1983) including expectancies of success, interest, enjoyment, usefulness, and perceived costs. In light of this overlap, a closer examination of EVT is warranted. Figure 1.1 visually represents EVT as a linear, two-dimensional theoretical model. Broadly, the elements of the model are sequential from left to right, beginning with *Cultural Milieu* and ending with *Achievement-Related Choices and Performance*, such as the choice to persist with a short- or long-term academic task. Most studies exploring EVT focus on the right side of the model, examining the influences of expectancy of success and subjective task value on achievement-related choices and performance. Implied in the model is that the initial presence and impact of cultural milieu, including three specified elements: gender and other social role systems, stereotypes of activities and the nature of abilities, and family demographics, are foundational relative to other conceptual components in the model. However, the model is complex and Eccles has articulated that achievement choices happen *within* cultural and social structures, not apart from them (IPPE, 2019). Eccles and Wigfield (2020) recently provided a more sophisticated iteration of EVT, now *Situated* EVT, more clearly positing that achievement motivation is both situationally specific and culturally bound. As a potential contribution to this theoretical evolution, this study offers two ideas. First, cultural milieu, as a sociocultural environment, would more explicitly include a fourth element: development of cultural wealth. Cultural wealth is dynamic in its influence on achievement-related choices such as persistence, not limited to placement in a single box, but ever-present, as suggested by *S*EVT. For example, a study by Pérez Huber (2010) found that the value of a college degree, in general, for Latinas was about much more than an economic payoff. The study described college degrees as ‘papelitos,’ or symbolic representations of collective struggle for families and communities. College degrees, as symbolic papelitos, are the product of capital conversion, such as aspirational capital, familial capital, navigational capital, and resistant capital. These are types of capital described in Yosso’s (2005) Community Cultural Wealth Model (CCWM). Second, if achievement choices are, indeed, situationally specific and culturally bound, then cultural wealth, expressed as the capitals just mentioned, may moderate the relationship between expectations of success, subjective task values, and achievement choices (see Figure 1.2). More specifically, cultural capital may moderate undergraduate Latina/o/x students’ achievement choices such as persistence in their STEM major.

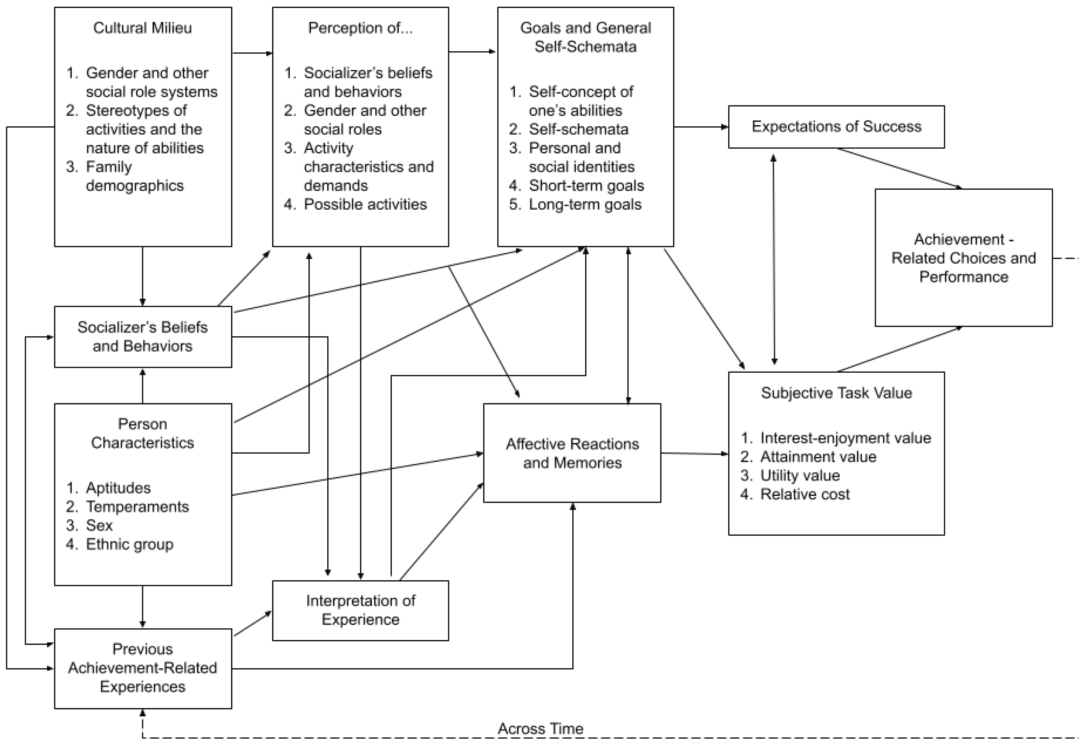


Figure 1.1

Eccles Expectancy-Value Model of Achievement Choices
Note. Re-created from Eccles & Wigfield (2020).

The Present Study

Given the importance of a diverse STEM workforce and given the need for institutions of higher education to evaluate the manners and magnitude of how they are serving underrepresented students, student persistence in STEM majors is a logical place to focus. In particular, HSIs should consider how they are evaluating their sense of service, especially given that federal funding for HSIs explicitly lists STEM access and attainment as a goal (US DOI & HACU, 2012). Many studies have been conducted on ways to improve college student engagement, retention, and persistence, including studies within the HSI setting as well as studies analyzing how academic motivation contributes to student success. Many of these studies even include culture, race, or ethnicity as a categorical variable to better understand potential differences among sociodemographic groups. Yet, little has been done to do put these three pieces together— HSI, achievement motivation, and culture—in the manner contained in this study, much less combined these pieces in a STEM context. This study's findings resulted in a discussion for how HSIs might improve purposefully serving Latina/o/x students beyond simply enrolling them, specifically in STEM fields.

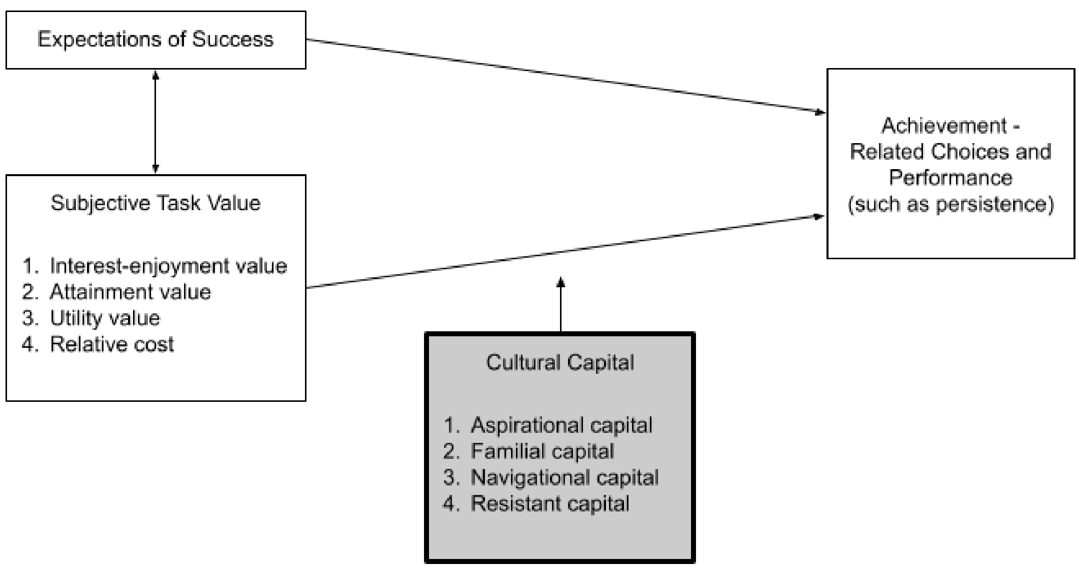


Figure 1.2

Expectancy-Value Model of Achievement-Related Choices Moderated by Cultural Wealth

Study Purpose and Research Questions

This study utilized a quantitative approach to explore the associations between elements of expectancy-value theory as independent variables and first-year Latina/o/x students' intentions to persist in their STEM major as a dependent variable, controlling for demographic variables and considering perceptions of CCW capital variables as moderators. The independent variables were expectancy of success, value, and cost. The dependent variable was intention to persist. The moderating variables were familial capital, resistant capital, aspirational capital, and navigational capital. The research questions (RQ) included:

- RQ 1: For Latina/o/x students in STEM majors enrolled at a Hispanic-serving institution, what are the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 2: In what ways do perceived CCW capitals, including familial capital, resistant capital, aspirational capital, and navigational capital moderate the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 3: Do the findings for question 2 differ depending on gender, socioeconomic status, or first-generation status?

Delimitations

This study was purposefully designed to collect data in the spring semester because this is a time, especially for first-year students, in which STEM majors can look back on at least one semester of coursework and consider leaning more toward or away from persisting in their STEM degree. The HSI setting was intentionally selected as a type of institution with goals to serve purposefully Hispanic students in STEM.

The Case for 'Latina/o/x'

For this study, the term *Hispanic* would be an easy choice as a demographic descriptor due to its direct usage in the term *Hispanic-serving institution*. Hispanic is a label first adapted by the U.S. government for the 1980 Census (Delgado-Romero et al., 2006). As an alternative, *Latinx* is an emergent cultural identifier which, for some, communicates increased inclusivity. The Oxford dictionary (n.d.) defines *Latinx* as a gender-neutral term encompassing persons of Latin American descent, but the Oxford citation and the U.S. government are admittedly sources of convenience which reduce the complexity of the term and highlight a potential lack of authentic understanding. It is not my intention to misrepresent or minimize the complex intersectionality of gender, language, race/ethnicity, and nationality through an assumed understanding of the term *Latinx* or by reducing a diverse people group as all being *Hispanic*. Salinas (2020) articulated the complex overlap of geographic origins or people groups, historical term usage, similarities and differences in written and spoken languages, and study participants' own voices regarding the term *Latinx*. For these reasons, among others, Salinas recommended simply using *Latin* in spoken communication and *Latin** in print to correspond with the many ways the asterisk (*) is used to expand search terms and encompass numerous possibilities. However, after all considerations, in a humble effort to honor people who identify both traditionally and nontraditionally, I use the term Latina/o/x when referencing the population of interest in this study unless using specific terminology from cited literature such as Hispanic or Chicana/o/x.

Organization of the Dissertation

Chapter 2 of this dissertation reviews salient literature with primary regard to the HSI context and the theoretical framework. Explication of expectancy-value theory of achievement motivation as well as the Community Cultural Wealth Model (Yosso, 2005) provides a theoretical foundation leading to the study methodology. The review of literature related to the two components of the theoretical framework is embedded within the framework sections. Chapter 3 details the methodology used in this study including the study design; population, sample, and recruitment; instrumentation and instrument analysis; data collection materials and procedures; data analysis plan; limitations; and ethical considerations. In Chapter 4, I present the findings from my study including descriptive statistics, instrument properties, and regression results. Chapter 5 concludes this paper with discussion of the results, implications for theory and practice, study limitations, and recommendations for future empirical directions.

2. LITERATURE REVIEW

This chapter is a review of literature in the key areas related to this study. First is a review of the development and evolution of the study context, a Hispanic-serving institution (HSI). HSIs are enrolling a growing percent of Latina/o/x students and are being more closely examined for the ways in which they are conceptualizing and operationalizing the S in HSI (Garcia, 2019). Although *servingness* is evident in increased Latina/o/x student degree attainment, there is still a representation gap between Latina/o/x and non-Latina/o/x students (i.e., Asian and White) in STEM. This chapter highlights the efforts to improve institutional retention and student persistence for Latina/o/x students in STEM, which all appear to be connected by the theme of strengthening STEM identity. A closer examination, then, of Latina/o/x student STEM identity reveals potential associations with elements of cultural capital as described in the Community Cultural Wealth Model (CCW) (Yosso, 2005).

This chapter also provides a foundational understanding of CCW as one part of the theoretical framework and reviews the literature for the ways in which it has been applied in the higher education setting. This is followed by the second piece of the theoretical framework regarding achievement motivation. The focus is on expectancy-value theory (EV) (Eccles et al., 1983; Eccles & Wigfield, 2020) which includes constructs related to STEM identity as well as cultural capital. This section includes how race/ethnicity and culture have been explored in prominent motivation theories and then reviews the literature for how EV constructs are related to STEM achievement and persistence. After discussion of each of the theoretical frameworks, I incorporate a review of related studies within each theory/model. The chapter concludes by proposing the exploration of a theoretical bridge between the CCW model and EV theory.

Hispanic-Serving Institutions

Development of Hispanic-Serving Institutions

The Hispanic-serving institution (HSI) designation is a relatively new term in the historical context of higher education. Through Title III of the Higher Education Act of 1965, some institutions of higher education became eligible for special funding due to their historical mission to serve minority students. Although the Hispanic Association of Colleges and Universities (HACU) was founded in 1986 and the term “Hispanic-serving institution” was coined (Santiago, 2006), it was not until the 1992 reauthorization of the Higher Education Act of 1965 that the Hispanic-serving institutions (HSIs) designation became official through instrumental support from the HACU (HACU, 2017). This development was not an organic evolution in higher education but a decades-long pursuit of educational equity by committed Latino leaders and advocates (Valdez, 2015).

Postsecondary institutions are broadly eligible for the HSI designation by the Department of Education if the institutional undergraduate enrollment is at least 25% Hispanic (U.S. Department of Education, 2016). Institutions may financially benefit from the HSI designation through awarding of funds to meet the goals established in the Memorandums of Understanding (MOUs) between the HACU and various federal agencies, organizations, and strategic partners. The two overarching goals of the MOUs are to assure educational access and expand career opportunities for the students served at HSIs, especially careers in STEM fields (U.S. DOI & HACU, 2012). HSIs have historically been broad access, more affordable institutions (Santiago, 2006) which increase access to higher education. Admitted students to less selective institutions are often lower-income, first-generation, and deemed less academically prepared, which can all negatively impact graduation rates (Rodriguez & Kelly, 2014). However, there are a growing number of HSIs across the country that are more selective, *R1* institutions (i.e., engage in very high research activity) (Center for Postsecondary Research, n.d.; HACU, n.d.a.). A narrow, negative historical view is that HSIs can *either* provide broad access *or* increase graduation rates. Findings from this study support an alternate *both-and* view by taking the more positive position that institutions can *both* increase access *and* increase graduation rates, particularly in STEM, through a better understanding of Latina/o/x students' CCW capital assets.

HSIs are different than other minority-serving institutions such as Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs) in three main ways. First, HBCUs and TCUs are guaranteed federal funding due to historic systematic exclusion of student access to other institutions. HSIs, however, are based on Hispanic-student enrollment, not historic discrimination, and their funding is competitive. Second, the number of HBCUs and TCUs has remained relatively stable, but the number of HSIs is steadily increasing (Garcia, 2019). By the 2018-2019 academic year, 539 colleges and universities had qualified for the HSI designation enrolling approximately two-thirds of all Hispanic undergraduate students in the U.S. and representing approximately 17% of all institutions of higher education (HACU, n.d.a.). Third, the total student enrollment at each HBCU and TCU is relatively small, but the enrollment at an HSI can be quite large and include a significant Black and Native American population, making the institution very diverse.

Unlike other minority-serving institutions such as HBCUs, HSIs are not guaranteed to receive federal funding. Instead, HSIs are eligible to apply for competitive grants which can improve their capacity to serve Latina/o/x students. The number of HSIs has nearly doubled over 20 years since 1994 (Calderón Galdeano et al., 2014; Garcia, 2019) and the unfortunate challenge is that if federal allocation amounts for HSIs become static, then funding will become more competitive as the number of HSIs increases. To remain competitive for HSI federal funding, it will be important for HSIs to continue to broaden their understandings about what it means to serve students effectively. The next section explores the concept of *servingness* and HSI organizational identity.

HSI Organizational Identity and the Concept of Servingness

Some scholars believe the HSI designation is manufactured and arbitrary (Contreras et al., 2008), while others believe that there are clear institutional commitments to community, access, and diversity (Garcia, 2013). Several sources of information may reveal the institution's attention and commitment to the HSI status such as the language used in an institution's mission statement or department goals and the extent to which culturally inclusive or culturally sustaining practices are evident in campus resources and classrooms (Malcom-Piqueux & Bensimon, 2015). Faculty composition may also contribute to HSI identity because minority or mixed-heritage faculty identify with challenges that Hispanic students face and subsequently tend to advocate for minority student needs (Murakami-Ramalho et al., 2010). Some HSIs may be considered "intentional" HSIs with a higher likelihood of ethnocentric content and other HSIs may be considered "incidental" by virtue of enrollment (Cole, 2011). Even with these sources of insight, the S—or serving—component of HSI is subjective and may carry different meanings for different post-traditional minority-serving institutions. For federal government purposes, S is measured in terms of undergraduate Hispanic enrollment at an institution and often judged by the institution's correlated graduation rates. However, because low-income status and first-generation status of Hispanic students can both contribute to lower graduation rates (Rodriguez & Kelly, 2014), perhaps S can and should mean more (Garcia & Okhidoi, 2015). Using a social constructivist perspective, Garcia (2016) challenged the notion of S being limited to enrollment and graduation rates. This pursuit of service and redefinition is not without tension as institutions navigate creating a balance between access and excellence (Doran, 2015). Instead of measuring service strictly in terms of numbers of students enrolled and numbers of students graduating, emergent ideas associated with an institutional serving identity include providing a regional access focus to enrollment, giving back to the community, connecting with students on a cultural level, seeing students as co-creators of knowledge, and believing that all students can be successful (Garcia, 2016).

Garcia (2017) published a typology matrix (see Figure 2.1) to help conceptualize the variations of service for HSIs. This matrix allows for the coexistence and continuum of both federal and non-federal types of organizational identities. Therefore, based on the Garcia (2017) typology, service is operationalized as the intentional institutional practices and policies which meet students' unique social, emotional, and cognitive needs and support student advancement toward a degree. Related to this typology, two areas of momentum are increasing in HSI contexts: serving Hispanic students through institutional outcomes in terms of graduation rates and serving Hispanic students through institutional culture. Garcia et al. (2019) reviewed 148 publications for ways in

Organizational Outcomes for Latinx Students			
	High	Latinx-Producing	Latinx-Serving
	Low	Latinx-Enrolling	Latinx-Enhancing
		Low	High
		Organizational Culture Reflects Latinx Students	

Figure 2.1

Typology of Hispanic-Serving Institution Organizational Identities
Note. From Garcia (2017).

which institutions serve Hispanic students and generated a model (see Figure 2.2) for conceptualizing service in a more comprehensive manner than the Garcia (2017) two-by-two typology of HSIs. Garcia (2018) posited that processes for persistence and completion are more complex for students of color than for White students, which is an important reason to pursue what works best for Latina/o/x students.

Understanding the connections between HSIs and Latina/o/x self-concept is also important given the strong relationship between self-concept, academic achievement, and student retention (Cuellar, 2014). Cuellar found that even though Latina/o/x self-concepts were very low when entering HSIs compared to their non-HSI peers, their self-concept showed more increase over the course of their education than their non-HSI peers, suggesting that institutional factors may play a role in supporting growth for Latina/o/x students' academic self-concept.

Despite the ways that institutions are making efforts to serve their Latina/o/x students, there is continued underrepresentation of Latina/o/x students in STEM majors and STEM fields (Chen, 2009; Provasnik et al., 2012; Wai et al., 2010). The Garcia et al. (2019) servingness framework goes so far as to explicitly list STEM degree completion

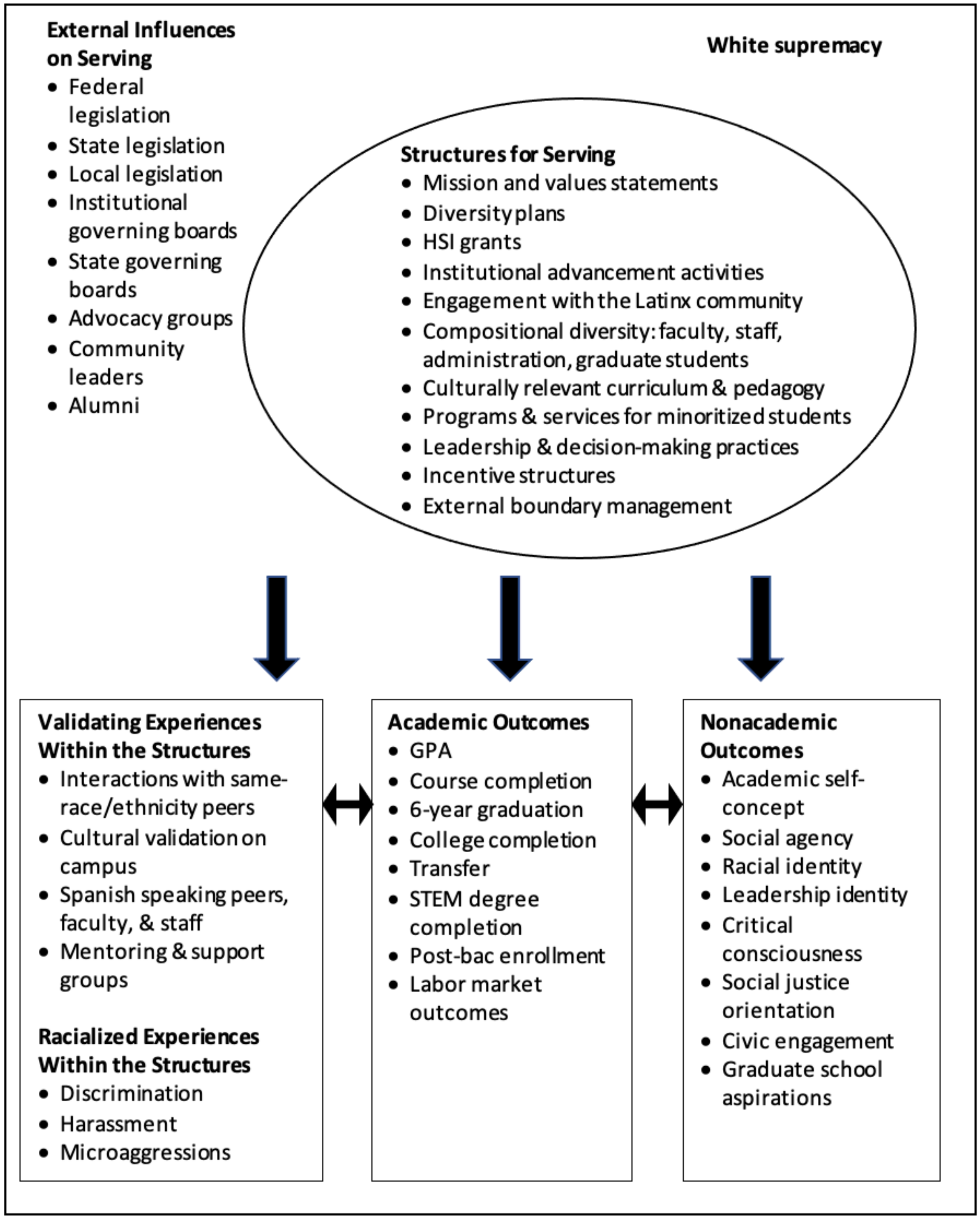


Figure 2.2

Multidimensional Conceptual Framework of Servingness in HSIs
Note. Recreated from Garcia et al. (2019).

as an academic outcome as opposed to listing other disciplines. This aligns with one of the Title V HSI goals to increase career opportunities in STEM fields (US DOI &HACU, 2012). The next section conceptualizes identity and contextualizes STEM identity within efforts to close representation gap of the Latina/o/x population in STEM.

The Importance of Strengthening STEM Identity for Latina/o/x Students

Identity and Intersectionality

Identity is precisely recognized as a singular term but is not operationalized in a singular manner. Individuals operationalize a number of identities which are fluid and evolving over time (Gee, 2000). Burke (2003) organized the interplay of identities in three broad ways. First, there is personal identity, which is highly individual and self-defined by characteristics and experiences. This may include beliefs such as "I am caring," "I am shy," or "I am adventurous." Second, there is social identity, which is collective/group-oriented and defined by shared experiences, histories, and membership. This may include associations such as "I am a member of this family," "I belong to this church community," "I associate with the LGBTQ community," or "I am a proud Mexican American." Third is a situational identity characterized by context and role. This may include associations such as, "I am an engineering student," "I am a sister," or "I am an activist." Further, there is not a limited identity selection from each of these three types. Indeed, an individual may claim all of the examples listed above and more such as, "I am a caring, adventurous Latina pre-med major with a supportive family that I get to see every week at our church."

Identities are complex and will mutually influence one another (Crenshaw, 1991; Patton et al., 2016). The saliency of any one identity is also context-dependent and might be described as situative because identities are underwritten with meaning through interpretive systems such as those which are historical, cultural, or institutional, for example (Taylor, 1994). The complexity of identity intersectionality also influences the short-term and long-term choices people might make. When faced with important life choices, developmental processes such as commitment and exploration (Marcia, 1993) will lead to selection and integration of one's personal goals and values that subsequently influence information gathering and reflection about the self and the situation.

The intersectional nature of identity heightens awareness of the need to critically interpret findings in education research because we cannot control for all of the different identities influencing participant data. Research will often reduce identities to broad nominal categories such as gender, race/ethnicity, and socioeconomic status which consequently returns broad findings. Even more, in studies with small samples, researchers may aggregate the data of underrepresented populations of color in order to increase statistical power which limits the insight on unique subpopulation experiences (Revelo & Baber, 2018). The omnipresence of intersectionality means that interpreting findings should be given care. This becomes even more urgent from a social justice orientation when the intersection of identities overlaps a continuum of privilege or disprivilege. For example, underrepresented students' STEM career aspirations decline over the course of high school, which is negatively amplified when the student is described as having a multiple URM (underrepresented minority) status (Saw et al., 2018) such as low socioeconomic status *and* Latina/o/x *and* female.

STEM Contextualization. One type of contextualized identity is STEM identity which is a prominent theme in the literature explaining the gap in STEM achievement for underrepresented populations. Hazari et al. (2010) framed the concept of a disciplinary identity, focused on a STEM context, with three points: performance-competence (perceptions of one's ability to both do and understand science, respectively), personal interest in the subject, and recognition (recognition by others as "being a science person"). These elements have similar qualities as the expectancy-value achievement motivation theory elements of perceived ability, interest/intrinsic value, and attainment value, respectively, discussed in more detail in a subsequent section.

The STEM identity framework of interest, recognition, and performance-competence is influenced by psychological, contextual/environmental, and cultural factors (Collins, 2018). STEM interest may be increased by informal science experiences before or during college, but even informal learning opportunities and informal science education (ISE) institutions such as at zoos or museums can alienate marginalized groups through unwritten expectations of visitors' scientific knowledge, language, and finances. Dawson (2014) conducted a qualitative, exploratory, ethnographic study in London with participant groups from Sierra Leone, Somalia, Asia, and Latin America. One theme was that participants felt that ISE institutions were "not for people like me." Experiential differences, such as frequenting ISE institutions, can influence conceptual scientific understandings (Cavallo et al., 2004; Chambers & Andre, 1997) which impact a student's perceived ability to both understand and do science. These self-beliefs about performance and competence impact beliefs about STEM career choice and beliefs about attainment (Moakler & Kim, 2014). For example, Seo et al. (2019) conducted a path analysis using data from the Education Longitudinal Study of 2002 (ELS:2002) and found that 10th grade math self-concept was positively related to both 10th grade math achievement as well as subsequent STEM career expectancy in college, college STEM achievement, and adulthood STEM career attainment.

Historically, STEM education has not represented Latina/o/x identities in scientific discovery, so Latina/o/x students do not tend to envision themselves as scientists (Guerra & Rezende, 2017). However, a student's belief about themselves can be influenced by how others see them (recognition), especially when the others are their parents (e.g., Jacobs & Eccles, 2000). Talking about science at a young age with close family was found through quantitative analysis to be predictive of Latina/o/x STEM identity in college (Dou et al., 2019; Dou & Cian, 2020). Gender is also a well-established predictor for Latina/o/x student STEM success. Castellanos (2018) found in a survey study of Latinas at predominantly White institutions (PWIs) in California that STEM career interest and goals were influenced by campus climate, academic involvement, and faculty support and encouragement. Friedensen et al. (2020) noted that "navigating hostile or indifferent climates in engineering makes it more difficult for women and students of color to develop their engineering identities" (p. 106). Especially for females, subjective and utility values, performance and ability, others' perceptions, effort, and stereotypes were also all found to contribute to their choice of major (Sullins et al., 1995), and are all elements related to STEM identity and expectancy-value theory of achievement motivation. The next section provides empirical findings supporting the ways in which strengthening STEM identity is operationalized and implemented.

STEM Identity in Predictors of Latina/o/x Student STEM Choice and Success

Pre-college factors known to predict Latina/o/x student STEM major and success include but are not limited to student interest and confidence, standardized test scores, achievement in math and science coursework, high school grade point average (GPA), Scholastic Aptitude Test (SAT) math scores, placement in less rigorous coursework, and parental STEM degree status (Crisp et al., 2009; Hinojosa et al., 2016; Sahin et al., 2018). Some in-college factors known to predict Latina/o/x student STEM major and success are student entry points (university/community college), over-placement in developmental coursework, rigorous STEM gatekeeper courses, first semester GPA, enrollment status (full-time/part-time), first-generation status, English language skills, and the financial burden associated with requiring more time to complete the degree (Bayer Corporation, 2012; Crisp et al., 2009; Jackson et al., 2013; Winterer et al., 2020, Villarreal & Cabrera, 2012). Findings related to student interests and perceived competence, which may be influenced both by achievement scores as well as course placement, show that elements of STEM identity predict STEM choice. If STEM identity is important in even *selecting* a STEM path, then STEM identity may also be important in *persisting* on that path.

STEM Identity in STEM Retention Practices with Latina/o/x Students in College

More than half of college students in engineering leave or change this major during their first year (Chen, 2013; Marcus, 2012). Hrabowski (2014) suggested that only 20% of those who aspire in this area actually succeed. Institutional interventions have shown success with retaining Latina/o/x students in STEM majors such as student empowerment workshops. For example, in a survey study of nearly 100% self-identified Hispanic students in a South Texas HSI, Casey et al. (2019) measured the effectiveness of a STEM retention intervention and found that a series of workshops which increased exposure to types of STEM jobs and opportunities improved learning for Hispanic STEM students and was effective in helping students to consider additional STEM options they were previously unfamiliar with. STEM connectedness also shows particular benefit to Hispanic students as well as other underrepresented student groups. In a review of the Cooperative Institutional Research Program's *The Freshman Survey* and the *College Senior Survey* data across 217 institutions with a diverse sample, Chang et al. (2014) found that underrepresented students who participated in STEM research and joined a STEM related student group were more likely to persist in STEM. Similarly, Dagley et al. (2016) found that at an HSI (University of Central Florida), women, African Americans, and Hispanic students all showed higher retention and graduation in STEM majors for students who participated in the EXCEL learning community, which combined residential/social and curricular components. As it relates to STEM identity, participation in STEM learning communities likely strengthens a student's sense of interest and recognition as students share common interests.

Experiential learning, such as faculty research project immersion with lab activities and close mentoring can also improve recruitment and retention for underrepresented populations in STEM, including Hispanic students. For example, a longitudinal study of 1,420 minority science students from 50 universities across the United States, of which 47% were African American and 40.3% were Hispanic, revealed through structural equation modeling that two semesters of research experience uniquely predicted overall science self-efficacy, identity, and values (Estrada et al., 2018). More importantly, the identity measure further positively predicted choosing a STEM career four years after graduation. Jin et al. (2019) utilized several quantitative measures to evaluate the impact of the Training in Environmental Research and Academic Success (TIERA) program at the University of Texas at El Paso (an HSI), which included increasing research experiences and creating STEM learning communities, on Hispanic student future career goals as environmental scientists. Findings showed that all students "agreed" or "strongly agreed" that doing research through the program confirmed their interest in the field of study and, on average, students were "more likely" to enroll in a graduate level STEM program. Findings also revealed that students became more confident in their ability to contribute to science and do well in future science courses. Similar to the TIERA project, the Course-based Undergraduate Research Experiences (CURE) program, in which students complete research projects, aimed to increase STEM persistence and retain diversity in the STEM pipeline. Shuster et al. (2019) evaluated the effectiveness of CURE at a land-grant HSI in the Southwest in which 86% of participants were Hispanic. Survey results indicated statistically significant increases in students' scientific self-efficacy, scientific identity, and scientific community values. Noteworthy was the statistically significant increase on intention to persist in STEM, specifically the intention to pursue a science-related career. Regarding STEM identity, experiential learning is a way to affirm student interests as well as boost confidence in science-related skills.

Sense of belonging has also been shown to improve STEM retention for URM students. For example, using a qualitative survey, Tomasko et al. (2016) found that the Ohio's Science and Engineering Talent Expansion Program summer bridge program at The Ohio State University statistically significantly improved STEM identity and subsequent STEM coursework success related to a sense of belonging for program participants compared to non-participants, including a greater difference for URM students in the program compared to URM students not in the program. Qualitative data from this study support existing theory suggesting that students' sense of belonging impacts their success (e.g., Tinto, 2010), including in STEM areas. The STEM identity aspect of recognition—being seen as a "STEM person"—is likely enhanced when sense of belonging increases.

More recently, Starr et al. (2020) tested a path model relating scientific classroom practices and experiences with students' STEM motivation (expectancy-value constructs), STEM identity, STEM career aspirations, and course grades. Participants included primarily second- and third-year students enrolled in several gateway biology courses at a large R1 HSI, 25% of whom were Hispanic. Controlling for a variety of background variables, data revealed that performing scientific practices statistically significantly predicted STEM motivation and STEM identity, mediated by recognition as a scientist, more so for URM students than for non-URM students. Even with these successes, the Bayer Corporation (2012) found that STEM retention programs, in general, were more effective for women than for other underrepresented populations, such as Latina/o/x students, and that both explicit and implicit negative biases in STEM fields toward underrepresented populations was still widespread in colleges and universities.

Linking the empowerment workshops, STEM learning communities, and experiential learning is the influence on Latina/o/x student STEM identity including the elements of supporting student interest, bolstering student confidence, and increasing recognition in which Latina/o/x students are viewed as being "science people." Strengthening Latina/o/x students' STEM identity as it relates to family connections (Maltese & Cooper, 2017; Sha et al., 2016) as well as the development of social networks through learning communities and research experiences may strengthen a sense of having usable capital—personal abilities and skills that are usable assets—on the road to academic success. The next section summarizes six types of *cultural* capital, conceptualized as cultural wealth, in the Community Cultural Wealth Model (Yosso, 2005).

Theoretical Framework Part I: Community Cultural Wealth Model

Tara Yosso, in a foundational 2005 text, presented a research agenda to "document and analyze the education access, persistence, and graduation of underrepresented students" (p. 73). What accompanied this agenda was the Community Cultural Wealth Model (CCWM). Community cultural wealth (CCW), as opposed to traditionally White middle class normed cultural capital, is "an array of knowledge, skills, abilities, and contacts possessed and utilized by Communities of Color to survive and resist macro and micro-forms of oppression" (Yosso, 2005, p. 77). The CCWM was informed by critical race-related theoretical models from the 1960s and 1970s and currently draws from five tenets of Critical Race Theory (CRT) (Solórzano, 1997, 1998), citing key scholars underpinning each tenet. One, there is intersectionality in oppression (Crenshaw, 1989, 1991) which negatively amplifies inequalities, inequities, and racism. Two, dominant ideology must be challenged, including White privilege and claims of objectivity (Ladson-Billings, 2000). Three, there must be an ongoing commitment to social justice (Freire, 1970; Ladson-Billings & Donner, 2005). Four, the experiential knowledge of people of color (POC) is both legitimate and necessary for understanding, analyzing, and teaching about racism (Delgado-Bernal, 2002). Five, CRT is transdisciplinary (Delgado, 1992) for both time and context. Guided by these tenets, CRT validates and centers the experiences of POC and utilizes transdisciplinary approaches to link theory with practice (Yosso, 2005).

Yosso asserted that in education, one of the most prevalent forms of contemporary racism continues to be deficit thinking (see Valencia, 1997). In other words, if we subscribe to a banking model of education (Freire, 1970), we may believe that learning is unidirectional in which learners are open containers, passively waiting for a deposit from the instructor. Some learners may need more deposits than others because they are seen as having “less than.” This is aligned with Bourdieu’s representation of cultural capital, also deficit-based, in which students who come from working class (lower class) families do not have the same type or amount of valued cultural capital as students from middle and upper classes (Bourdieu & Passeron, 1977). Bourdieu depicted cultural capital as an exclusionary advantage that privileges the middle and upper socioeconomic classes toward tangible academic success. Although Bourdieu intended to critique the education system for being complicit in reproducing societal disparities, Bourdieu’s theory has ironically become utilized as a ‘how-to’ model (Yosso & Burciaga, 2016) for accomplishing such reproduction.

For the Chicana/o population, cultural deficit models point to dysfunction in cultural values, such as emphasis on cooperation over competition, as contributing to low educational and occupational attainment (Yosso, 2006). Cultural deficit models also imply that Chicana/o social structures are also problematic claiming that large, disorganized, female-headed families along with nonstandard English spoken in the home result in and continue a culture of poverty. Further, a cultural deficit model holds that families of color fail because they do not assimilate and embrace the educational values of the dominant group which consequently reduces educational mobility (Solórzano & Yosso, 2001; Yosso, 2006).

Forms of Cultural Capital

As an alternative to deficit thinking, Yosso (2005) offered transformative thinking. For example, the term *cultural differences* in schools goes widely unexamined but can have racially grounded deficit thinking as its undercurrent. The CCWM provides a way of thinking about cultural differences that legitimizes the "behaviors and values that are learned, shared, and exhibited by a group of people" (Yosso, 2005, p. 75). For people of color, culture often encompasses multiple identities and is often represented symbolically in language. For students of color, culture nurtures and empowers them using communal *funds of knowledge* (Moll et al., 1992). Another way to think about cultural wealth through the lens of CRT is "the sense of group consciousness and collective identity" that serves to support "the advancement of an entire group" (Franklin, 2002, p. 177). Cultural capital may broadly be understood as "the kinds of knowledge and skills a person brings to bear on a situation" (Dawson, 2014, p. 985). Yosso (2006) made the distinction, though, that *wealth* is the accumulated assets or types of capital which work together and is meant to be shared. Students of color can "draw on diverse community and cultural resources that are often ignored in capital research focused on White middle-class culture" (Duncheon, 2018, p. 361). The six main types of cultural capital which contribute to CCW (Yosso & Solórzano, 2005; Yosso, 2006; Yosso & Burciaga, 2016) are as follows:

- *Aspirational capital* refers to the ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers. Aspirations are linked to familial desires beyond present circumstances for children to reach dreams goals that the parents did not, often “without the resources or other objective means to attain these goals” (Yosso & Solórzano, 2005, p. 130). Aspirational capital is seen as resilience in the form of “a disposition toward success” (Samuleson & Litzler, 2016, p. 97).

- *Linguistic capital* includes the intellectual and social skills attained through communication in multiple languages and/or language styles (including communication through art, music, poetry, theatre, and dance). The prevalence and importance of storytelling helps to develop memorization skills, attention to detail, and awareness of different audiences.
- *Navigational capital* refers to skills in maneuvering through social institutions. This implies a resilience in the form of skills and abilities to maneuver through institutions not historically created with communities of color in mind. This capital recognizes that individuals still have agency even in the face of systemic constraints, especially through the utilization of social networks.
- *Social capital* can be understood as networks of people and community resources that assist in the navigation through social institutions. The sharing of rich resource information happens in social spaces which is a reminder that people are not alone in their struggles.
- *Familial capital* refers to those cultural knowledges nurtured among familia (kin) that carry a sense of community history, memory, and cultural intuition. There is a commitment to community well-being that occurs both within and between families as well as through church, sports, school, and social community settings. This capital contributes to the strength of social networks.

- *Resistant capital* refers to those knowledges and skills which increase awareness of forms of oppression, and which foster oppositional behavior and thinking that challenge inequality. This includes resisting self-doubt and imposter syndrome in academic spaces, accompanied by a desire to prove others wrong.

Review of Literature: CCW in Higher Education

To date, the literature on CCW has centered on Latina/o/x cultural wealth in which students bridge the space between home and school, bringing their cultural knowledge to the educational spaces and bringing school-based knowledge to their home and communities (Salinas, 2020). Even so, the CCWM seems to allow room for additional types of capital as it may be applied and studied with additional people groups. The forms of capital are "not mutually exclusive or static, but rather are dynamic processes that build on one another" (Yosso, 2005, p. 77). This interdependence—capitals working in tandem—is often evidenced being leveraged to access academic opportunities and move students toward educational success.

The CCWM has been applied in a variety of higher education contexts including high school-to-college transition, persistence in undergraduate studies, and persistence in graduate school. Findings from several studies highlighted the interconnected nature of types of CCW as it relates to persistence, the outcome variable in this study (intention to persist). For example, in a qualitative case study of migrant farmworker students at an HSI in the Southwest, Araujo (2012) found through interviews and a focus group that one participant's (Santiago, a pseudonym) first-year success in college was connected to several types of cultural capital. These capitals worked together including unconditional familial support, collective familial aspiration for Santiago to be successful, and collective resistance to the status quo that suggested Santiago's lack of English language was too great a barrier for college success. In a qualitative case study of eight first-generation Latinx students from a low-performing urban high school, Duncheon (2018) found that during the first year of college at their respective institutions, students who recognized their lack of academic preparation tapped into their navigational abilities to identify and utilize institutional supports, motivated by aspirations, in order to be successful. Findings from Liou et al.'s (2009) mixed methods study supported the notion of capital interconnectedness as high school students with a strong sense of social, familial, navigational, and resistance capital felt well prepared for college. A combination of aspirational capital and resistant capital was associated with increasing motivation to succeed, what Liou et al. (2009) called "marginalization as motivation" (p. 546), echoing hooks's (1990) position that the margin can be a space for generating hope and transformational resistance. Liou also found that social capital developed through relationships formed in religious communities supported Latina/o student persistence. Through interviews in a qualitative study, Sánchez-Connelly (2018) found that first-generation Latinx undergraduate college students utilized social, resistant, and aspirational capital to manage and be successful in racially challenging academic environments at PWIs. Participants manifested social capital by either creating or joining counter spaces at their respective campuses in order to bolster emotional support. Participants transformed aspirational and resistant capital into self-affirming narratives of believing in themselves.

In graduate school, aspirational and resistant capital were shown to be interdependent as students pushed to learn, do, and be more. In a qualitative study of 33

Mexican American participants who earned doctoral degrees, Espino (2014) found that aspirational capital alone was not perceived as sufficient for sustaining perseverance through graduate school. One participant transformed resistant capital into perseverance through a desire to "prove them wrong" (Espino, 2014, p. 561). Another participant accessed her social network (social capital) to strengthen her ability to traverse the doctoral application process (navigational capital). One third of participants shared that they revisited previous fears and doubts regarding their academic abilities which were subsequently alleviated by strong, positive relationships with both family and academic advisors.

The CCWM has also been used in studies to analyze behaviors of faculties of color. Martinez et al. (2017) found in a qualitative study that assistant professors of color (APOC) faced stereotype threat and ongoing microaggressions from both students and other faculty. The participants, which included a cross section of races/ethnicities, a diverse set of academic fields, and varied postsecondary settings, regularly used resistant, social, and navigational capital to deal with racism and marginalization. For example, one Latina APOC who was hired to advance critical conversations about race and racism was accused by students of *being* racist. Although she did not feel entirely supported by her program coordinator, she persisted with her teaching, leaned into other faculty of color for support, and slowly began to see change in students' beliefs about diversity and social justice.

CCW Applications in the Higher Education STEM Literature. As CCW applies to STEM in higher education, there is evidence of cultural capital interconnectedness. In a qualitative study of 14 Black STEM major students, navigational capital coupled with resistant capital led to stronger performance-competency aspects of STEM identity (Ortiz et al., 2019). One computer science participant noted that through the process of seeking help, he realized, "...how strong I'm able to become, the potential growth that I can achieve..." (p. 319). Samuelson and Litzler (2016), in a large mixed methods study of undergraduate engineering students across 11 universities and different geographic regions, found that more than 60% of engineering students of color made reference to both navigational capital and aspirational capital with regard to their persistence. Additionally, the authors highlighted the interactive nature of types of capital, that capitals were used in conjunction with one another with regard to persistence in engineering. With that said, this same study also found differences in populations of color with regard to cultural capital and persistence. African American males referenced resistant capital far more than did African American females or Latina/o/x males, and African American females referenced navigational and aspirational capital far more than Latina/o/x females. These differences suggest the need for more exploration. A major methodological limitation to this study, however, is the use of secondary qualitative analysis; the original data were collected to examine the climate in undergraduate engineering with foci on persistence, women, and URM students. The literature would benefit from a more purposeful methodology using instrumentation intended for assessing perceived cultural capital.

Another qualitative study analyzed the experiences of first-generation engineering transfer students using the CCWM as a theoretical framework, but posited experiential capital as an additional type of capital not described in Yosso's work. By and large, the students attributed successful transfer to their self-motivation associated with this cultural capital than to institutional supports (Mobley & Brawner, 2019). In adhering more strictly to the CCWM, this experiential capital may be considered as related to navigational capital.

Some forms of capital are *emergent* as described in a study of Latina/o engineering students (Revelo & Baber, 2018). For example, collective resistance through membership, such as in a family-like student organization; successive role modeling, such as recalling inspiration from their own role models and then becoming role models to other engineering students; and purposeful community outreach, such as speaking to middle and high school students about STEM were three types of resistant behaviors. However, these were considered *emerging* resistant capital because although the behaviors focused on improving opportunities for marginalized populations, they did so by changing individual and group dispositions to better match norms within the existing structure rather than challenging the structure itself.

In a Denton et al. (2019) meta-review of 33 CCWM studies regarding STEM, findings revealed that studies tended to use qualitative methods (75%) and have a focus on engineering students (45%) within the higher education setting. The meta-review used four inclusion criteria: there were empirical results from an empirical study, the discussion and results included at least one of the six types of CCW capital, the study centrally positioned at least one STEM discipline or STEM education, and the study was published since 2005 citing Yosso's 2005 work on CCW. All but one of the qualifying studies were conducted in the United States. Twelve studies (36%) included all six types of capital and 17 studies (51%) focused more narrowly on three to five types of capital. The majority of studies (82%) were conducted at four-year institutions, although only 3

(9%) were conducted at HSIs. Approximately half of the studies focused on the Latina/o/x population (48%). Conspicuously missing from the review was the list of independent and dependent variables in the quantitative studies. Even so, a search of the CCW literature combined with a search of the EVT literature reveals little in the way of quantitative studies which are both situationally specific and culturally bound such that the methodology considers both of these SEVT aspects. A summary of the available study characteristics is located in Appendix A.

Gaps in the CCW-Higher Education Literature

Nuñez (2009) called for studies regarding the ways in which students access and utilize capital within higher education spaces, calling this the "dynamics of capital conversion" (p. 42). The present study adds to this body of literature because although a number of studies regard CCW capitals *as* motivation (e.g., Liou et al., 2009), none are making explicit connections to motivation theory. Therefore, the next section of this chapter will present the second piece of the study's theoretical framework and review the literature regarding empirical connections between expectancy-value constructs, sociocultural variables, and STEM achievement.

Theoretical Framework Part II: Achievement Motivation Theory

Motivation Theory Landscape

Why do people do what they do, say what they say, or think what they think? These questions have particular prominence in modern educational research in which scholars seek to understand motivation in a variety of contexts and with a variety of lenses. Theories include, but are not limited to, attribution theory (e.g., Graham, 1997; Weiner, 1985), mindset (e.g., Dweck & Leggett, 1988; Yeager & Dweck, 2012; Yeager et al., 2016), goal orientation theory (e.g., Elliot, 1999; Zusho & Clayton, 2011), and control-value theory of achievement emotions (e.g., Fong et al., 2018; Pekrun, 2006; Pekrun et al., 2010). Additionally, scholars attempt to understand motivation within social-cognitive theory (e.g., Bandura, 1977; Cantrell et al., 2013; Lent, et al. 2005); self-determination theory (e.g., Ryan & Deci, 2000), expectancy-value theory (e.g., Eccles et al., 1983), social influence (e.g., Gray et al., 2018; Wentzel et al., 2016), and culture and identity (e.g., Maehr, 2008; Matthews et al., 2014; Rodgers & Summers, 2008).

For purposes of this study, academic motivation, also referred to in this paper as achievement motivation, is operationally defined as "that which influences initiation, direction, magnitude, perseverance, continuation, and quality of goal-directed academic behavior" (Kumar et al., 2018). The phrase "goal-directed activity" is applied in this study to mean longer-range goals, such as the completion of a college degree, as opposed to more immediate choices, such as studying for a test (Graham, 2020). Persistence toward completion of this specific long-term task would necessarily include continued enrollment in required degree coursework. Understanding motivation beliefs and behaviors is important because research reveals that these beliefs and behaviors are positive predictors for student engagement, achievement, and persistence with academic interests (e.g., Eccles & Wigfield, 2002), especially in higher education (for meta-analytic reviews, see Fong et al., 2017; Lazowski & Hulleman, 2016; Richardson et al., 2012; Robbins et al., 2004). It is also important because students' motivation tends to decrease from elementary school through high school (e.g., Jacobs et al., 2002; Lepper et al., 2005, Muenks et al., 2018) which exacerbates the already troublesome issue of undermined motivation in historically underrepresented or marginalized student populations (Gray et al., 2018; Usher, 2018).

Koenka (2020) recently cast a spotlight on three underexplored issues in motivation theory: diversity, methodology, and interventions. The first two are particularly relevant to this study. Koenka noted that more than 95,000 papers are associated with several prominent motivation theories over the past 20 years. While this number is large, the complex nature of motivation means that work is still needed, particularly work that includes greater diversity and a careful consideration of methodology. Very few articles published in top tier educational psychology journals embraced a race-focused or race-reimaged position (DeCuir-Gunby & Schutz, 2014) with the vast majority of participants formally described as European Americans from middle socioeconomic status background, more informally described as White and middle-class. One problem with this is that "Western-centered, value-neutral ideology situates rigid curriculum and inflexible pedagogy as traditions of rigor rather than forms of sociocultural dominance" (Revelo & Baber, 2018, p. 252). Since more than 30% of the current U.S. population identifies as a person of color (U.S. Census Bureau, 2019), it may benefit the larger body of scholarship to pursue additional studies that use a race-focused or race-reimaged approach.

Race, Ethnicity, and Culture Across Motivation Theories. This section considers how race, ethnicity, and culture already appear in several prominent theories because some scholars in the field are asking whether it is time for a more unified theory (Anderman, 2020). With that said, Anderman also stated that there must be theoretical balance with regard to precision, utility, and contemporary context. Perceived reasons for outcomes, such as “Why did I fail that test?” are the foundation of attribution theory, which is widely attributed to, no pun intended, Weiner and colleagues (Weiner, 1986, 1995, 2006, 2018). Scholars do not all agree on some aspects of the theory, particularly the locus x stability x controllability matrix (Dweck, 2006; Weiner, 1986) due to literature which shows that context, such as culture, may play a role impacting elements of this theory (Betancourt & Weiner, 1982; Crocker & Major, 1989; Major & Sawyer, 2009). There have been very few studies over the last 40 years in which race/ethnicity (or culture) have been central to attribution theory research questions (Graham, 2020) suggesting that new research needs to be alert to differences among ethnic or cultural groups for the sake of theory refinement.

Achievement goal theory of motivation emphasizes social-cognitive meanings, including the notion that perceptions, beliefs, and goals are the primary underlying motivating factors (Urdan & Kaplan, 2020) rather than the stability of traits, for example, as seen in attribution theory. Early theorists also emphasized the importance of situational, contextual, and cultural influences on motivation (e.g., Maehr & Braskamp, 1986; Maehr & Midgley, 1996). These assumptions led to the belief that not only is there more than one way to be motivated, but there are also person-specific definitions of success (Urdan & Kaplan, 2020). Subjective differences lead to three general types of goal orientations conceptualized in terms of systems that are influenced by the student’s perception of ego threat, expectation of success, likely behavioral response to any failure, and the student’s identity, which is partially influenced by their cultural background (Urdan & Kaplan, 2020). Urdan and Kaplan (2020) summarized this as “meaning, development, culture, identity, and context” (p. 2). Achievement goal theory is positioned within the view of social justice regarding the development of children of all ability levels and is inclusive of definitions of success and behaviors that are valued in different cultures (Ames, 1992; Maehr, 1974; Nicholls, 1989). There is evidence of differential correlation among ethnic or cultural groups for motivation and achievement constructs (e.g., Kaplan & Maehr, 1999; Midgley et al., 1996; Zusho & Clayton, 2011), but the findings in the literature are not entirely consistent for the extent to which ethnicity, culture, and gender are factors in selecting one orientation over another (Butler & Hasenfratz, 2017; Meece et al., 2006; Zusho & Clayton, 2011).

Self-determination theory (SDT) has scholarly roots in literature from Ryan and Deci (2000) using the terminology autonomy, competence, and relatedness. Autonomy is characterized by a sense of initiative and ownership supported by interest and value, thwarted by external controls; competence by a sense of mastery through opportunity, challenge, and growth; and relatedness by connectedness and belonging as fostered through care and respect (Ryan & Deci, 2017). Academic motivation is impacted by the extent to which these basic psychological needs are met (Ryan et al., 2019). The motivation taxonomy of SDT is conceptualized on a continuum from amotivation (lack of perceived competence, lack of value, and irrelevance) to extrinsic motivation to intrinsic motivation through a process of internalization (Ryan & Deci, 2017). Intrinsic motivation is linked to positive academic outcomes across developmental levels, contents, countries, and cultures (Froiland & Worrell, 2016; Guay et al., 2010; Howard et al., 2017; Manganelli et al., 2019; Taylor et al., 2014). The majority of SDT work is related to creating supportive psychological learning environments. However, even though the *presence* of basic psychological needs may generalize across cultures, that may not mean the basic needs are *valued* the same across cultures (Marcus et al., 1996). That said, SDT studies from collectivist cultures such as Nigeria, India, and Japan (e.g., Sheldon et al., 2009) have shown positive predictive value between the motivational components of SDT and academic outcomes. Still, cultural differences are nuanced and must be treated with sensitivity because identity is intersectional (Ryan & Deci, 2020). The next section focuses on expectancy-value theory as the other main component of this study's theoretical framework.

Expectancy-Value Theory

From the set of dominant motivation theories used in education, expectancy-value theory (EVT) (Eccles & Wigfield, 2020) was selected to help guide this dissertation. EVT includes two general factors which influence achievement-related choices, persistence, and performance: expectation of success (ES), commonly synonymous with self-efficacy, and subjective task value (STV). STV consists of contributing aspects of value including attainment value, interest value, utility value, effort cost, opportunity cost, and psychological cost. Through empirical evidence, some scholars make the argument that costs factor separately from values in their influence on achievement choices and, consequently, that the theory name should be expanded to include *cost* as its own factor (Barron & Hulleman, 2015). For this study, *values* and *costs* are recognized as two aspects of a single net STV, "pros" and "cons," respectively. This approach is consistent with Eccles et al.'s (1983) theoretical model. Regarding STV, Eccles and Wigfield (2020) are careful to point out that there is no assumption of equal weight to the aspects listed in the STV box (refer to Figure 1.1), nor is it an exhaustive list, despite the numbered appearance. Instead, their belief is that "the relative weights of each potential

STV influence are impacted by developmental processes, situational processes, individual differences, and individual by context processes" (p. 3).

This complex model generally "reads" or "moves" from left to right with a socio-cultural grounding as seen in the positioning of *Cultural Milieu* (see Figure 2.3). The model attempts to integrate aspects of different motivation and identity theories, some of which are hypothesized as mediators between an individual's development, formation, and experiences and their ultimate achievement choices. Eccles and Wigfield (2020) updated the theory name to *situated expectancy-value theory* (SEVT). This addition reflects their beliefs that the range of options an individual considers in any given situation is limited by prior experience as well as by the cultural norms, values, and characteristics surrounding the individual as they mature over time. In other words, "SEVT is both situationally specific and culturally bound" (p. 2). These two components, "situationally specific" and "culturally bound," guided my decisions for defining the variables and parameters in this study.

Despite the complexity of the theoretical model (Figure 2.3), many studies focus only on the two factors in closest proximity to the actual achievement-related choice, ES and STV (e.g., Fong & Kremer, 2020; Fong et al., 2021). In one approach, ES and STV are positioned as dependent variables. For example, participants may be asked to quantify these factors in terms of perceived "high" and "low" levels, such as a self-efficacy Likert-type agreement item: "I am confident I can be successful in *such and such endeavor*." Then, data analysis may include a comparison of these data using participant characteristics as independent variables such as race/ethnicity and sex to determine if there are statistically significant differences. In a second approach, ES and STV are positioned as *independent* variables which may predict dependent variable outcomes such as participants' achievement scores and/or persistence with a task or a goal. Broadly, ES and STV are positively correlated with both achievement and persistence (Eccles & Wigfield, 2020). The following sections provide examples of these explicit connections and reveal differences among populations, including the characteristics of race/ethnicity, culture, and gender.

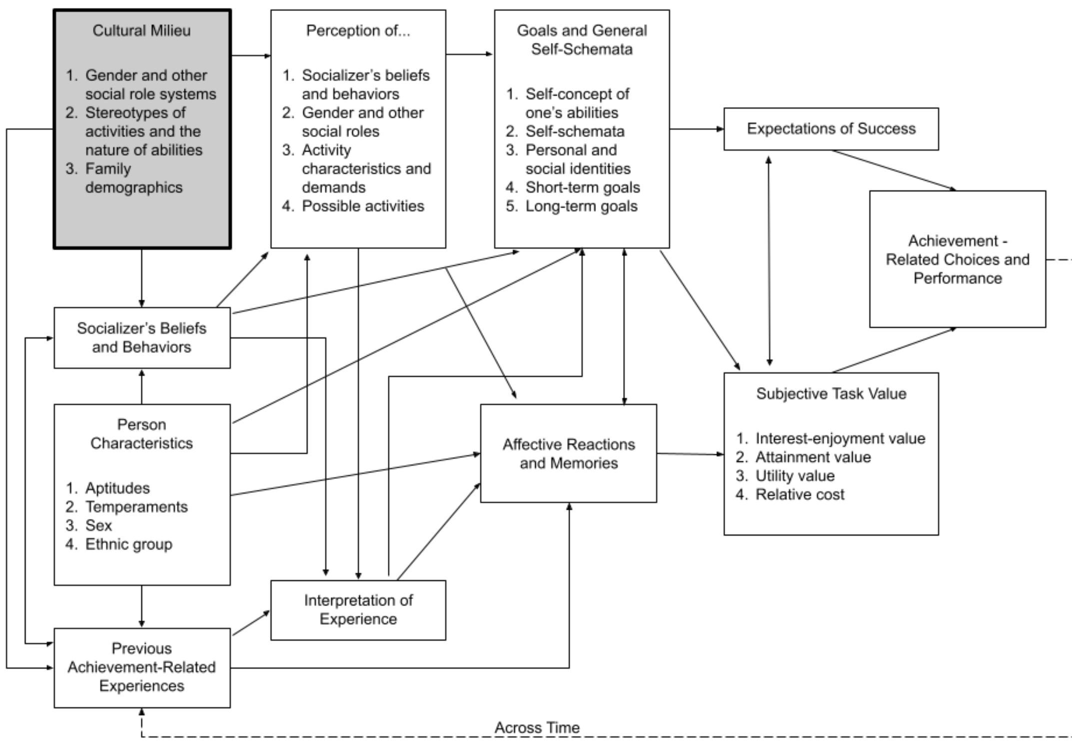


Figure 2.3

Locating Cultural Milieu Within Eccles Expectancy-Value Model of Achievement Choices
Note. Re-created from Eccles & Wigfield (2020).

Review of Literature: Relationships Between E-V Constructs and STEM

Expectations of Success, Achievement, and Persistence in STEM. A learner's ES, widely synonymous with self-efficacy, is associated with self-beliefs about and associated confidence in their abilities to perform a certain task (Bandura, 1977). These beliefs, which are domain-specific (such as a science domain or a math domain), tend to positively correlate with persistence and performance, including in STEM. However, there are often differences among participant characteristics. For example, controlling for individual background differences, Saw and Chang (2018) found that Hispanic high school students had both lower levels of ES and lower levels of math achievement compared to their White and Asian counterparts. This type of correlation may have implications for intentions to persist in STEM in college, even starting with selecting a STEM major. Moakler and Kim (2014) determined from national college freshmen survey data that student confidence level in mathematics was a statistically significant predictor for choosing a STEM major. In another study of secondary school students ages 14–19 in the Netherlands, van Aalderen-Smeets et al. (2019), using structural equation modeling (SEM), revealed statistically significant positive correlations between implicit STEM ability beliefs, STEM self-efficacy, and intention to opt for a STEM bachelor's degree. Simon et al. (2015), also using SEM to explore how expectancies may indirectly relate to STEM outcomes, found that once *in* a STEM major, Canadian college students with higher self-efficacy reported higher levels of intrinsic motivation and positive affect. The students with higher levels of positive affect were, in turn, more likely to persist in STEM programs. Although these studies reveal a trend in the relationship between of expectations of success and persistence in STEM in areas related to this study, the literature does not appear to capture the potential influence of a moderating variable, such as cultural capital, on persistence.

With regard to expectancy differences across racial groups, the effects of math expectancy on math test scores have been shown to be around 2.5 times greater for Hispanics than non-Hispanics (Saw & Chang, 2018). Simpkins et al. (2020) found that Latina/o/x students' perceptions of their family's support was predictive of the students' science ability self-concept. This echoes literature from the earlier section on STEM identity in which family recognition was related to positive impact on STEM identity. It also further supports the possibility of familial capital as cultural wealth being a meaningful part of STEM success. Eccles et al. (2006) found that a strong, positive ethnic or racial identity can buffer the negative impact of day-to-day racial discrimination that results in a decline of academic self-concept. Even so, there is also concern for unconscious stereotype activation (Graham & Lowery, 2004) which can negatively impact motivation regarding emotion, potentially connecting to psychological cost.

Subjective Task Value, Achievement, and Persistence in STEM. Within EVT, the value that a person places on a task is subjective and is a *net* value as influenced by several contributing value-based beliefs. These include intrinsic value, attainment value, utility value, and cost.

Interest Value. Interest value is conceptually similar to intrinsic motivation from self-determination theory (mentioned earlier) and refers to the interest and enjoyment one anticipates gaining by engaging in the task (Eccles & Wigfield, 2020). A survey item measuring this concept in STEM may be as simple as "I enjoy learning about engineering." In the literature, interest value is shown to be positively related to academic choice outcomes. For example, in a longitudinal questionnaire study of students grades 8–12 from both Australia and the United States, Watt et al. (2006) found that interest in ("liking") mathematics was the strongest influence on students' decisions to enroll in mathematics courses. In a large study of approximately 50,000 students across 25 four-year institutions, a measure of vocational interest was a statistically significant predictor for third-year persistence in the students' majors, including STEM majors (Allen & Robbins, 2008). More recently, in a national survey investigation of 11th and 12th grade students' intentions to choose a STEM major, hierarchical logistic regression analysis revealed that attitude toward STEM, as an indicator of interest in and enjoyment of STEM, predicted STEM major and career choice over other variables such as gender and math achievement scores (Moore & Burrus, 2019).

There is renewed scholarly interest in the role of interest value within EVT, or more currently *S*EVT. Although the findings in this section indicate consistency in the relationship between STEM interests and STEM-related behaviors, the literature would benefit from an exploration and elaboration of how the predictive power of interest may operate differently in certain situations, such as with more specific populations in more specific contexts, which is the focus of the current dissertation.

Attainment Value. Attainment value is a personal/identity-based importance that individuals attach to tasks which then influences individuals' decisions to engage (Eccles & Wigfield, 2020). In other words, an individual's decision to engage in a task is influenced by the extent to which the task does or does not allow the person to manifest behaviors they perceive as central to their self-schema or collective identities. Recall that personal, social, and situational identities are intersectional; therefore, attainment value is influenced by the saliency of identity aspects such as gender identity and cultural identity. A survey item which assesses attainment value may be simply stated, such as "Becoming a nurse is important to me," with the response influenced by unique identity-based qualifiers such as "*since I come from a family of nurses*." This example reveals the saliency of identity as a member of a family. In the literature, attainment value is a positive predictor for academic behaviors, including in STEM. For example, Fong and Kremer (2020) found that math attainment value at the beginning of high school was a positive predictor of math achievement as well as the intent to major in STEM after high school.

Utility Value. Utility value is conceptualized as the extent to which a task or activity is useful for completing one's current or achieving future plans (Eccles & Wigfield, 2020). In general, utility value is positively related to achievement motivation. In other words, the greater the utility value one assigns to a task, the more motivated they likely are to persist in completing the task. For example, science utility value as early as in the 8th grade was shown to positively predict STEM degree attainment (Maltese & Tai, 2011).

Eccles & Wigfield (2020) pointed out goal-oriented aspects to utility value, one related to extrinsic rewards such as "by completing this task, I can earn a better grade," and another related to a sense of identity such as "by completing this task, I'll be one step closer to achieving my dream of becoming a nurse." This relatedness between utility value and attainment value has guided methodological decisions. For example, Lazarides et al. (2020) combined utility value with attainment value and conceptualized this as an overall importance. Lazarides then included importance along with expectancy and intrinsic value to create latent profiles of motivation. In general, individuals with profiles of low motivation had lower levels of math achievement, math-related majors, and math-related occupational plans and occupations long after high school. There is evidence that interventions aimed at increasing utility value can be beneficial. In a value-reappraisal intervention study, Acee and Weinstein (2010) found that not only could intervention improve students' perceptions of the usefulness of learning statistics, but that this increased utility value translated into higher academic performance on exams.

Cost. STV is partially a result of perceived costs associated with completing a task, perhaps conceptualized as negative values as opposed to the positive intrinsic, attainment, and utility values. In EVT, these are typically described as effort cost, opportunity cost, and psychological (or emotional) cost (Eccles & Wigfield, 2020). EVT holds that costs reduce task value and consequently result in decreased motivation for engaging in or completing the task. For example, Perez et al. (2014) found in a study of undergraduate students in a chemistry course for STEM majors that all three costs were positively correlated with an intent to leave STEM. This is particularly problematic given that Robinson et al. (2019) found that undergraduate engineering students' perceived costs of pursuing engineering increased over a two-year period. Further, the students with a greater rate of increased cost were less likely to persist in their engineering major.

The conceptualization of cost is not consistent across achievement motivation theories and needs further exploration. The literature on implicit theories of learning (e.g., Dweck & Leggett, 1988) suggests that effort should be embraced positively as a necessary part of incremental growth. This theoretical mismatch with EVT's conceptualization that cost is a negative value opens the door to consider how person-centered differences, such as culture, might impact how a learner perceives cost. For example, Gaspard et al. (2020) found that specific aspects of attainment and utility value were negatively correlated with cost for German and Chinese students, but positively correlated with cost for Korean students.

EV Constructs Predict STEM Motivations, Aspirations, and Persistence. For grade school students, expectancy-value constructs are shown to predict college aspirations and career choice, especially as they relate to STEM. For example, using data from the Eccles et al. (1993) *Childhood and Beyond* (CAB) study, Musu-Gillette et al. (2015) found that individuals high in math self-concept, interest, and importance were most likely to choose a math-intensive major in college. Also using data from the CAB study, Lauermann et al. (2017) found that ES and STV beliefs at the beginning of high school were predictive of math-related career attainment as many as 15 years after high school.

Several studies have used a profiles-based approach to analyze the predictive power of EV constructs, clustering participants into profile groups such as “high” and “low.” Using task value profiles, Chow et al. (2012) found that 10th grade students both in the United States and in Finland who had higher task value profiles for math and science were more likely to aspire to physical sciences and IT-related sciences one to two years later. Gaspard et al. (2019) found that German students in their last year of secondary school who were in a “High Math/Low English” expectancies and values profile were most likely to choose a STEM major compared to other profiles and that the profile was a stronger predictor than demographic characteristics and achievement. Lazarides et al. (2020) found that 12th grade membership in the “high motivational beliefs" profile correlated to a statistically significantly higher math-related occupation than those in the "low motivational beliefs" profile. In Fong et al.'s (2021) study using a public-use data set of the High School Longitudinal Survey of 2009, data analysis resulted in five math-science expectancy-value profiles in which the *High Math/High Science* profile not only had the highest overall college persistence rate (88% of the profile membership), but also the highest 12th grade STEM major intentions (50% of profile) and STEM major choice three years after high school (50% of profile). Further, among students who intended to major in a STEM discipline, members in this profile were least likely to change (46% of profile).

For college students, there are mixed findings regarding EVT constructs related to STEM. In a survey study at a small, private, primarily undergraduate institution in the Midwest, Young et al. (2018), using the Science Motivation Questionnaire, found evidence of decline in STEM motivation, but also evidence of rebound over an academic year for students taking introductory STEM courses across a variety of disciplines. The survey was given within the first two weeks of the semester and again the last week of the semester for two consecutive semesters. In the fall, both intrinsic motivation and self-efficacy decreased, followed by a complete "recovery" after the winter break four to seven weeks later. Career motivation was also found to increase over winter break. The study did not measure EVT-distinct constructs.

Similar to the secondary grade level studies, researchers have used a profile-approach with college students to analyze the associations of EVT constructs and STEM outcomes such as persistence. Perez et al. (2019a) generated three profiles of motivation regarding competence, values, and cost: *Moderate All, Very High Competence/Values-*

Low Effort Cost, and *High Competence/Values-Moderate Low Costs*. Over four years, students classified in the *Moderate All* profile for competency, values, and cost, completed approximately five fewer STEM courses than students in the *High Competence/Values-Moderate Low Costs* profile and approximately eight fewer STEM courses than students in the *Very High Competence/Values-Low Effort Cost* profile. Cumulative STEM course completion over four years may be considered an indicator of STEM persistence. That said, the study sample, from a highly selective university in the United States, was more than 75% White or Asian, less than 10% Latino, and less than 10% African American. Although the study included all three types of positive EVT values, the study did not measure emotional cost but only effort cost and opportunity cost.

In another study conducted with students in an undergraduate biology course for science majors at a minority-serving institution in the Mid-Atlantic region, Perez et al. (2019b) used a cross-lagged path analysis of survey data to determine the associations between seven distinct EVT sub-components at two points in time, the beginning and end of a single semester. The single outcome variable of biology achievement was measured as the final course grade. Results from the final model showed that expectancy at time 1 was a strong, positive predictor for expectancy at time 2, but only a weak predictor for attainment value and interest value at time 2. Attainment value at time 1 was a weak positive predictor for effort cost and opportunity cost at time 2. Utility value at time 1 was a weak predictor for attainment value at time 2. Expectancy at time 2 held the strongest association to the final biology course grade, followed by weak associations with effort and opportunity costs. Perez also conducted a moderation analysis which showed that only the interaction variable of expectancy at time 2 x effort cost had a statistically significant association with the final biology course grade, controlling for all other variables and interactions. Although the sample was more ethnically diverse than the Perez (2019a) study with 45% White, 26% African American, and 14% Asian, the study sample was still less than 10% Hispanic/Latino. Further, the study outcome variable was course achievement and although it was situationally specific as suggested in the new SEVT, it did not include a methodological element of being culturally bound.

Robinson et al. (2019) also used survey data to study the changes in seven distinct EVT components and their associations with achievement as well as STEM retention over a two-year period. The sample, approximately 70% White, 17% Asian, 7% Black/African American, and 4% Hispanic/Latina/o, included first-year engineering students at a large, public university. Expectancy as well as interest, attainment, and utility values all declined over the two-year period with attainment value showing the most stability (least decline). Opportunity, effort, and psychological costs all increased over the two-year period with effort cost showing the greatest increase. Expectancy, interest value, attainment value, utility value, and effort cost were all strongly associated with both grades and retention in engineering, but a more nuanced analysis revealed that attainment value was the strongest predictor for retention in an engineering major. Recall that attainment value is identity-based, which supports giving consideration to other identity-based variables, such as cultural capital, as being salient to influencing persistence in a STEM major.

The literature is rich with studies of EVT having parameters related to this study. In fact, the impetus for much of Eccles' and others' work in EVT has been to explore the differences in math- and science-related outcomes by gender as well as by race/ethnicity. Yet, the literature in postsecondary STEM studies with EVT as a framework does not appear to combine the setting, population, and variables as finely tuned as in this study.

Theoretical Gap: Positioning Cultural Capital as a Moderator within Expectancy-Value Theory

Most of the literature intersecting EVT with race/ethnicity (R/E) use R/E as a nominal category for data comparison rather than for considering ways of knowing and being as central to the study design, like much research in educational psychology (DeCuir-Gunby & Schutz, 2014). One study that gets closer to centralizing knowing and being found that communal goal orientation, as lived in Native American cultures, was disprivileged in a Western STEM culture dominated by persistent individualistic practices of White men (Smith et al., 2014). This difference in communal versus individualistic goal orientation can threaten a sense of belonging linking back to negative recognition in STEM identity. One other study that explored EVT using a Confucian lens found four main motivations for Chinese doctoral students studying in the US: interest in research, optimism in American doctoral education, utility value of the degree leading to permanent residence, and high social cost of quitting (Zhou, 2014). This study revealed how cultural beliefs can shape motivations. However, neither of these studies position cultural capital as a moderator for the association of EVT variables with STEM persistence.

As previously noted, EVT recently received a name modification with the addition of the term "situated." The new *S*EVT is intended to reflect the authors' beliefs that "all aspects of the model are situative" (Eccles & Wigfield, 2020, p. 10). Further, the authors acknowledge the limited ability of oft-used quantitative questionnaires to capture the complex, situative nature of motivation, especially over time. The authors also called for research that addresses the intersectionality of culture, ethnicity, and gender. For example, in a longitudinal study of Hispanic high school students from 9th through 12th grades, Safavian (2019) found that gender moderated the levels of expectancy-value in mathematics as well as math course participation and performance. However, while this study focused on Hispanic student motivation, it did not explicitly measure culture-specific variables.

Other scholars call for research that returns to meaning systems (Nolen, 2020) which are integrative, complex, dynamic, and culturally influenced (Urdan & Kaplan, 2020) and research which requires authentic context because students' multiple goals tend to operate simultaneously (Brophy, 2005). Urdan and Kaplan (2020) noted that there has been little research regarding the interactions between students' perceptions of their identities and cultural definitions of success (Schutz & DeCuir-Gunby, 2017; Zusho & Clayton, 2011) and how this interaction shapes students' perceived options.

Missing in the literature is a theoretical bridge that can answer questions regarding the extent to which EVT constructs' associations with STEM persistence depend on the amount of perceived cultural capital. Consider that capital, in general, may be conceptualized as a resource, or an asset, or an advantage that can be leveraged for obtaining or producing something. In the context of this study, for example, if a student has only a moderate level of expectancy of success in STEM, does having a strong sense of navigational capital bolster the student's intention to persist in STEM? The findings noted above from the Ortiz et al. (2019) study suggest this may be true. In another example, if a student has higher sense of psychological cost regarding persisting in their STEM major, perhaps due to stereotype threat, does having a strong sense of resistant capital mitigate the negative influence of cost on persistence? Qualitative findings from Sánchez-Connelly (2018) suggested that first-generation Latinx undergraduate college students utilized social, resistant, and aspirational capital to manage and be successful in racially challenging academic environments. Given that Eccles and Wigfield's (2020) position that motivation is situationally specific and culturally bound, motivation theory would benefit from exploring the interactions between ES/STV and cultural capital.

Exploring Differences Based on Gender, Socioeconomic Status, and First-Generation Status

EVT, STEM, and Gender. This study includes an exploratory research question regarding potential gender differences for any moderating effects of cultural capital on STEM persistence. The literature establishes that identity is intersectional; therefore, understanding findings regarding one aspect of identity is useful for understanding other aspects of identity such as race, ethnicity, or culture. The connection between EVT and gender has been well-explored in which females do not tend to fare as well as males, particularly related to STEM education and occupations. Both gender differences as well as differences within gender are linked to different beliefs regarding elements of EVT, including ability self-concepts and elements of STV which can then play out in STEM-related occupational choices (Eccles, 2011). Studies reveal that compared to men, women more often hold expectancy-value beliefs that do not lead to STEM careers and the ones who do tend to select health-related fields over mathematics, physical sciences, engineering, and computer sciences (e.g., Eccles & Wang, 2016; Kimmel et al., 2012).

Watt et al. (2012) found that attainment and utility values were more indicative of high school female career choices which is suggestive of potential interventions for increasing STEM pursuit. The significance of identity was evident in Wegemer & Eccles's (2019) longitudinal study of participants from 7th grade through age 26 that found a sense of altruism and femininity, as types of identity values, predicted STEM choices toward life sciences rather than toward physical sciences. As EVT constructs relate to STEM persistence outcomes once students are in college, Robinson et al. (2019) identified that gender was not a statistically significant predictor of motivational changes in engineering students over a two-year period. With no gender differences in the motivational trajectories, the analysis could not subsequently link gender as a statistically significant predictor for retention in STEM. The present study extends the literature by being more situationally specific with an HSI context and culturally bound by considering perceived cultural capital as a moderating variable.

EVT, STEM, and Socioeconomic Status. Recall that an institution of higher education meets eligibility to earn HSI status if the undergraduate student enrollment is at least 25% Hispanic. Beyond this basic measure, another component for eligibility in Title V Part A of the Higher Education Act is that the institution must have an undergraduate enrollment of *needy students*. Needy is defined in two ways: the institution either has an undergraduate enrollment for which at least 50% of the degree students are "receiving need-based assistance" or "a substantial percentage" of students are receiving Pell Grants (US Dept of Education, 2016). In other words, the institutional undergraduate enrollment is not only a minimum of 25% Hispanic, but also substantially in need of financial aid. Although not an exact match, the measure of students in need of financial aid may be used as a proxy for the measure of students with lower socioeconomic status (SES). With HSI as the context for this study and a component for HSI eligibility being related to students with financial need, I included SES as an exploratory variable.

Lower SES is widely believed to be detrimental to overall student success as it relates to access to and utilization of resources. However, Xie et al. (2015) reported that there are many contextual, family, and individual factors which influence the extent of any negative impact of lower SES status on success such as class size, teacher quality, race, family structure, cognitive abilities, and non-cognitive (affective) skills. Regarding STEM, more selective factors may include local labor market characteristics or students' geographic proximity to science-focused industry. In higher education, among other factors, findings from Chang et al. (2014) suggested that characteristics of institutional context and climate influence students' persistence in STEM. Furthermore, Chen and Soldner (2014) found that attrition from STEM was less pronounced when controlling for other factors such as achievement. Given these findings, the mechanisms through which family SES influence STEM education from early grades through college remain unclear, including how SES impacts elements of motivation as they relate to STEM degree persistence. Including SES as an exploratory variable may shed light on the extent to which this background variable has any association with perceived cultural capital, EVT motivation constructs, and STEM major persistence.

EVT, STEM, and First-Generation Status. If one views the likelihood of college student success through a Bourdieuan lens of cultural capital reproduction, then first-generation college students would appear to be at a distinct disadvantage, having no one in their family to pass along tacit college knowledge such as how to write a scientific paper or how to work with a variety of technologies. Findings in the literature are inconsistent. Dumais and Ward (2010) found that although traditionally recognized types of capital such as knowing how to apply to college was a statistically significant predictor for enrolling in a four-year college, first-generation status was not a statistically significant predictor of college graduation once enrolled. However, a finding by Shaw and Barbuti (2010) study revealed that first-generation students were statistically significantly more likely to leave their intended STEM major than non-first-generation students, albeit a small difference. The literature suggests that the first-generation status is more of a predictor for getting into college, but not as much of a factor for persisting and graduating. In a qualitative study of first-generation students and STEM persistence, Burnett (2017) found that participants, half of whom were classified as having lower SES, were highly motivated to succeed and had "intense" interest in STEM (p. 105). The study found connections to family support, high school preparation, and institutional environment, but did not present connections to cultural capital as conceptualized in the CCWM. These findings align with Robinson et al.'s (2019) longitudinal study of engineering students in which first-generation status was a predictor for higher levels of initial interest value as well as initial expectancy. First-generation status was not a statistically significant predictor of initial levels of utility value, effort cost, or any changes in EVT motivation constructs over time. Including first-generation status as an exploratory variable in this study may extend the literature by considering any potential associations between perceived cultural capital, EVT motivation constructs, and STEM major persistence.

Situating the Study Within Developmental Education

Developmental education (DE) practices have been supporting learners in higher education for more than 300 years (Arendale, 2014). By reviewing positions about DE from scholars, institutions, and professional organizations, we know that DE is intended to support holistically all postsecondary learners through purposeful coursework, programs, and structures which positively impact both cognitive and affective learner domains (Boylan & Bonham, 2014; NOSS, n.d.; Patton et al., 2016; Texas State University, n.d.). However, we also know that while student diversity has increased in higher education, the application of student development and learning theory to support these students has largely continued to rely on research conducted by and with White males (Boylan & Bonham, 2014; Patton et al., 2016). Further, this research certainly has not considered intersectionality as discussed earlier in this paper. Bronfenbrenner's (1979, 1993) ecological approach to development acknowledges and considers the layers of influential systems such as cultural expectations, social forces, policies at various levels, family, faculty, friends, and so forth, on the development of the individual. This complex process illustrates the need to conduct research using more than White, middle-class participants and norms.

DE is not without its critics and a poor light has been cast on DE as being a field mired in ineffective remediation (e.g., Bailey et al., 2010). Remediation is deficit oriented as it regards students (Cassazza, 1999), but perhaps it is the *researchers* who are deficient in a lack of understanding of how student development and learning theory work among diverse student populations. In the midst of increasing criticism, higher expectations, and diminishing resources, it is especially important to know what is working and what is not.

If the field of DE is to move away from a deficit-based reputation (Higbee, 2012), then scholars must conduct research that is not deficit oriented.

Two emergent ways to accomplish a movement away from deficit orientation and toward asset orientation are race-focused research and race-reimaged research (DeCuir-Gunby & Schutz, 2014). In race-focused research, a racial construct is centralized and essential for understanding participants' educational experience. Race-reimaged research, on the other hand, selects a traditional construct that was not likely developed with racial theory in mind and views it with a sociocultural lens. This study aligns with race-reimaged research as it views a long-standing motivation theory through the lens of culturalized assets. A race-reimaged study does not compare racial groups, but instead focuses on how groups, such as Latina/o/x students, experience particular constructs, such as expectancy of success, value, or cost (DeCuir-Gunby & Schutz, 2014).

Learning Support

This study focused on the affective aspects of student development which can influence academic achievement. This is a prime example of learning support (LS) because it is possible that even short-term events, such as motivational changes, can have lasting consequences on student achievement outcomes (Goudas & Boylan, 2012). Learning support is the practical application of what learning theory suggests, such as how institutions implement learning strategies courses, conduct advising, use assessment measures, develop course curricula, or support learner motivation. It meets students right where they are and engages them in the process of moving forward. Anzaldúa (2002) reminded us that "change requires more than words on a page—it takes perseverance, creative ingenuity and acts of love" (p. 574). This study was such an act as it strives to move the needle in DE toward research that considers the whole student; an act able to make a positive difference in individual lives by identifying learner talents and utilizing those strengths to build up weak areas (Cassazza, 1999). Developmental educators see the complexity of each student and their emotional and motivational needs. Thus, developmental education and learning support are central to this dissertation focused on the cultural and motivational assets of Latina/o/x postsecondary learners.

Chapter Summary

As a result of the literature review, several key facts, themes, and concerns are clear. First, not only are HSIs enrolling an increasing percent of Latina/o/x students, but HSIs are also being called to task for the ways in which they are or are not operationalizing the S in HSI (Garcia, 2019). *Serve* can mean both strong Latina/o/x organizational culture as well as strong Latina/o/x student completion rates. However, even within increased completion, there is still a representation gap between Latina/o/x and non-Latina/o/x students in STEM. Increased Latina/o/x STEM presence is explicitly named as a goal in both the scholarly literature and other documents (e.g., Garcia, 2019; US DOI & HACU, 2012). The literature reveals that existing interventions for Latina/o/x student STEM retention and persistence employ efforts to strengthen Latina/o/x student STEM identity.

Second, STEM identity is one facet of situational or contextual identity (Hazari et al., 2010) and the STEM identity facet intersects with other identity facets, including those which are personal and collective. STEM identity, including “self-perceptions of competence, values, and costs” is not excluded from being framed by both personal and collective identities (Perez et al., 2014, p. 317). Emerging from the literature on

Latina/o/x student STEM identity is the positive influence of family support (e.g., Maltese & Cooper, 2017) which could be related to the development of types of cultural capital as described in the CCWM, but the literature is limited regarding this explicit connection.

Third, the literature on CCW reveals that CCW capitals do not tend to operate in isolation (e.g., Liou, 2009). Even more, the bonds between types of CCW capital are often seen as a source of Latina/o/x student motivation (e.g., Mobley & Brawner, 2019). Even with this established connection between CCW capital and motivation that leads to persistence, the literature is not explicit about the connection to motivation *theory*. The Denton et al. (2019) meta-review highlights the emphasis in CCW literature on qualitative methods and exposes the fact that CCW capitals have consistently been studied as variables directly related to outcomes such as persistence in engineering, degree attainment, and transition to university life, not as moderating variables within established theories such as motivation theory.

Fourth, academic motivation is linked to STEM outcomes (e.g., Acee & Weinstein, 2010). However, there is a call from the field for more research in motivation theory regarding diversity (e.g., Koenka, 2020). To that end, EVT includes constructs that are already aligned with constructs in STEM identity as well as the CCW capitals. This alignment presents a unique opportunity to study EVT from a race-reimaged approach (DeCuir-Gunby & Schutz, 2014) in which the traditional EVT constructs are more carefully studied using a sociocultural lens. Scholars on EVT have acknowledged that the two-dimensional EVT model with “cultural milieu” placed in a single box in the corner of the model does not adequately communicate the complex nature of motivation theory

(Eccles & Wigfield, 2020), much less make room for motivation to be situative and culturally bound.

Putting this together, if CCW capitals are shown to be related to Latina/o/x STEM student persistence through increased motivation, and if motivation is known to be related to STEM persistence as supported in the motivation literature, then how are CCW capitals and EVT motivation constructs more precisely related to *each other*? The answer may be through supporting Latina/o/x students' abilities to increase, access, and utilize forms of CCW capital related to STEM identity such as, but certainly not limited to, familial and social capital related to recognition. Perhaps they are related as aspirational capital supports overall STEM identity. Perhaps it is the utilization of navigational and resistant capitals which support performance and competence. I also consider that perhaps HSIs better reflect more inclusive STEM cultures in which resistant capital is less needed as a defense against the "politics of exclusion" which Camacho and Lord (2011, p. 136) noted was a marginalizing factor for Latina/o students in engineering. A meta-analysis (Parker et al., 2020) of EVT studies revealed that intersectionality including gender, socioeconomic status, and ethnic diversity explained differences in EVT constructs and STEM outcomes more than any single nominal variable. There is a clear gap in the literature as no study to my knowledge has integrated these perspectives and contexts in a single study.

This study is well-positioned between the need for inspecting why there is still Latina/o/x student underrepresentation in STEM and scholarly calls in motivation theory to embrace race-reimaged research. More specifically, it theoretically positions the CCW capitals within EVT regarding Latina/o/x students' STEM persistence. Research must not unnecessarily exploit student assets but use understandings to serve the purpose of social and racial justice (Yosso, 2005). Findings, then, may inform HSIs regarding how best to serve their students, using Garcia's (2017) typology, both through culture and through degree attainment. The next chapter outlines a methodology which is well-suited to answering the research questions.

3. METHODOLOGY

The purpose of this chapter is to provide the research methodology for this quantitative design study regarding the associations between elements of expectancy-value theory (EVT), CCW capitals, and intentions to persist, specifically for Latina/o/x STEM major students. A hierarchical regression approach allowed me to control for variables entered earlier in the regression while determining the contributions of variables entered later in the regression. Through a cross-sectional survey design, the associations derived from this study were correlational (not causal). Primary components of this chapter include a rationale for the study design, study participant recruitment and selection, instrument development, data collection procedures, analysis plan, and ethical concerns.

Research Questions

The research questions (RQ) were:

- RQ 1: For Latina/o/x students in STEM majors enrolled at a Hispanic-serving institution, what are the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 2: In what ways do perceived CCW capitals, including familial capital, resistant capital, aspirational capital, and navigational capital, moderate the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 3: Do the findings for question 2 differ depending on gender, socioeconomic status, or first-generation status?

Table 3.1 summarizes the variable abbreviations.

Table 3.1

Variable Names and Abbreviations

Variable Name	Variable Type	Abbreviation
Expectancy of Success	Independent	ES
Attainment Value	Independent	AttV
Interest Value	Independent	IntV
Utility Value	Independent	UtV
Effort Cost	Independent	EffC
Opportunity Cost	Independent	OppC
Psychological Cost	Independent	PsyC
Aspirational Capital	Independent	AspC
Familial Capital	Independent	FamC
Navigational Capital	Independent	NavC
Resistant Capital	Independent	ResC
Intention to Persist in STEM	Dependent	ItP

For this dissertation and its primarily exploratory research questions, specific hypotheses regarding findings were not as applicable as general predictions regarding associations among variables; therefore, I made general predictions and not formal hypotheses. Based on the review of literature, it was reasonable to predict that ES and values would be positively associated with ItP (e.g., Hecht et al., 2019). In other words, when students' ES of STEM success and STEM major values are higher, then ItP will be higher. Based on related literature, it was reasonable to predict that, when considered separately, perceived costs would be negatively associated with ItP (Eccles & Wigfield, 2020). In other words, when perceived costs of persisting in a STEM major are higher, then ItP will be lower. I qualified this prediction based on the continuing impact of the COVID-19 pandemic. Not only were there typical perceived costs associated with completing a STEM degree through hands-on, face-to-face instructional and laboratory experiences, but there may have been unknown complications of perceived costs due to the number of courses delivering instruction remotely and lab experiences becoming more virtual. There were also real and perceived COVID-19-related costs of pursuing a STEM occupation such as health care professions which work on the front lines in medically precarious times, a saliency of personal safety that students may not have previously been considered. The immediate impact of COVID-19 may have negatively affected students' abilities to fund their college education. Alternately, perceived need for more people working in STEM jobs nationally, particularly in health care, may have mitigated perceived costs perhaps because of altruistic goals. These were just a few of the unknowable COVID-19-related factors that may impact students' motivations toward STEM majors and subsequent careers.

Separately, I predicted theoretically that students with higher perceived levels of CCW capital would have higher ItP. For example, when students have a strong sense of aspirational capital, they would have a higher ItP than students with lower aspirational capital. Similarly, students who have a stronger sense of navigational, familial, or resistant capital would also have a higher ItP.

For RQ 2, based on the literature regarding CCW capitals, motivation, and persistence, it was reasonable to predict theoretically that there would be a difference in ItP between students with lower levels of perceived CCW capitals and higher levels of perceived CCW capitals (e.g., Liou et al., 2009). In other words, any influences of ES and values on persistence would be greater when there is a stronger sense of CCW capitals, and any negative influences of costs would be less when there is a stronger sense of CCW capitals. Research question 3 was exploratory in nature. For that reason, there were no specific predictions regarding differences in the moderating effects of CCW capitals on persistence based on gender, socioeconomic status, or first-generation status. However, the literature points to the possibilities of CCW capitals such as aspirational capital contributing to increased persistence in STEM with first-generation students (e.g., Burnett, 2017).

Study Design

In selecting a research design to best answer the research questions, it was important to first reflect on and identify a philosophical worldview, meaning "a basic set of beliefs that guide action" (Guba, 1990, p. 17). A worldview, which some also reference as epistemology, represents my general philosophical orientation about the nature of learning and research (Crotty, 1998) as it relates to my research interests in the social sciences, specifically in the field of education. Creswell and Creswell (2018) offered insight into the topic of worldviews and how they shape research. It was primarily from this text that I drew my own conclusions about personal beliefs. Of the four major worldviews (postpositivism, transformative, constructivism, and pragmatism), the two that resonated with me the most were constructivism and pragmatism. First, constructivism is often associated with qualitative research approaches because this worldview holds that "individuals develop subjective meaning of their experiences" (Creswell & Creswell, 2018, p. 8). In this worldview, the goal of research is not only to include participants' views and perspectives, but to rely on them. Further, these subjective meanings are "negotiated socially and historically" (p. 8). This worldview accommodates my belief that learning *as* meaning cannot be divorced from circumstance or context. The present study was an effort to better understand how cultural perceptions play a role in the effects of traditional motivation theory variables on important postsecondary outcomes. This necessarily required allowance for subjective interpretation, allowance for differing, equally valid perspectives to be included in the understanding of how motivation variables operate regarding persistence. Second, I resonated with pragmatism as a belief that centers around actions and solutions to problems because I tend to be a person who seeks purpose and application for what is learned. I believe we have one fleeting and valuable life, so learning more about the nature of problems and then researching viable solutions to these problems was a purposeful way to contribute to education scholarship. Like constructivists, pragmatists view research within social, historical, political, and other contexts. That said, pragmatism utilizes both qualitative and quantitative approaches to arrive at a "*little t* truth," truth that exists in context, i.e., the focus of the specific research question at hand. For this reason, the partnering of constructivism and pragmatism produced my worldview which is described as one which seeks and embraces inclusion of participants' perspectives to acknowledge and validate cultural differences while also seeking and embracing applicable findings. Constructivists may be more likely to utilize qualitative methods to answer research questions, but in a recent American Psychological Association (APA) Division 15 meeting (Zusho et al., 2020), scholars engaged in dialogue about how quantitative research might be conducted more critically with approaches that are perhaps race-focused or race-reimaged. The use of statistical analyses seems inherently postpositivistic, but this study was positioned at a critical quantitative threshold, one at which quantitative methods could support and advance a critical race agenda in education research (Garcia et al., 2018; Sablan, 2019). This study utilized a quantitative approach that included traditional motivation theory variables as well as sociocultural (DeCuir-Gunby & Schutz, 2014) variables which included participants' culturally nuanced perceptions and perspectives accommodated by constructivist and pragmatic approaches to prioritize an asset-based narrative of Latino/a/x motivation and capital.

With a pragmatic-constructivist worldview as a guide, I used a quantitative approach, non-experimental correlation design, which is useful for describing and measuring the degree of association among variables. Specifically, my survey design provided a "quantitative description of trends, attitudes, and opinions" (Creswell & Creswell, 2018, p. 147) of a population by studying a sample within the population. Broadly, this study explored the relationship between two sets of constructs: expectancy-value theory (EVT) variables and a subset of Yosso's (2005) Community Cultural Wealth model (CCW) variables. EVT variables can be analyzed in a variety of ways. One is to uniquely consider as many as seven distinct variables: expectancy of success plus six contributors to subjective task value (AttV, IntV, UtV, EffC, OppC, PsyC). Alternately, EVT variables might be researched using a composite approach in which the elements of subjective task value are combined in one or more ways transformed and represented as composite scores in the data. Similarly, CCW capital variables might be viewed either independently or as a composite. The literature suggests that types of CCW capital tend to operate in tandem with one another, such as aspirational capital and resistant capital becoming "marginalization as motivation" (Liou et al., 2009). Further, creating distinct scales for each type of CCW capital is not a clean process as seen in Sablan's (2019) efforts. With that in mind, the data analysis section will provide detail regarding the analysis methods used in this study to account for these options. A cross-sectional, online survey design was the preferred method for this study because it had economy of design and rapid turnaround in data collection (Creswell & Creswell, 2018).

Positionality

I would be remiss in moving forward without a statement of positionality. I brought beliefs to the study shaped by my own experiences. I am a White woman (pronouns she, her, hers) who conducted a study around the intersection of achievement motivation and culture with students who identified differently than I do, likely in several ways. Noticing what surprised or bothered me was a useful way to reveal my hidden beliefs and values; therefore, self-examination of any biases I had, explicit or hidden, was ongoing as I completed all aspects of this study. The tenets of *QuantCrit* (Gillborn et al., 2018) helped to guide this self-examination and awareness:

- "The centrality of racism as a complex and deeply rooted aspect of society that is not readily amenable to quantification;
- The acknowledgment that numbers are not neutral, and they should be interrogated for their role in promoting deficit analyses that serve white racial interests;
- The reality that categories are neither 'natural' nor given and so the units and forms of analysis must be critically evaluated;
- The recognition that voice and insight are vital: data cannot 'speak for itself' and critical analyses should be informed by the experiential knowledge of marginalized groups;
- The understanding that statistical analyses have no inherent value, but they can play a role in struggles for social justice" (Garcia et al., 2018, p. 151).

Population and Sample

The broad population of interest was Latina/o/x students in higher education pursuing a STEM degree because this population continues to be underrepresented in STEM degrees and STEM fields as noted in the literature review. The National Center for Education Statistics defined STEM majors as “biological and biomedical sciences, computer and information sciences, engineering and engineering technologies, mathematics and statistics, and physical sciences and science technologies” (NCES, 2018). For the purposes of this study, the target population was self-identified Latina/o/x STEM major students at a four-year Hispanic-serving institution in the south-central United States. It is important to remember that there are differences within cultures and acknowledging the regional nature of the population serves as a reminder that findings should be viewed within context.

The study site was a Hispanic-serving institution (HSI), from here on referred to using the pseudonym South Central University (SCU), with a growing Latina/o/x student population identified by SCU as “Hispanic.” In the fall of 2020, approximately 39% (14,621) of the students at SCU identified as Hispanic which exceeds the minimum federal threshold of 25% for HSI eligibility. The overall Hispanic student population at SCU (undergraduates and graduates) grew from 31.6% to 38.7% since 2014 which represents a 26% increase in the Hispanic student population in only six years. Despite the national underrepresentation of the Latina/o/x population in the STEM workforce (Funk & Parker, 2018), SCU had a nearly proportional undergraduate representation of Hispanic students enrolled in a STEM college as were enrolled in the institution (see Table 3.2). The percent of all undergraduates who were Hispanic at SCU was about 41%

and the percent of all undergraduates enrolled in a STEM college who were Hispanic was about 42%, approximately 3,700 students, of which approximately two-thirds were enrolled in the College of Science and Engineering and one-third were enrolled in the College of Health Professions. Further, this proportional representation was seen through four years of classification status which invites a closer look at what might be happening at the undergraduate level regarding STEM recruitment and retention. Table 3.3 shows the relative distribution of Hispanic students enrolled in the two STEM colleges at SCU. Further inspection of SCU's publicly available data showed that although the overall Hispanic student retention in STEM was steady, there was a shift in STEM enrollment from the College of Health Professions to the College of Science and Engineering over the course of four years.

Voluntary, convenience response sampling was used in this study given the focus on students who self-identified as Latina/o/x. Although this method can carry some bias because it is not as rigorous as random sampling or systematic sampling (Johnson & Christensen, 2017), the recruitment of participants targeted both the College of Science and Engineering as well as the College of Health Professions in order to yield a cross section of participants from both colleges. The survey included self-report items related to demographic variables; therefore, stratification of the sample did not take place prior to participant recruitment.

Table 3.2

South Central University's Hispanic Enrollment and Representation 2020-2021

Enrollment status at SCU	All students	Hispanic students	Percent (%) of all students who are Hispanic
Undergraduate students	27,422	13,467	40.6
Undergraduate students in a STEM college	8763	3723	42.5
Freshmen students in a STEM college	2307	1008	43.7
Sophomore students in a STEM college	1910	812	42.5
Junior students in a STEM college	2044	870	42.6
Senior students in a STEM college	2502	1033	41.3

Table 3.3

Distribution of Hispanic Students by STEM College at South Central University 2020-2021

Enrollment of Hispanic students by classification	All Hispanic students in a STEM college	College of Science and Engineering		College of Health Professions	
		Number	Percent (%)	Number	Percent (%)
Freshmen	1008	584	57.9	424	42.1
Sophomore	812	502	61.8	310	38.1
Junior	870	593	68.1	277	31.8
Senior	1033	822	79.6	211	20.4

For an experimental study, the minimum sample size would be best determined by conducting a power analysis. However, this study was nonexperimental, and Keith (2019) suggested that there is little consensus regarding guidelines for determining sample size with this approach. Keith noted that a common rule of thumb is to have 10–20 participants per independent variable when analyzing data with multiple regression. Conservatively, I intended to analyze data from as many as 14 independent variables, which suggested a sample target range of 140–280 participants. Keith noted that one slightly more sophisticated rule of thumb may be to use $N > 50 + 8k$ (with k being the number of independent variables). This produces a value of 162, within the 140–280 range. With these approaches as a guide, my target sample size was 300 which more than accounted for the ratio of participants to variables. This target sample size served to minimize the possibilities of both Type I and Type II errors in interpretation of findings (Johnson & Christensen, 2017). Type I errors occur when statistical analysis inaccurately results in a statistically significant finding, otherwise known as a false positive result. Type II errors occur when a statistically significant finding fails to be detected, also known as a false negative.

Participant Recruitment

To recruit participants, I contacted via email instructors of large enrollment sections of traditionally first- and second-year science courses whose course catalog descriptions indicated that they were intended for science majors or were required courses across several STEM majors (e.g., Functional Biology, Organic Chemistry, Electricity and Magnetism, and Calculus). After data collection began, I expanded the recruitment to include additional STEM courses available to second- and third-year students due to lower-than-desired participation rates from the initial set of emails (e.g., Environmental Engineering, Computer Science Assembly Language, and Clinical Immunology). In all, I sent emails to 149 different instructors across 99 courses. See Appendix B for a complete list of courses included in the email recruitment process. On March 22, 2021, I began emailing instructors to introduce myself and the study and request that the instructors forward the email to students in the indicated sections or to post the survey link to their Canvas announcements. I sent subsequent follow-up emails approximately two weeks after sending the first email request. All initial and follow-up emails to the instructors followed Texas State University IRB requirements and the templates are in Appendix C. I elected to use this focused strategy of having the instructor forward the email to their students (or post in Canvas announcements) to increase the chances that students elect to participate versus a blanket email from me to the entire institution. The survey link was offered to all students in the course, but I only included participants in the data set who self-identified as both a STEM major and as one of the Hispanic or Latina/o/x options. As a modest monetary incentive to participate, I provided the opportunity for participants to win one of 10 $20 Amazon gift cards through a drawing at the close of the survey data collection period. Participants voluntarily offered their email address to be eligible for the drawing; however, no identifying information was included in the study or retained. All identifying information is being kept confidential in accordance with IRB requirements. It was possible that students were simultaneously enrolled in more than one of the targeted courses, which created the possibility of repeated survey participation. To prevent a violation of the assumption of independence in data, I used the Qualtrics survey protection setting which reduced the chances of participants taking the survey more than once. At the conclusion of data collection, I assigned a number to each email address and used an online random number generator to select winners. All winners were notified via email on Monday, May 11, 2021. This email template is also located in Appendix C.

Instrumentation

The instrument for this study had two main sections: first was an introduction to the survey and directions for completing the survey; second was the collection of survey items. The introduction page on the survey encouraged participants to select responses that best reflected their beliefs, not responses they thought *should* be selected or that others would want them to select. The introduction also explained that "STEM" related to science, technology, engineering, and mathematics fields. The survey items were clustered into five sections: first was a collection of EV items, second was a collection of CCW capital items, third was a collection of persistence items, fourth was a set of open-ended items, and the final section included demographic information. All EV and CCW capital items were Likert-type items with the following negative-to-positive values: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree. All four of the persistence items were Likert-type items, but three used the negative-to-positive response orientation, while one was reverse coded. All demographic items were categorical.

Expectancy-Value Items

The EV items used STEM-specific language. All items were adapted from a recent study on the development and roles of expectancy, task values, and costs in early college engineering (Robinson et al., 2019). These items were previously shown to have Cronbach's alpha reliability coefficients with values ranging from acceptable ($\alpha = .74$) to strong ($\alpha = .92$). Robinson et al. (2019) cited prior sources from which the items were adapted. The EV items were blocked together on the survey but were presented in random order within the block. Appendix D summarizes items' original sources from the Robinson et al. (2019) study and a side-by-side visual of any item language modification.

Expectancy of Success. The expectancy of success subscale of four items measured the extent to which students believe they can or will be successful in their STEM-related courses required for their STEM degree. One item was: "I am confident that I can master the content in the STEM-related courses required for my degree."

Task Values. The task values subscale consisted of 11 items related to attainment value, interest value, and utility value. Four items for attainment value assessed the importance of their STEM field to their identity. One item was: "Being involved in my STEM field is a key part of who I am." Four items for interest value assessed students' feelings of enjoyment related to their STEM courses. One item was: "I enjoy my STEM-related courses." Three items for utility value measured students' beliefs about the usefulness of their STEM degree to their current or future goals. One item was: "This STEM degree will help me get a good job in the future."

Perceived Costs. The perceived costs subscale consisted of 10 items regarding students' perceived effort, opportunity, and psychological costs related to persistence in their STEM major. Three items for effort cost measured students' perceptions of the effort required to complete their STEM degree. One item was: "I am unsure if completing this STEM degree will be worth the effort." Three items for opportunity cost measured students' beliefs about the loss of valued alternative activities in pursuing their STEM degree. One item was: "I am concerned that success in this STEM degree requires that I give up other activities I enjoy." Four items regarding psychological cost assessed students' perceptions about the emotional consequences of persisting in their STEM degree. One item was: "I am anxious that I won't be able to handle the stress that goes along with completing my STEM degree."

CCW Capital Items

The CCW capital items were adapted from Sablan's (2019) survey development study that created and analyzed four CCW capital scales based on Yosso's (2005) scholarship: aspirational capital, familial capital, navigational capital, and resistant capital. Sablan probed the viability of these subscales to open doors for future research using quantitative methods through the lens of critical race theory. Given this purpose, Sablan developed the items by utilizing content validity testing (e.g., review of literature), expert reviews (e.g., academics with expertise in cultural capital theory and community cultural experts), pilot testing, and cognitive interviewing (e.g., a "think aloud" session). Sablan then conducted reliability tests and an exploratory factor analysis (EFA). Although EFA allows for researcher discretion during interpretation of results, Sablan used standard dimension reduction techniques to guide decisions about the final composition of the scales. The coefficients α for the scales each exceeded a commonly accepted reliability threshold of .70 for social sciences (Acock, 2010): aspirational capital, $\alpha = .79$; familial capital, $\alpha = .87$; navigational capital, $\alpha = .83$; and resistant capital, $\alpha = .78$. The EFA further revealed strong supporting evidence for including the familial capital and navigational capital items in the final scale without modification. For familial capital, the eigenvalue = 4.21, with the single factor structure accounting for 52.6% of the variance in the items, loading with a coefficient range of .67–.79. For navigational capital, the eigenvalue = 3.56, with the single factor structure accounting for 50.8% of the variance in the items, loading with a coefficient range of .61–.77. The EFA for the aspirational capital and resistant capital scales revealed more than one factor and some cross-loading of items which were examined or removed, and then retested. Four items were retained for aspirational capital, eigenvalue = 2.44, accounting for 60.9% of variance in the items, loading with a coefficient range from .63–.85. For resistant capital, the EFA revealed a distinct two-factor structure with the items in one factor more related to identification of oppression in society and the other factor more related to motivation to transform oppressive structures. For this study, I modified the items to capture both factors into a single factor structure. The CCW capital items were blocked together on the survey but were presented in random order within the block.

Familial Capital. The familial capital subscale consisted of four items related to the connections to and knowledge of family and kinship networks. One item was: “I learn a lot of valuable knowledge from my family members.” All four items used language identical to that in Sablan (2019).

Resistant Capital. The resistant capital subscale consisted of four items related to knowledge of and motivation to transform oppressive structures (Sablan, 2019). Two items used language identical to that in Sablan (2019): “I want to make a difference in the broader society.” and “I want to make a difference in my racial/ethnic/cultural community.” I modified one item from Sablan (2019): “I believe I will be able to make a difference in society, even if there are racial barriers.” I wrote one original item for this study: “I believe I can contribute to society in spite of racial/ethnic discrimination.”

Aspirational Capital. The aspirational capital subscale consisted of four items related to students’ ability to maintain hopes and dreams for the future (Sablan, 2019). One item was: “I believe that my dreams for my future are possible.” All four items used language identical to Sablan’s (2019) scale.

Navigational Capital. The navigational capital subscale consisted of four items related to the ability to navigate through schooling institutions that were not designed with communities of color in mind (Sablan, 2019). One item was: “I know how to find resources at my college.” All four items used language identical to that in Sablan (2019). Note that the literature tends to contextualize navigational capital within institutions which were not designed with communities of color in mind, but SCU has been a Hispanic-serving institution since 2010. One might assume that the institution has making efforts to operationalize the S in HSI for ten years. Evidence of such efforts may be related to the increase in Hispanic graduates overall, but also related to Hispanic students pursuing and earning STEM degrees. This contextualization of navigational capital and the related subscale may have presented challenges when interpreting results.

Persistence

I wrote five items related to persistence intentions in college which assessed students' intentions to continue their college education broadly, but also regarding their STEM major. The first item was "I plan on continuing my college education in Fall 2021." This item was presented to all participants prior to the remaining ItP items. The remaining items, presented in random order, included: "I intend to continue pursuing a STEM major after this semester," "I plan to continue taking courses for a STEM major," "I am thinking about switching my STEM major to a non-STEM major," and "I will obtain a STEM-related degree." The latter four items comprised the intent to persist in STEM scale.

Participant Eligibility Items

Two items were presented at the beginning of the survey to remind the participant that the survey was designed for STEM majors: "STEM is Science, Technology, Engineering, and Mathematics. If you are a STEM major, which of the following best describes your STEM major?" "If you are STEM major, which college is your STEM major in?" These items were self-report items and were worded such that students who were not yet "officially" STEM majors may still have considered themselves to be such.

Any student who considered themselves to be a STEM major and met the other sample criteria was included in the data. I generated the list of STEM majors based on SCU's undergraduate admissions webpage of majors and degrees titled "Science, Technology, Engineering, and Math." Two additional items helped to confirm inclusion of the participant in the data set. One item was: "With which of the following ethnic/cultural groups do you identify? Mark all that apply." The response options were: Hispanic, Latina/o, Mexican American, Chicana/o, Cuban, Puerto Rican, Central American, South American, None of these, and Other (Please write in). If a participant marked any of the options (other than None of these), they were eligible for further inclusion consideration in the final data set. Although they were not segregated out in the data other than for descriptive purposes, giving participants the options to mark specific options was an effort to acknowledge the many ways that Latina/o/x people identify ethnically and culturally. The other item was for academic classification which helped to identify a participant's year in school. Because there is sometimes ambiguity with the terms "freshman," "sophomore," etc., I asked the participant for the semester in which they first started taking courses at this institution, "In what semester did you start taking classes at this institution?" The response options indicated a semester and year: Spring 2021, Fall 2020, Summer 2020, Spring 2020, Fall 2019, and Before Fall 2019.

Items to Answer RQ 3

There were three items which helped to answer research question 3. These items included self-identification of gender, socioeconomic status (SES), and first-generation status. Gender was included due to its long history as a demographic variable in motivation and STEM research. SES and first-generation status were included because these were variables describing sizeable populations at Hispanic-serving institutions. The item for gender was carefully considered for sensitivity and included the following response options: Man / Transgender Man, Woman / Transgender Woman, Other (Please write in), and I prefer not to respond. The SES item asked about participants' eligibility for free or reduced breakfast and lunch when they were in high school. This served as a dichotomous proxy for their socioeconomic status. Response options were: Yes, No, and I'm not sure. The first-generation status item was: "Are you a first-generation college student in your family?" Response options were: Yes, No, and I'm not sure.

There were four additional demographic variables not a focus of this study but included as potentially useful and insightful for future study analysis. These included race, current GPA, international status, and housing status. A review of available national surveys including the United States Census 2020 (United States Census 2020, n.d.) and the race/ethnicity module of the Community College Survey of Student Engagement (CCCSE, n.d.) helped to inform the language used in these demographic items. All demographic items were presented in a specific order, not randomized.

Although none of the items were set to a forced response, I used a Qualtrics setting that "nudged" participants to answer any items that appear to be skipped. Appendix E includes the complete survey.

Open-Ended Items

There were four open-ended items which provided participants an opportunity to share additional information related to college persistence as well as STEM major persistence. These were presented in a fixed order and included: "Are you involved in any campus programs or organizations focused on student success in STEM? If yes, please briefly explain," "Has the COVID-19 pandemic positively or negatively impacted your decision to stay in college? If so, please briefly explain," "Has the COVID-19 pandemic positively or negatively impacted your decision to pursue a STEM degree? If so, please briefly explain," and "Are there aspects of your culture or family background that play a role in your decision to pursue a STEM degree? If so, please briefly explain."

Instrument Considerations

In utilizing existing items, constructing new items, and arranging the sequence of items in this instrument, I considered Johnson and Christensen's (2017) principles for questionnaire construction. Considerations included ensuring that item language matched the research objectives; using natural and familiar language; avoiding leading, loaded, double-barreled, and double-negative items; and checking for mutually exclusive and exhaustive responses categories. Table 3.4 provides an instrument summary aligning items to each research questions.

Instrument Analysis

Although the items from EVT and CCW have validity and reliability support in the literature, I still conducted instrument analyses for the current study. Prior to collecting data, I requested feedback from one Latina and two Latino doctoral students regarding the length of the instrument as a whole and on specific item language for general understandability. Through email correspondence, the feedback indicated that the survey as a whole was "organized and concise." Reviewers offered ideas for items ES_1, IntV_2, AspC_1, and ResC_1, but also noted that the items were understandable as written. I consulted Dr. Carlton Fong regarding item language and after considering all input, I chose to leave the item wording alone.

Table 3.4

Instrument Summary

Research Question	Item on Survey			
RQ 1	D1	D2	D_Ethn	D_Class
	ES_1	ES_2	ES_3	ES_4
	IntV_1	IntV_2	IntV_3	IntV_4
	AttV_1	AttV_2	AttV_3	AttV_4
	UtV_1	UtV_2	UtV_3	
	EffC_1	EffC_2	EffC_3	
	OppC_1	OppC_2	OppC_3	
	PsyC_1	PsyC_2	PsyC_3	PsyC_4
	ItP_1	ItP_2	ItP_3R	ItP_4
	ItP_5			
RQ 2	AspC_1	AspC_2	AspC_3	AspC_4
	FamC_1	FamC_2	FamC_3	FamC_4
	NavC_1	NavC_2	NavC_3	NavC_4
	ResC_1	ResC_2	ResC_3	ResC_4
RQ 3	D_GEND	D_SES	D_FirstGen	
Potential future exploratory analysis	D_GPA	D_Race		
	D_InterSt	D_House		
Open-ended items	OE_1	OE_2	OE_3	OE_4

Data Collection Materials

I used Qualtrics to construct the survey. The recruitment email to course instructors included a link to the survey in Qualtrics. Data collected by Qualtrics were exported to SPSS for data inspection and analysis. In this study, the survey instrument served as the single method of data collection.

Procedures

All procedures were designed to maintain the health and safety of all parties in the ongoing presence of COVID-19. I obtained Institutional Review Board (IRB) approval for the study from the study site. Once approval was given, I sent recruitment emails to selected instructors. Approximately two weeks following the first recruitment email, I sent follow-up reminder emails to instructors in an effort to boost student participation.

The survey remained open for a period of approximately six weeks from late March (just after spring break) to the end of April (the end of the spring semester). I inspected the data to determine which participants met eligibility criteria for final sample inclusion and completed the steps listed in the data analysis plan. The planning, data collection, and data analysis process is summarized in a three-phase process shown in Figure 3.1.

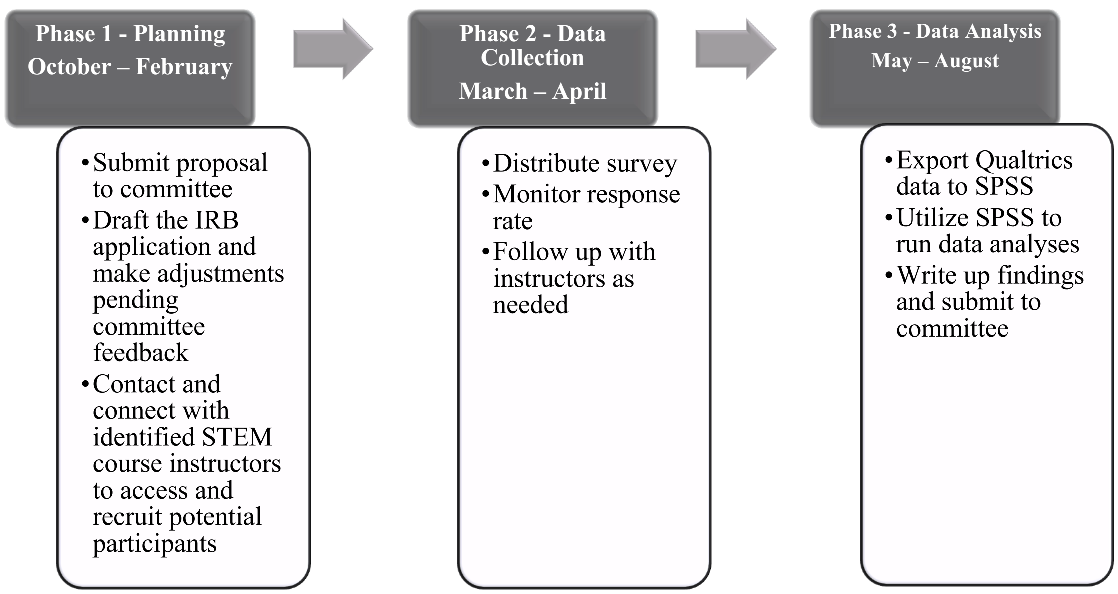


Figure 3.1

Flow Chart for Study Planning, Data Collection, and Data Analysis

Data Analysis

All analyses were conducted using SPSS**.**

Data Inspection

I reviewed the data set for participation consent and remove any cases for non-consent. I then inspected the data in several ways. First, I examined the cases for missing data beginning with necessary demographic information including the STEM major indicator and ethnicity indicator. These two pieces of information were required to determine eligibility for inclusion in the study sample. Next, I examined the data for missing data and considered the appropriateness of using different approaches to handling missing data such as multiple imputation and listwise deletion. I continued data inspection by reviewing outliers in the survey duration for times that seemed unusually short or long. Finally, I reviewed the item for general persistence as an additional criterion for sample inclusion. If participants indicated they were not returning to college at all, they were not eligible for inclusion.

In the next phase of data inspection, after reviewing for any item means that were unusually high or low, I generated a descriptive analysis for all variables in the study including means, standard deviations, and ranges of scores. I checked the assumption of normality by examining skewness and kurtosis as well as assessing a normal predicted probability (P-P) plot to determine if the residuals were normally distributed. Finally, I created an intercorrelation matrix with all independent and dependent variables.

Instrument Psychometric Properties

Although an instrument's psychometric properties may be located here in the methodology chapter, especially when items have considerable validity and reliability support in the literature (i.e., EV subscales), this study's instrument included CCW capital subscales with limited evidence of their psychometric properties within the literature. Therefore, I include a brief analysis plan in this chapter for the CCW capital scales but provide more details in Chapter 4. Psychometric properties for the EV scales are in Appendix F.

I conducted an exploratory factor analysis (EFA) to determine the dimensionality of the items in the CCW capital subscales. In theory, this analysis would reveal alignment with the same number of subscales in the studies from which the items originated (aspirational, familial, navigational, and resistant); however, with a different racial/ethnic group than Sablan's (2019) sample, some differences might be expected. I used statistical guidance from Price (2017) to facilitate the EFA process. The final number of factors should explain a substantial amount of cumulative variance, generally greater than 60% as a rule of thumb. A scree plot provided additional visual indication of how many factors had an eigenvalue greater than one, which should generally align with the number of factors contributing to the cumulative variance. Items that load onto a factor should have pattern matrix values of .60–.90. I examined the wording of items that loaded onto factors with values lower than .60 to consider whether the item should remain in the data. For items that cross-loaded onto more than one factor, I examined the item to determine whether to keep the item with one factor or the other (using theoretical guidance) or remove the item entirely. The factor correlation matrix showed the extent to which individual factors were correlated with one another. I conducted reliability analyses (using Cronbach's alpha) for the internal consistency of variable subscales. Scales with α

< .70 required item review to determine if certain items should be retained or removed followed by an updated reliability check with the new set of items.

Regression Analyses

RQ 1. To analyze RQ 1, I conducted a multiple (hierarchical) linear regression analysis to assess associations between the independent variables (ES, Values, and Costs) and the dependent variable (ItP). Multiple linear regression allowed me to determine both combined influence (overall model) of the independent variables on the dependent variable as well as the unique influence of each independent variable on the dependent variable. The following regression equation (main effects model) was used: y = b1*x1 + b2*x2 +b3*x3+…+ c; where y = estimated dependent variable, c = constant (which includes the error term), b = regression coefficients, and x = independent variables. The regression coefficients were useful for making predictions about what might happen to the dependent variable when there is control over the independent variables (Keith, 2019).

I assessed the assumptions of multiple regression: linearity, homoscedasticity, and absence of multicollinearity. Linearity assumes a straight-line relationship between the predictor variables and the criterion variable, and homoscedasticity assumes that scores are normally distributed about the regression line. I assessed linearity and homoscedasticity by examining a scatter plot. The absence of multicollinearity assumes that predictor variables were not too related and were assessed using variance inflation factors (VIF). VIF values over 10 suggested the presence of multicollinearity.

For the hierarchical multiple linear regression, variables were entered in blocks. I conducted the regression when I created or added a new block of variables. Therefore, the first regression needed to be Model 0 with only demographic variables in the first block. This is illustrated in Figure 3.2.

Figure 3.2

Research Question 1: Regression Model 0

To answer RQ 1, I then added to the regression by entering the EV variables simultaneously into the equation in the second block (see Figure 3.3). Variables were evaluated by what they added to the prediction of the dependent variable which is different from the predictability afforded by the other predictors in the model by assessing the amount of change in the R^2 value. I reported R^2—the multiple correlation coefficient of determination—and used the R^2 value to determine how much variance in the dependent variable was accounted for by the set of independent variables. The F-test was used to assess whether the variance explained from a set of independent variables collectively predicting the dependent variable was statistically significant. I used the standardized coefficients β to determine the significance of each predictor; standardized coefficients provided information about the relative importance of various influences on the dependent variable (Keith, 2019).

Considering empirical support in the literature (e.g., Fong et al., 2021; Jiang et al., 2018), I conducted regression analyses using composite variables for values and costs instead of analyses for three separate types of values and three separate types of costs. The values composite combined AttV, IntV, and UtV and the costs composite combined EffC, OppC, and PsyC. Future use of the terms *value* and *cost* variables in this study refer to the composite forms of these variables. Figure 3.3 illustrates the regression model. It is important to note that I also ran three "sub" regressions in which only one of the three EV variables was entered into block 2. In other words, in all, there were four regression models for EV variables in block 2, noted in Chapter 4 as Models 1 a-1 through 1 a-4. Prior to analyzing any interaction effects of CCW capitals with EV variables on ItP, it was important to know if CCW capitals had any influence on ItP without the presence of EV variables. Therefore, I conducted an additional regression like Model 1a, but I used CCW capitals instead, depicted in Figure 3.4. Similar to Model 1a, I conducted "sub" regressions for the CCW capitals by entering only one CCW capital at a time in block 2. Given the literature that suggests CCW capitals do not operate in isolation, I also ran a regression for an averaged composite CCW capital variable and a regression with simultaneous entry of the four CCW capitals. Although empirical work has not yet been done, there is conceptual consideration for both a composite CCV variable and for simultaneous entry (e.g., Espino, 2014; Ortiz et al., 2019; Samuelson & Litzler, 2016; Sánchez-Connelly, 2018). In all, there were six regression models for CCW capital variables in block 2, noted in Chapter 4 as Models 1 b-1 through 1 b-6.

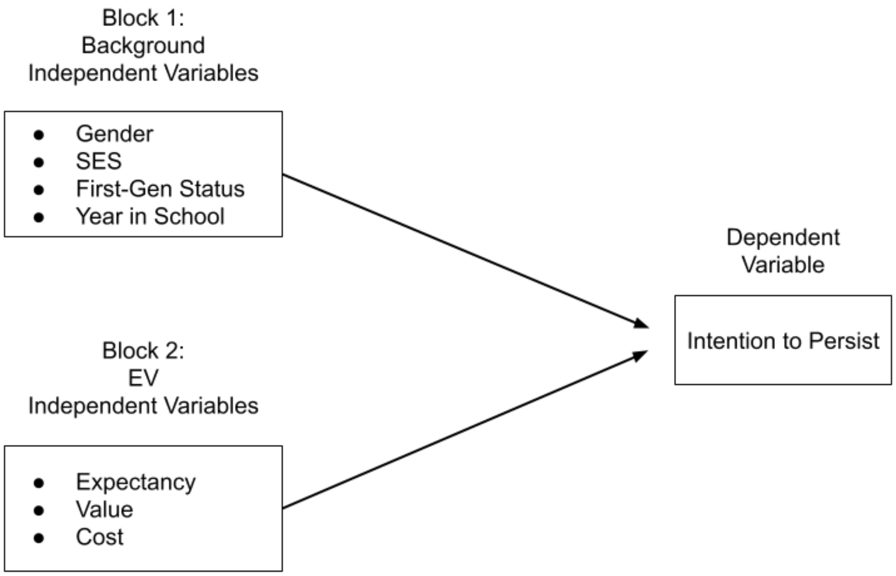


Figure 3.3

Research Question 1: Regression Model 1 a-4

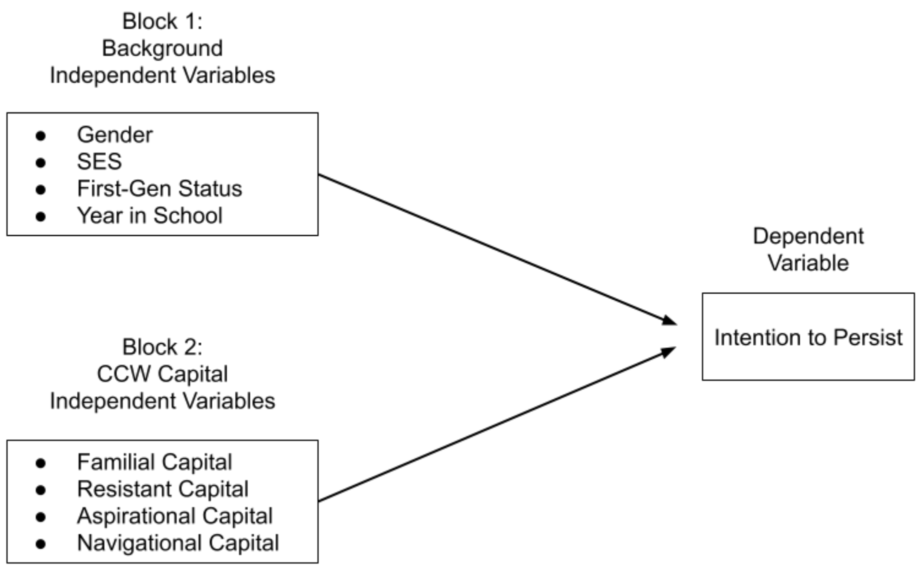


Figure 3.4

Research Question 1: Regression Model 1 b-6

RQ 2. To answer RQ 2, I conducted a set of hierarchical multiple linear regressions to test for interactions between the EV variables and the CCW capital variables. In other words, if one were to ask, "What is the influence of perceived costs on persistence?" The answer might be, "It depends on the magnitude of the student's perceived aspirational capital." The general sense of "it depends" means that a variable may moderate the extent to which the independent variable influences the dependent variable. To accomplish this, I created cross-product variables by multiplying the potential CCW capital moderator by the EV independent variable. The block sequencing was similar to RQ 1, with the addition of a CCW capital in a third block and then a cross-product variable in a fourth block. Again, I checked for the statistical significance of ΔR^2.

To help interpret statistically significant interaction effects, I conducted 2 x 2 ANOVAs and plotted interactions to assist in visualizing any differences. I ran this analysis for one CCW variable at a time. Statistical assumptions for this multiple regression were the same as for RQ 1 and were handled in the same way. I again evaluated the *F* test, ΔR^2, and standardized β. To systematically analyze combinations of CCW capitals and interactions, there were a total of 30 regression models for RQ 2, noted in Chapter 4 as Models 2 a-0 through 2 f-4. One sample regression model is illustrated in Figure 3.5.

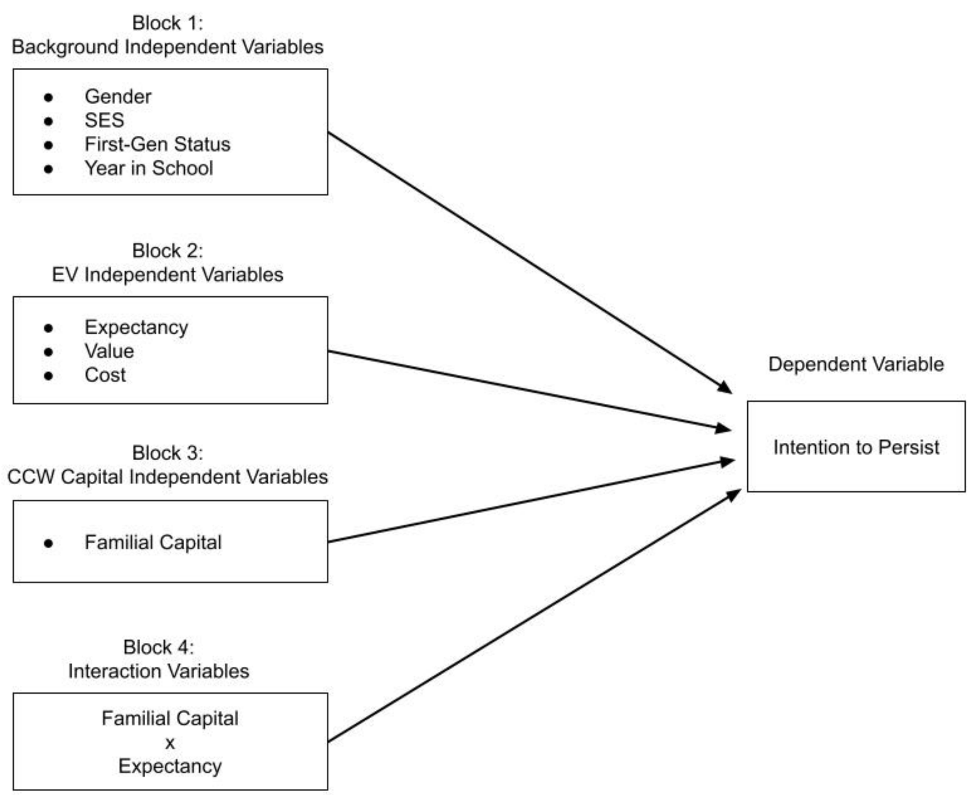


Figure 3.5

Research Question 2: Regression Model 2 a-1

RQ 3. The purpose of RQ 3 was to explore if there were any differences in the findings for RQ 2 based on gender, socioeconomic status, or first-generation status. As with RQ 2, the analyses were conducted using hierarchical multiple linear regression. The fifth block contained interaction variables that were the products of previous interaction terms with a dummy-coded demographic variable, such as ((Familial Capital x Expectancy) x Non-low SES). In all, there were three regression models for RQ 3, noted in Chapter 4 as Models 3 a, 3 b, and 3 c. One sample regression model is illustrated in Figure 3.6.

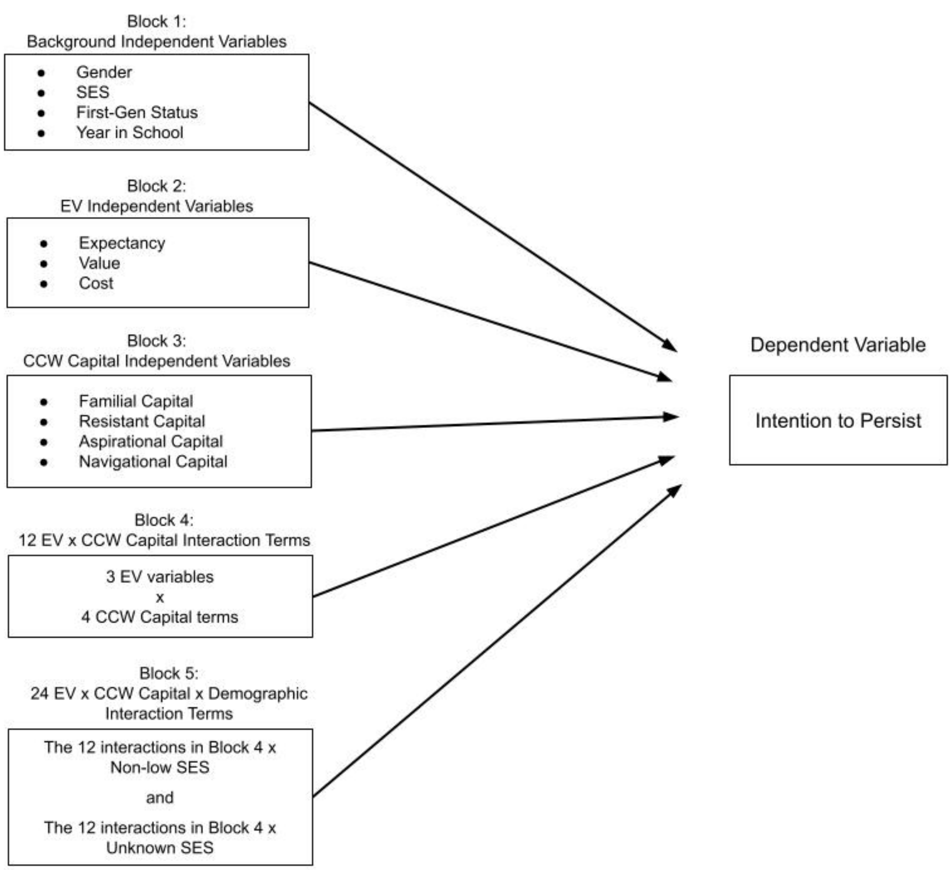


Figure 3.6

Research Question 3: Regression Model 3 a

Had there been statistically significant findings, i.e., an interaction effect, I would have conducted a pair of regressions to explore or tease apart any interactions indicated. For example, if there was an interaction indicated for gender, then I would have removed gender from Block 1, sorted the sample into subsets for men and women and rerun applicable regressions similar to the models in RQ 2. Analysis would have included a comparison of the findings for relative differences between groups, such as between men and women, including any statistically significant differences. In all the regression analyses, I interpreted standardized β values as noted in Table 3.5 (Keith, 2019).

Table 3.5

Effect Size Ranges

Magnitude of the effect	β
No meaningful effect	$\beta < .05$
Small effect	$\beta > .05$
Moderate effect	$\beta > .10$
Large effect	$\beta > .25$

Ethical Considerations

It is critical in any study that participants are treated in a manner which does not intentionally harm them physically, emotionally, or psychologically. The Belmont Report (United States, 1978) provides the imperative that participants in a study are not to be treated unethically. Special attention and care are given to vulnerable populations such as children and those who are incarcerated. In this study, all participation was voluntary for all aspects of data collection and required informed consent that included the nature and purpose of the study, the expected benefits, any potential harm, information about anonymity, confidentiality, and data security, and the right to withdraw from the study at any time. Informed consent was included in both the participant recruitment email as well as the beginning of the survey following the institution's template for survey informed consent. There were minimal perceived risks for participation. It is possible that while completing the survey, a student may have reflected that pursuing a STEM degree is not what they wanted to continue. Consequently, this realization may have upset the student if they believed they had wasted their time in STEM degree required courses. On the other hand, one potential benefit to participants was that by reflecting on their beliefs related to self-efficacy, values, costs, and CCW capitals, participants developed a new resolve and commitment toward persisting in their STEM field. This may have affirmed a student's inclination to persist with a STEM course of study or may have nudged a student to persist who was doubting. Or, if STEM was not what they wanted to continue, they may have experienced relief that they were leaning toward a new college major earlier in their college career rather than later.

To obtain site authorization, the required IRB form was submitted to the study site's IRB in all manner and time required. Approval from the IRB was received on March 22, 2021. There were no known conflicts of interest for me to conduct this research study. In addition, there was no purpose for incomplete disclosure, deception, or concealment; therefore, all items were designed and intended to be fully transparent regarding elements of motivation and elements of CCW capital. The full IRB approval letter is in Appendix G.

4. RESULTS

This study examined in detail the influences of motivation variables and community cultural wealth (CCW) capital variables on Latina/o/x students' intentions to persist (ItP) in their STEM major. The research questions (RQ) were:

- RQ 1: For Latina/o/x students in STEM majors enrolled at a Hispanic-serving institution, what are the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 2: In what ways do perceived CCW capitals, including familial capital, resistant capital, aspirational capital, and navigational capital moderate the associations between expectancy-value variables and students' intention to persist in their STEM major?
- RQ 3: Do the findings for question 2 differ depending on gender, socioeconomic status, or first-generation status?

This study was exploratory; therefore, general theoretical predictions were more applicable than specific hypotheses. For RQ 1, I predicted that expectancy of success (ES) and value would be positively related to ItP and that costs would be negatively related to ItP. Based on the literature, I also predicted that higher levels of CCW capitals would be positively related to ItP. For RQ 2, I predicted, theoretically, that CCW capitals would moderate the influence of motivational constructs on ItP. For example, if two students both had a high expectancy of success, perhaps the student with higher aspirational capital would have higher ItP, and CCW capitals would be multiplicative. Conversely, if two students both had a high sense of cost in persisting in their STEM major, which can reduce ItP, perhaps navigational capital would mitigate the negative impact and the student with greater navigational capital would have a higher ItP. For RQ 3, there were no predictions regarding differences in ItP across gender, first-generation status, or socioeconomic status.

The results presented in this chapter are organized as follows. First, I share my process of data cleaning and handling of missing data. Next, to describe the sample, I present descriptive statistics for background independent variables (gender, first-generation status, and socioeconomic status), STEM majors represented (e.g., biology, chemistry, etc.), Latina/o/x-related ethnicities represented (e.g., Chicana/o, Hispanic, South American, etc.), and additional demographic characteristics. Then, I report the psychometric properties of the survey instrument including findings from exploratory factor analyses as well as reliability coefficients. Next, I provide descriptive statistics for the independent and dependent variables (e.g., means, standard deviations, etc.) along with bivariate correlations. Then, I show the regression results for each research question including analyses of variances (ANOVAs) for statistically significant interaction effects. Finally, I summarize the results and preview the study discussion, implications, and conclusions.

Sample Characteristics

Data Cleaning and Missing Data

A total of 424 participants accessed the survey. First, I reviewed the data set for participation consent and removed two cases for selecting non-consent. Next, I examined the completeness of each case as percent completion. I marked all entries with less than 50% completion as ineligible for analysis (n = 51). I marked several additional entries ranging from 80–84% completion as ineligible for analysis because they lacked necessary demographic information to determine inclusion into the final sample (*n* = 5). All remaining cases were 100% complete for all survey items necessary for the analysis (i.e., demographic characteristics and subscales). As this seemed unusual, I double checked each survey item for each case and verified that there were no missing data. This meant that I made no additional statistical decisions for handling missing data.

I examined remaining cases for survey duration outliers. Qualtrics reported a participant's survey duration in seconds, which I converted to minutes for easier interpretation. I inspected the data for durations that seemed unusually short or long which may indicate the extent to which a participant was giving the survey too little attention to consider as a reliable set of responses. I calculated a mean number of minutes (18.31 minutes), then calculated the standard deviation (*SD* = 75.29). Using bounds for the mean time spent on the survey (mean ±1 SD, mean ± 2 SD, and mean ± 3 SD), I found that 97.54% of all cases (*n* = 357) fell within one SD of the mean, 98.63% of all cases (*n* = 361) fell within two SDs of the mean, and 98.91% of all values (*n* = 362) fell within three SDs of the mean. I elected to remove the three entries at each end of the data (duration ≤ 4.4 minutes, duration ≥ 5.5 hours) and keep all remaining entries.

Next, I examined the data for general persistence and found that four students indicated they would not be returning to college at all in fall 2021. I marked these cases ineligible for analysis. Upon closer inspection, these appeared to be students who began attending the institution prior to fall 2019, meaning that graduation was a likely reason they were not returning. After removing cases for non-consent, incompletion, duration outliers, and non-persistence, remaining cases totaled 356.

Next, I examined demographic responses and created additional variables codes that condensed detailed codes to binary codes. For example, I created a binary code for the student's major, 0 = non-STEM major and 1 = STEM major. I also created a binary code for ethnicity, 0 = none of the Latina/o/x options and 1 = any of the Latina/o/x options. I examined gender data marked as "Other" and recoded them as either man or woman based on their text entry (*n* = 13). I recoded seven to "None indicated" for gender selections of "I prefer not to respond" and text entries such as "King."

Final Sample Demographic Characteristics

The final sample included 152 undergraduate students who self-identified as both Latina/o/x and as a STEM major. Although I intended to include only first-year students, I needed a minimum sample size relative to the number of independent variables (Keith, 2019) of 140. As the data collection progressed, it became increasingly clear that reaching 140 with only first-year students was unlikely. Therefore, I included students who were not only first-year STEM majors, but also second- and third-year STEM majors. The sample was approximately 30% first-year students (*n* = 46), 36% second-year students (*n* = 55), and 34% third-year students (*n* = 51). Due to the inclusion of second- and third-year students, I elected to control for year in school in the regression analyses. Overall, the sample was approximately 41% male (*n* = 62) and 59% female (*n* = 90); approximately 48% first-generation (*n* = 73), 49% non-first-generation (*n* = 74), and 3% unknown generation status (*n* = 5); and approximately 48% low socioeconomic status in high school (*n* = 73), 41% non-low socioeconomic status in high school (*n* = 63), and 11% unknown socioeconomic status in high school (*n* = 16). These data are summarized in Table 4.1.

Table 4.1

Participant Demographic Characteristics Included in the Analysis

Demographic characteristic	All Years		Year 1	Year 2	Year 3
	n	%	*n*	*n*	*n*
All participants	152	100	46	55	51
Gender					
Male	62	40.79	13	25	24
Female	90	59.21	33	30	27
First-generation status					
First-generation student	73	48.03	19	24	30
Non-first-generation student	74	48.68	24	31	19
Unknown first-generation status	5	3.29	3	0	2
Socioeconomic status (SES) in high school					
Low SES	73	48.03	20	25	28
Non-low SES	63	41.45	18	23	22
Unknown SES	16	10.53	8	7	1

Recall that two criteria were used to determine participant inclusion. One was the self-identification of STEM major. At the study site, STEM majors are housed across colleges and include majors related to agriculture, biology, chemistry, computer science, engineering, exercise and sports science, family and consumer science, geographic sciences, health sciences, mathematics, nursing, physics, and pre-professional certified majors (e.g., pre-medical). As a point of interest, three majors accounted for more than half of the participants. Biology majors were approximately 30% of the sample (n = 46), engineering majors were 13% of the sample (n = 19), and pre-professional majors were also 13% of the sample (n = 20). The second criterion for participant inclusion was self-identification with any of the Latina/o/x-related ethnicities. Nearly 50% of participants selected more than one term to describe their Latina/o/x-related ethnic identity. That noted, nearly 80% of participants selected *Hispanic* as an identifier. Nearly 40% selected *Latina/o*, and approximately 35% selected *Mexican American*. Although the data were not analyzed by specific STEM major or by specific Latina/o/x identification, Tables 4.2 and 4.3 offer detailed representations.

Table 4.2

Participant Demographic Characteristics – STEM Major Detail

Demographic characteristic	All Years		Year 1	Year 2	Year 3
	n	%	*n*	*n*	*n*
All participants	152	100	46	55	51
STEM Major					
Agricultural Sciences: General Agriculture, Animal Science, Horticulture, and Agricultural Mechanics	8	5.26	5	2	1
Biology: General Biology, Aquatic Biology, Microbiology and Wildlife Biology	46	30.26	9	20	17
Chemistry and Biochemistry	13	8.55	2	6	5
Computer Science	6	3.95	0	2	4
Engineering: Civil Engineering, Electrical Engineering, Engineering Technology, Industrial Engineering, and Manufacturing Engineering	19	12.50	5	6	8
Exercise and Sports Science	2	1.32	2	0	0
Family and Consumer Science: Nutrition and Foods (Dietetics)	2	1.32	0	1	1
Geography: Geographic Information Science, Resource and Environmental Studies, Water Resources	4	2.63	2	2	0
Health Science: General Health Science, Clinical Laboratory Science, Radiation Therapy, and Respiratory Care	10	6.58	4	4	2
Mathematics	12	7.89	2	4	6
Nursing	8	5.26	6	2	0
Physics	1	0.66	1	0	0
Pre-Professional: Pre-Dental, Pre-Medical, Pre-Pharmacy, Pre-Veterinary	20	13.16	8	5	7
STEM Major not specified	1	0.66	0	1	0

Table 4.3

Participant Demographic Characteristics – Ethnicity Detail

Demographic characteristic	All Years		Year 1	Year 2	Year 3
	n	%	*n*	*n*	*n*
All participants	152	100	46	55	51
Ethnicity					
Central American	20	13.16	10	5	5
Chicana/o	7	4.61	3	2	2
Cuban	6	3.95	1	3	2
Hispanic	119	78.29	34	43	42
Latina/o	59	38.82	12	26	21
Mexican	1	0.66	0	0	1
Mexican American	53	34.87	10	19	24
Puerto Rican	5	3.29	0	5	0
South American	5	3.29	1	3	1
Marked more than one response	73	48.03	15	33	25

Note. Some participants marked more than one response; therefore, the total percent will not equal 100.

Four additional self-reported demographic characteristics including race, grade point average (GPA), housing status, and international student status are summarized in Table 4.4. These data were not independent variables analyzed in this study but may be a source of data for future research and still offered valuable contextual information for the sample. More than two-thirds of participants (n = 107) identified as *White*, which is consistent with the United States Census's inclusion of Hispanic people groups in this category. However, roughly 10% of participants selected more than one option for race and an additional 13% marked *None of these*. This indicates that nearly one in four participants determined that the list of races did not offer an option that was either sufficient or applicable. The grade point average (GPA) data show that just over 60% of participants have a current overall GPA above 3.0, which is a GPA level typically indicative of strong overall student achievement (i.e., a student with at least a 3.0 GPA for the semester "makes the Dean's List" at SCU). Approximately 20% of participants indicated that they lived on campus and another 20% lived off campus with family. The majority, approximately 58%, indicated that they lived off campus, not with family, and 2% preferred not to respond. Only two participants (1.32%) indicated an international status.

Table 4.4

Participant Demographic Characteristics – Not Included in the Study

Demographic characteristic	All Years		Year 1	Year 2	Year 3
	n	%	*n*	*n*	*n*
All participants	152	100	46	55	51
Race[a]					
African American / Black	10	6.58	3	4	3
American Indian or Alaska Native	9	5.92	5	3	1
Asian	5	3.29	0	4	1
Native Hawaiian / Pacific Islander	3	1.97	1	1	1
White	107	70.39	33	39	35
None of these	20	13.16	6	4	10
Marked more than one response	15	9.87	5	8	2
Prefer not to respond	10	6.58	1	7	2
Grade point average (GPA)					
0.0 – 0.5	0	0.00	0	0	0
0.6 – 1.0	1	0.66	1	0	0
1.1 – 1.5	0	0.00	0	0	0
1.6 – 2.0	6	3.95	1	2	3
2.1 – 2.5	16	10.53	2	4	10
2.6 – 3.0	28	18.42	2	8	18
3.1 – 3.5	52	34.21	20	22	10
3.6 – 4.0	43	28.29	17	17	9
I do not know my GPA.	5	3.29	3	2	0
I do not have a GPA yet.	1	0.66	0	0	1
Housing status					
I live on campus.	29	19.07	24	2	3
I live off campus with family.	31	20.39	9	14	8
I live off campus, not with family.	89	58.55	12	39	38
I prefer not to respond.	3	1.97	1	0	2
International student status					
International student	2	1.32	0	0	2
Not an international student	150	98.68	46	55	49

[a] Categories are based on the 2020 United States Census. Some participants marked more than one response; therefore, the total percent will not equal 100.

Instrument Psychometric Properties

An instrument's psychometric properties are often discussed in the methodology chapter, especially when instrument items have considerable validity and reliability support in the literature. The survey instrument in this study included both well-studied subscales (i.e., expectancy, value, and cost) as well as CCW capital subscales, which have limited evidence of their psychometric properties within the literature. For this reason, I opted to split the reporting of psychometric properties into two locations. I placed the well-supported properties of expectancy, value, and cost in Appendix F for reference, and made exploration of the psychometric properties for the CCW capitals a priority in the analysis plan. Given the emergent quantitative use of the CCW capital subscales, it seemed most appropriate to report all instrument psychometric properties of validity, dimensionality, and reliability together in this chapter.

Dimensionality and Reliability

Stating the purpose of the test is vital when reporting and considering validity evidence because the evidence may be dependent on context including characteristics of the population. The intent of the EVT subscales was to assess participants' beliefs for expectancy, value, and cost related to their STEM major. The intent of the CCW capital subscales was to assess participants' perceived levels of CCW capital, regardless of college major. For this reason, I examined construct validity, focusing mainly on analyzing the internal structure of the instrument and the extent to which relationships among survey items align with the survey's intended construct(s), i.e., factor analysis (Price, 2017). I conducted an exploratory factor analysis (EFA) and reliability analyses (using Cronbach's alpha) for both the EV items as well as the CCW capital items.

Appendix H includes the EFA options and indicators considered and used for this instrument.

Exploratory Factor Analysis: CCW Capital Items

Ideally, the 16 items representing four types of CCW capital would factor as intended. The principal components analysis (PCA) approach with promax rotation produced the greatest percent variance explained (60.3%) with the strongest initial factor loadings. I pursued a series of adjustments by removing one or another cross-loading item or items, and I also created iterations using a fixed (forced) number of factors. In some iterations, items AspC_1 and AspC_4 factored as their own factor as did NavC_2 and NavC_4. Having multiple items on a scale can increase construct validity by measuring different aspects or attributes of a construct. When items are removed from scales, there is risk of reducing content validity and determining reliability. Given these limitations, after reviewing the item language, I nevertheless kept only the two aspirational capital items that used future-oriented language (AspC_2 and AspC_3) and removed the two items that were not future-oriented (AspC_1 and AspC_4). More closely examining item content, I also elected to remove NavC_2 and NavC_4 as being more closely related to social capital (not a type of CCW capital included in this study) than to a resource- and process-oriented capital. Although having two CCW capital subscales with two items each was not ideal, the resulting pattern matrix for the remaining 12 CCW capital items, without a forced number of factors, explained 71.4% of the variance (see Table 4.5 and Table 4.6). Figure 4.1 shows the scree plot, which visually supports a four-factor structure with items loading on theorized subscale constructs. Bartlett's test of sphericity was statistically significant (χ^2 (66) = 669.67, p < .000) indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicated that the strength of the relationships among variables was high (KMO = .758), indicating it was acceptable to proceed with the analysis.

Table 4.5

Percent Variance Explained for CCW Capitals

	Initial Eigenvalues			Extraction Sum of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.93	32.75	32.75	3.93	32.75	32.75	2.87
2	2.03	16.95	49.70	2.03	16.95	49.70	3.03
3	1.44	12.01	61.70	1.44	12.01	61.70	2.56
4	1.17	9.71	71.41	1.16	9.71	71.41	2.03
5	.62	5.18	76.59				
6	.58	4.82	81.41				
7	.53	4.41	85.82				
8	.45	3.75	89.57				
9	.39	3.27	92.84				
10	.34	2.82	95.66				
11	.29	2.38	98.04				
12	.24	1.96	100.00				

Note. Extraction method: Principal component analysis.
[a]When components are correlated, sums of squared loadings cannot be added to obtain a variance.

Table 4.6

Pattern Matrix for an Unforced CCW Capital Structure

	Component			
Item	1	2	3	4
FamC_1	**.879**			
FamC_4	**.826**			
FamC_2	**.704**		.319	
FamC_3	**.693**			
ResC_1		**.948**		
ResC_2		**.873**		
ResC_4	.271	**.613**		
ResC_3		**.586**	.338	.225
AspC_3			**.921**	
AspC_2			**.895**	
NavC_3				**.905**
NavC_1				**.855**

Note. Extraction method: Principal component analysis. Rotation method: Promax with Kaiser normalization. Rotation converged in 5 iterations. Loading values below .20 were suppressed.

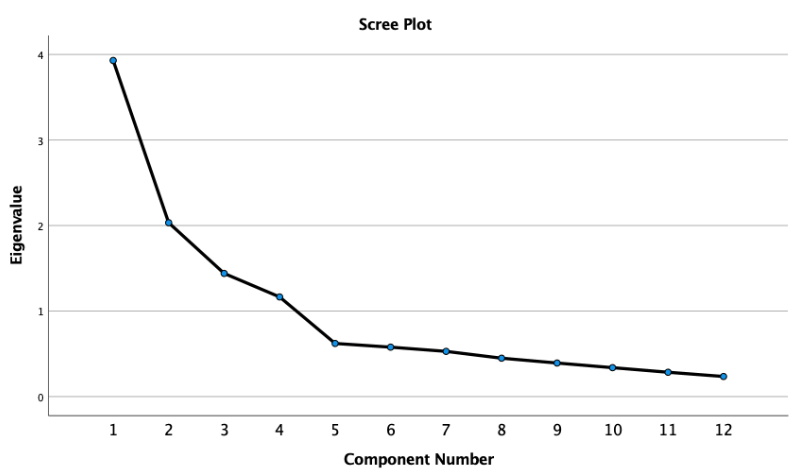


Figure 4.1

Scree Plot for CCW Capitals

A Cronbach's alpha coefficient value of α = .80 is a widely preferred minimum standard for reliability, although α = .70 is considered acceptable (Price, 2017). Subscale reliability coefficients for familial capital (α = .78), resistant capital (α = .82), aspirational capital (α = .81), and navigational capital (α = .72) each met acceptable research standards. I also calculated reliability statistics for a composite CCW capital subscale using all 12 CCW capital items (α = .80).

I examined reliability statistics for the persistence scale (ItP) and examined the single item that was reverse coded. This included examining the order of the reverse-coded item response options. The Cronbach's alpha coefficient without the reverse-coded item was much higher (α = .89) than with the reverse-coded item (α = .71); therefore, I elected to remove the reverse-coded item from further analysis.

Descriptive Statistics for Theoretical Subscales

This section provides descriptive statistics for subscale response range, means, standard deviations, and skewness. Table 4.7 provides a statistical summary; histograms for each scale are in Appendix I. The responses for each subscale ranged from the minimum of 1 to the maximum of 5. Overall, the means for STEM expectancy (*M* = 3.84, *SD* = .63) and STEM major value (*M* = 4.10, *SD* = .48) were high, whereas the mean for STEM major cost (*M* = 3.32, *SD* = .72) was moderate, or closer to the midpoint of the scale. In the CCW capitals, aspirational and resistant capital had high means (*M* = 4.39, *SD* = .71; *M* = 4.28, *SD* = .64, respectively). Navigational and familial capital had means closer to the midpoint of the scale (*M* = 3.72, *SD* = .85; *M* = 3.58, *SD* = .99, respectively). The composite capital computed variable mean was 3.97 (*SD* = .56). Skewness values for these subscales ranged from -1.53 to -.23, which falls within a generally accepted skewness range from -2 to 2 (Field, 2000, 2009; Gravetter & Wallnau, 2014; Trochim & Donnelly, 2006). However, I observed that the mean for ItP was negatively skewed beyond the acceptable cutoffs of the absolute value of 2 (*M* = 4.58, *SD* = .58, skewness = -2.15). This was problematic because the primary purpose of the study was to explore relationships between theoretical constructs and students' intentions to persist in their STEM major. If the mean for the ItP scale was already high at 4.58, there was little room for analysis and potentially indicated a ceiling effect. To adjust for skewness, I transformed the raw data using several approaches including using the log values, square root values, cube root values, squared values, and reciprocal values. The reciprocal approach reduced skewness the most (skewness = -.50). All regression analyses were completed for both the raw and transformed data. I use subscripts r and t to denote these two versions of the outcome variable, raw and transformed, respectively.

Table 4.7

Descriptive Statistics for All Subscales

Subscale	Number of Items	Cronbach's alpha	Subscale Mean	Standard Deviation	Skewness
Expectancy	4	.77	3.84	.63	-.85
Value	11	.82	4.10	.48	-.58
Cost	10	.83	3.32	.72	-.23
Familial capital	4	.78	3.58	.99	-.72
Resistant capital	4	.82	4.28	.64	-.92
Aspirational capital	2	.81	4.39	.71	-1.53
Navigational capital	2	.72	3.72	.85	-.66
Composite capital	12	.80	3.97	.56	-.33
Intention to persist	3	.89	4.58	$.58_r$	-2.15_r
				$.24_t$	$-.50_t$

Note. r = raw data, t = transformed data

Bivariate Correlations

An examination of bivariate correlations (see Table 4.8) revealed relationships within and across theoretical constructs and provided a check for linearity between the predictor variables and the criterion variable. Within expectancy-value theory, as expected, expectancy of STEM major success and STEM major value had a moderate, positive correlation ($r = .439$, $p < .01$). STEM major cost had a moderate negative correlation with STEM major expectancy ($r = -.442$, $p < .01$) and a weak, negative correlation with STEM major value ($r = -.246$, $p < .01$). Within CCW capitals, all types of capital were statistically significantly and positively correlated, with the strongest correlation between aspirational capital and resistant capital ($r = .448$, $p < .01$). In other words, when students' aspirational capital increased, their resistant capital also tended to increase and vice versa. The weakest correlation was between aspirational capital and familial capital ($r = .161$, $p < .05$).

Across theoretical constructs, there was one moderate correlation between STEM major expectancy and aspirational capital ($r = .427$, $p < .01$). Additionally, STEM major expectancy had a small to moderate positive association with resistant capital ($r = .317$, $p < .01$), navigational capital ($r = .310$, $p < .01$), and composite capital ($r = .307$, $p < .01$). STEM major value indicated a small to moderate positive association with resistant capital ($r = .310$, $p < .01$), navigational capital ($r = .321$, $p < .01$), and composite capital ($r = .301$, $p < .01$). STEM major cost showed a small, negative association with aspirational capital ($r = -.258$, $p < .01$), navigational capital ($r = -.266$, $p < .01$), and composite capital ($r = -.202$, $p < .05$).

Table 4.8

Bivariate Pearson Correlations

	ES	Value	Cost	FC	RC	AC	NC	CC	ItP_r
E	--								
V	.439***	--							
C	-.442***	-.246**	--						
FC	.029	.130	-.074	--					
RC	.317***	.310***	-.094	.283***	--				
AC	.427***	.112	-.258**	.161*	.448***	--			
NC	.310***	.321***	-.266**	.276**	.226**	.211**	--		
CC	.307***	.301***	-.202*	.807***	.702***	.532***	.549***	--	
ItP_r	.292***	.250**	-.239**	.010	.148	.149	.096	.119	--
ItP_t	.338***	.329***	-.258**	.012	.120	.178*	.116	.120	.924***

Note. E = expectancy, V = value, C = cost, FC = familial capital, RC = resistant capital, AC = aspirational capital, NC = navigational capital, CC = composite capital, ItP = Intention to persist, r = raw, t = transformed
$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Regression Analyses

The two main purposes of this study were to examine the associations between expectancy-value theory constructs of expectancy, value, and cost and Latina/o/x students' intentions to persist (ItP) in their STEM major and to explore the possibility that CCW capitals moderate these associations. To answer these questions, I conducted hierarchical multiple linear regression analyses, controlling for background demographic variables. I used a systematic approach to construct the regression models, and I reported results for both the raw ItP data as well as the transformed ItP data. This section includes the regression models and results per research question.

Assumptions

I tested the regression data for assumptions of normality, homoscedasticity, and absence of multicollinearity using standard statistical methods. For normality, in addition to assessing the kurtosis and skewness of the measured variables, I examined a normal predicted probability (P-P) plot to determine if the residuals were normally distributed. Residuals conformed to the diagonal normality line indicated in the plot shown in Figure 4.2. A review of scatterplots for both the raw and transformed data suggested a visual pattern meeting the assumption of homoscedasticity (a non-cone-shaped plot). The variance inflation factors (VIF) for all predictor variables were less than a value of 10 in both the raw and transformed data, indicating an absence of multicollinearity.

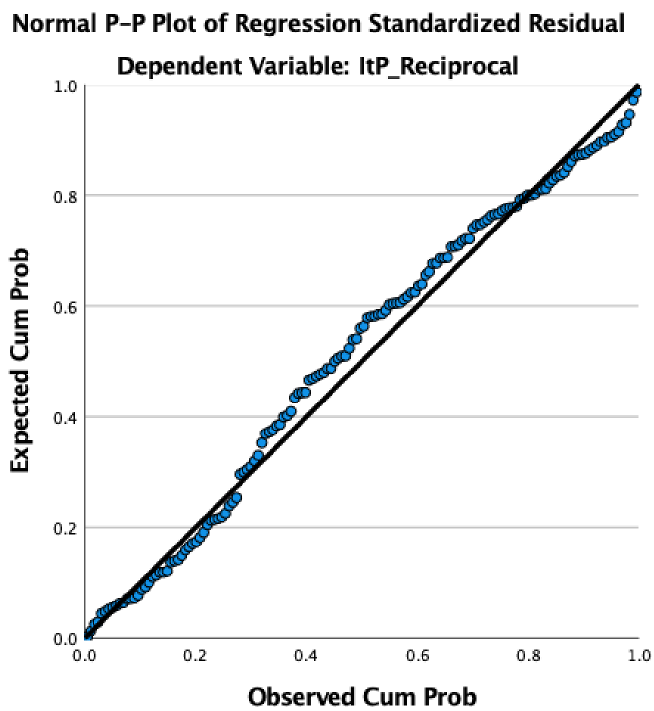


Figure 4.2

Normal Predicted Probability Plot for the Dependent Variable

Background Demographic Variables

Prior to conducting regressions for the research questions, I ran regressions for the background demographic variables of gender, first-generation status, and socioeconomic status. Year in school was not originally a control variable but was added when I elected to include more than first-year students in the sample. Results from this regression are noted as *Model 0* (see Tables 4.9 and 4.10).

For the raw data, taken as a set, the demographic predictors of gender, first-generation status, socioeconomic status, and year in school accounted for 5.8% of the total variance in students' ItP in their STEM major. The overall regression model was not statistically significant, $F(8, 143) = 1.097$, $p = .369$, $R^2 = .058$. However, when controlling for all other demographic variables, the students with higher SES had higher ItP ($\beta = .200$, $SE = .107$, $p = .03$) compared to students with lower SES. This was the only statistically significant predictor in this model.

For the transformed data, taken as a set, the same set of demographic predictors accounted for 8.2% of the total variance in students' ItP in their STEM major. The overall regression model was not statistically significant, $F_t(8, 143) = 1.591$, $p_t = .132$, $R^2_t = .082$. However, when controlling for all other demographic variables, both the students with higher SES and even unknown SES had higher ItP ($\beta_t = .242$, $SE_t = .043$, $p_t = .008$; $\beta_t = .176$, $SE_t = .067$, $p_t = .044$) compared to students with lower SES, respectively. Once again, this was the only statistically significant predictor for this model.

Table 4.9

Regression Model 0: Background Demographic Variables

Model	Block 1	Block 2	Block 3	Block 4
0	Demographics	-----	-----	-----

Note. Demographics include gender, first-generation status, socioeconomic status, and year in school.

Table 4.10

Regression Results for Model 0: Background Demographic Variables

Demographic Variables	Raw Data			Transformed Data		
	β_r	SE_r	R^2_r	β_t	SE_t	R^2_t
Model 0			.058			.082
Gender: Woman	-.050	.098		-.073	.039	
Gender: Unknown	.032	.664		.043	.266	
First-generation status: Not First-generation	-.010	.104		-.045	.041	
First-generation status: Unknown	.069	.306		.074	.123	
Socioeconomic status (SES): Not low SES	.200*	.107		.242**	.043	
Socioeconomic status (SES): Unknown	.159	.166		.176*	.067	
Year in school: Year 2	.032	.119		.104	.048	
Year in school: Year 3	.089	.124		.104	.050	

Note. Gender reference = Man, First-generation status reference = First-generation student, SES reference = Low SES, Year in school reference = Year 1
*$p < .05$, **$p < .01$

Research Question 1: For Latina/o/x students in STEM majors enrolled at a Hispanic-serving institution, what are the associations between expectancy-value variables and students' intention to persist in their STEM major?

I constructed the hierarchical regression models such that each model provided results for a single variable at a time. I then included a model in which all related variables were added at the same time. This systematic approach allowed me to identify when constructs were making statistically significant unique contributions to the variance in ItP. By also constructing a model in which multiple related variables were simultaneously entered, I could identify which constructs continued to make unique contributions to the variance and which no longer made unique contributions, while controlling for all other variables. These are represented as Model 1. (Note that although the original research question did not include the associations between CCW capital variables and students' ItP in their STEM major, it made sense to also explore these associations prior to positioning CCW capital variables as potential moderators.) Therefore, models 1 a-1 through 1 a-4 represent the regressions for the expectancy-value variables, and models 1 b-1 through 1 b-6 represent the regressions for CCW capital variables (see Table 4.11). Model 0 is the "parent model" for Model 1, or the model controlling for demographic variables prior to entering additional blocks.

Table 4.11

Hierarchical Regression Model 1: Research Question 1

Model	Block 1	Block 2	Block 3	Block 4	Block 5
1 a-1	Demographics	Expectancy	-----	-----	----
1 a-2	Demographics	Value	-----	-----	----
1 a-3	Demographics	Cost	-----	-----	----
1 a-4	Demographics	Expectancy, Value, Cost	-----	-----	----
1 b-1	Demographics	Familial Capital	-----	-----	----
1 b-2	Demographics	Resistant Capital	-----	-----	----
1 b-3	Demographics	Aspirational Capital	-----	-----	----
1 b-4	Demographics	Navigational Capital	-----	-----	----
1 b-5	Demographics	Composite Capital	-----	-----	----
1 b-6	Demographics	Familial Capital, Resistant Capital, Aspirational Capital, Navigational Capital	-----	-----	----

Models 1 a-1 through 1 a-4. In Model 1 a-1, for both the raw and transformed data, taken as a set, the demographic predictors plus expectancy of STEM major success accounted for 15.3% and 21.2% of the total variance in students' ItP in their STEM major, respectively. The overall regression models were statistically significant, $F_r(9, 142) = 2.851$, $p_r = .004$; $F_t(9, 142) = 4.211$, $p_t = .001$. A change in R^2 indicates the increase of explained variance in ItP above and beyond the previous regression block (parent model). Not only can an overall model be statistically significant, but the *change* in percent variance explained can also be statistically significant, indicating a statistically significant amount of variance explained above and beyond the variables from the prior block(s). The change in percent variance explained was statistically significant in both the raw and transformed data. The addition of expectancy of STEM major success increased the percent variance explained by 9.5% in the raw data, $F_r(1, 142) = 15.970$, $p_r < .001$, and 12.9% in the transformed data, $F_t(1, 142) = 23.201$, $p_t < .001$. Expectancy of STEM major success was a statistically significant and positive, unique contributor to the variance when controlling for other variables ($\beta_r = .314$, $p_r < .001$; $\beta_t = .366$, $p_t < .001$).

In model 1 a-2 in the transformed data, taken as a set, the demographic predictors plus STEM major value accounted for 17.3% of the total variance in students' ItP in their STEM major. The overall regression model was statistically significant, $F_t(9, 142) = 3.289$, $p_t = .001$. The overall model in the raw data was not statistically significant. The addition of STEM major value to the model increased the percent of variance explained by 5.1% in the raw data, $F_r(1, 142) = 8.125$, $p_r = .005$ and 9.1% in the transformed data, $F_t(1, 142) = 15.578$, $p_t = .000$. As a negative predictor, STEM major value was a statistically significant unique contributor to the variance when controlling for other variables ($\beta_r = .231$, $p_r = .005$; $\beta_t = .308$, $p_t < .001$).

For both the raw and transformed data in model 1 a-3, taken as a set, the demographic predictors plus STEM major cost accounted for 11.6% and 15.4% of the total variance in students' ItP in their STEM major, respectively. The overall regression models were statistically significant, $F_r(9, 142) = 2.078$, $p_r = .035$; $F_t(9, 142) = 2.879$, $p_t = .004$. The addition of STEM major cost to the regression increased the percent variance explained by 5.9% in the raw data, $F_r(1, 142) = 9.412$, $p_r = .003$, and 7.3% in the transformed data, $F_t(1, 142) = 12.193$, $p_t = .001$. STEM major cost was a statistically significant unique contributor to the variance when controlling for other variables ($\beta_r = -.245$, $p_r = .003$; $\beta_t = -.273$, $p_t = .001$).

In model 1 a-4, for both the raw and transformed data, taken as a set, the demographic predictors plus the three simultaneous EV variables resulted in statistically significant models explaining 17.4% and 24.6% of the variance in ItP, $F_r(11, 140) = 2.682$, $p_r = .004$; $F_t(11, 140) = 4.162$, $p_t < .001$. The addition of all three expectancy-value variables increased the percent variance explained by 11.6% in the raw data, $F_r(3, 140) = 6.567$, $p_r < .001$) and 16.5% in the transformed data, $F_t(3, 140) = 10.200$, $p_t < .001$. Only expectancy of STEM major success was a statistically significant unique contributor to the variance ($\beta_r = .213$, $p_r = .026$; $\beta_t = .233$, $p_t = .011$) while controlling for the other related expectancy-value variables, which were not statistically significant. See Table 4.12 for a summary of results.

Table 4.12

Hierarchical Regression Results for Model 1 a: Expectancy, Value, and Cost

	Raw Data				Transformed Data			
Regression model	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 0			.058				.082	
Model 1 a-1			.153**	.095***			.211***	.129**
Expectancy	.314***	.073			.366***	.029		
Model 1 a-2			.109	.051**			.173**	.091***
Value	.213**	.098			.308***	.038		
Model 1 a-3			.116*	.059**			.154**	.073**
Cost	-.245**	.065			-.273**	.026		
Model 1 a-4			.174**	.116***			.246***	.165***
Expectancy	.213*	.089			.233*	.034		
Value	.099	.107			.166	.042		
Cost	-.125	.071			-.126	.027		

*$p < .05$, **$p < .01$, ***$p < .001$

Models 1 b-1 through 1 b-6. For model 1 b-1, in both the raw and transformed data, the addition of familial capital to the regression did not result in a statistically significant overall model, nor was the increase in percent variance explained statistically significant. The same was true for model 1 b-4 in both the raw and transformed data. The addition of navigational capital to the regression did not result in a statistically significant overall model, nor was the increase in percent variance explained statistically significant.

In model 1 b-2, in the addition of resistant capital to the regression resulted in a statistically significant overall model in the transformed data, $F_t(9, 142) = 2.239$, $p_t = .023$. The addition of resistant capital also resulted in a statistically significant increase in the percent variance explained above and beyond the background demographics. Resistant capital statistically significantly increased the percent variance explained by 4.9% in the raw data, $F_r(1, 142) = 7.810$, $p_r = .006$, and 4.3% in the transformed data,

$F_t(1, 142) = 6.897$, $p_t = .01$. Resistant capital also provided a statistically significant unique contribution to the variance in ItP ($\beta_r = .257$, $p_r = .006$; $\beta_t = .239$, $p_t = .01$).

In model 1 b-3, the addition of aspirational capital to the regression resulted in a statistically significant overall model in the transformed data, $F_t(9, 142) = 2.929$, $p_t = .003$. Aspirational capital statistically significantly increased the percent variance explained by 4.7% in the raw data, $F_r(1, 142) = 7.469$, $p_r = .007$, and 7.5% in the transformed data, $F_t(1, 142) = 12.606$, $p_t = .001$. Aspirational capital also provided a statistically significant unique contribution to the variance in ItP ($\beta_r = .237$, $p_r = .007$; $\beta_t = .299$, $p_t = .001$).

In model 1 b-5, the addition of composite capital to the regression resulted in a statistically significant overall model in the transformed data, $F_t(9, 142) = 2.171$, $p_t = .027$. Composite capital statistically significantly increased the percent variance explained by 2.9% in the raw data, $F_r(1, 142) = 4.488$, $p_r = .036$, and 3.9% in the transformed data, $F_t(1, 142) = 6.339$, $p_t = .013$. Composite capital also provided a statistically significant unique contribution to the variance in ItP ($\beta_r = .187$, $p_r = .036$; $\beta_t = .218$, $p_t = .013$).

Model 1 b-6 represents the simultaneous entry of the four CCW capitals. The overall model was statistically significant in the transformed data, $F_t(12, 139) = 2.398$, $p_t = .008$. The addition of all four capitals simultaneously increased the percent variance explained statistically significantly by 7.2% in the raw data, $F_r(4, 139) = 2.865$, $p_r = .026$, and 9.0% in the transformed data, $F_t(4, 139) = 3.768$, $p_t = .006$. Among the four CCW capitals, only aspirational capital was a statistically significant unique contributor to the variance in ItP when controlling for all other variables, and only in the transformed data (β_t = .239, p_t = .014). See Table 4.13 for a summary of results.

Table 4.13

Hierarchical Regression Results for Model 1 b: CCW Capitals

	Raw Data				Transformed Data			
Regression model	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 0			.058				.082	
Model 1 b-1			.058	.001			.084	.002
Familial Capital	.027	.053			.052	.021		
Model 1 b-2			.107	.049**			.124*	.043*
Resistant Capital	.257**	.084			.239*	.034		
Model 1 b-3			.105	.047**			.157**	.075**
Aspirational Capital	.237**	.071			.299*	.028		
Model 1 b-4			.069	.011			.100	.018
Navigational Capital	.106	.056			.138	.022		
Model 1 b-5			.087	.029*			.121*	.039*
Composite Capital	.187*	.092			.218*	.037		
Model 1 b-6			.130	.072*			.172**	.090**
Familial Capital	-.076	.055			-.055	.022		
Resistant Capital	.189	.097			.118	.038		
Aspirational Capital	.155	.081			.239*	.032		
Navigational Capital	.063	.058			.084	.023		

$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Research Question 2: In what ways do perceived CCW capitals, including aspirational capital, navigational capital, familial capital, and resistant capital, moderate the associations between expectancy-value variables and students' intention to persist in their STEM major?

I constructed the hierarchical regression models for RQ 2 such that Model 1 a-4 (demographic variables in the first block) was the parent model for all regressions in Model 2 (expectancy, value, and cost simultaneously in the second block). In the third block, I added a single CCW capital, and in the fourth block, I added a single interaction term between that capital and one of the expectancy-value variables. With the large number of models, I am providing the sub-models and results separately to visualize the connections more easily.

Model 2 a: Familial Capital. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of familial capital resulted in statistically significant models, but there was virtually no change in R^2 from the parent (previous) model that did not include familial capital. In other words, neither the addition of familial capital, nor the interaction between familial capital and the EVC variables statistically significantly increased the total percent of variance explained beyond what was previously explained. See Tables 4.14 and 4.15 for the model and regression summaries.

Table 4.14

Hierarchical Regression Model 2 a: Familial Capital

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 a-0	Demographics	Expectancy, Value, and Cost	Familial Capital	-----	----
2 a-1	Demographics	Expectancy, Value, and Cost	Familial Capital	FC x E	----
2 a-2	Demographics	Expectancy, Value, and Cost	Familial Capital	FC x V	----
2 a-3	Demographics	Expectancy, Value, and Cost	Familial Capital	FC x C	----
2 a-4	Demographics	Expectancy, Value, and Cost	Familial Capital	FC x E, FC x V, and FC x C	----

Note. FC = familial capital, E = expectancy, V = value, C = cost

Table 4.15

Hierarchical Regression Results for Model 2 a: Familial Capital

	Raw Data				Transformed Data			
Regression model	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 1 a-4			.174**				.246***	
Model 2 a-0			.174**	.000			.246***	.000
Familial Capital	-.009	.050			.008	.019		
Parent model: Model 2 a-0			.174**				.246***	
Model 2 a-1			.174**	.000			.247***	.000
Familial Capital x Expectancy	-.115	.067			-.042	.026		
Model 2 a-2			.175**	.000			.248***	.002
Familial Capital x Value	-.185	.086			-.391	.033		
Model 2 a-3			.176**	.002			.248***	.001
Familial Capital x Cost	.235	.063			.201	.024		
Model 2 a-4			.176**	.002			.250***	.003
Familial Capital x Expectancy	.007	.082			.220	.032		
Familial Capital x Value	-.135	.103			-.502	.040		
Familial Capital x Cost	.222	.066			.200	.025		

*$p < .05$, **$p < .01$, ***$p < .001$

Model 2 b: Resistant Capital. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of resistant capital resulted in statistically significant models, but again, there was very little change in R^2 from the parent model that did not include resistant capital. In other words, neither the addition of resistant capital, nor the interaction between resistant capital and the EVC variables statistically significantly increased the total percent of variance explained. See Tables 4.16 and 4.17 for the model and regression summaries.

Table 4.16

Hierarchical Regression Model 2 b: Resistant Capital

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 b-0	Demographics	Expectancy, Value, and Cost	Resistant Capital	-----	----
2 b-1	Demographics	Expectancy, Value, and Cost	Resistant Capital	RC x E	----
2 b-2	Demographics	Expectancy, Value, and Cost	Resistant Capital	RC x V	----
2 b-3	Demographics	Expectancy, Value, and Cost	Resistant Capital	RC x C	----
2 b-4	Demographics	Expectancy, Value, and Cost	Resistant Capital	RC x E, RC x V, and RC x C	----

Note. RC = resistant capital, E = expectancy, V = value, C = cost

Table 4.17

Hierarchical Regression Results for Model 2 b: Resistant Capital

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 1 a-4			.174**				.246***	
Model 2 b-0			.184**	.010			.249***	.003
Resistant Capital	.130	.089			.065	.035		
Parent model: Model 2 b-0			.184**				.249***	
Model 2 b-1			.186**	.001			.251***	.002
Resistant Capital x Expectancy	.305	.100			.418	.039		
Model 2 b-2			.191**	.007			.254***	.005
Resistant Capital x Value	.813	.117			.674	.046		
Model 2 b-3			.189**	.004			.253***	.004
Resistant Capital x Cost	-.536	.104			-.550	.040		
Model 2 b-4			.196**	.012			.257***	.008
Resistant Capital x Expectancy	-.531	.137			-.240	.053		
Resistant Capital x Value	.965	.135			.697	.053		
Resistant Capital x Cost	-.689	.127			-.586	.049		

*$p < .05$, **$p < .01$, ***$p < .001$

Model 2 c: Aspirational Capital. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of aspirational capital resulted in statistically significant models. Similar to the results for familial and resistant capital, there was generally very little change in R^2 from the parent model that did not include aspirational capital. However, the addition of all three interactions simultaneously increased the percent variance explained statistically significantly by 4.6% in the raw data, $F_r(3, 136) = 2.691$, $p_r = .049$. The interaction between aspirational capital and value produced two statistically significant unique contributions to the variance in ItP: first in model 2 c-2 in which the interaction term was entered individually into block four ($\beta_r = -2.242$, $p_r = .039$; $\beta_t = -2.118$, $p_t = .04$) and again in model 2 c-4 when all three interaction terms were entered into block four simultaneously ($\beta_r = -3.094$, $p_r = .01$; $\beta_t = -2.764$, $p_t = .015$). See Tables 4.18 and 4.19 for the model and regression summaries.

Table 4.18

Hierarchical Regression Model 2 c: Aspirational Capital

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 c-0	Demographics	Expectancy, Value, and Cost	Aspirational Capital	-----	----
2 c-1	Demographics	Expectancy, Value, and Cost	Aspirational Capital	AC x E	----
2 c-2	Demographics	Expectancy, Value, and Cost	Aspirational Capital	AC x V	----
2 c-3	Demographics	Expectancy, Value, and Cost	Aspirational Capital	AC x C	----
2 c-4	Demographics	Expectancy, Value, and Cost	Aspirational Capital	AC x E, AC x V, and AC x C	----

Note. AC = aspirational capital, E = expectancy, V = value, C = cost

Table 4.19

Hierarchical Regression Results for Model 2 c: Aspirational Capital

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 1 a-4			.174**				.246***	
Model 2 c-0			.181**	.007			.262***	.016
Aspirational Capital	.104	.077			.152	.029		
Parent model: Model 2 c-0			.181**				.262***	
Model 2 c-1			.184**	.003			.263***	.001
Aspirational Capital x Expectancy	.357	.067			.214	.026		
Model 2 c-2			.206**	.025			.284***	.022
Aspirational Capital x Value	-2.242*	.163			-2.118*	.063		
Model 2 c-3			.182**	.000			.264***	.002
Aspirational Capital x Cost	.102	.087			.269	.033		
Model 2 c-4			.227**	.046*			.300***	.038
Aspirational Capital x Expectancy	1.225	.089			1.094	.034		
Aspirational Capital x Value	-3.094*	.180			-2.764*	.069		
Aspirational Capital x Cost	.451	.109			.580	.042		

$*p < .05$, $**p < .01$, $***p < .001$

To probe these two statistically significant interactions, I conducted a 2 x 2 factorial ANOVA for aspirational capital and value to better understand the moderation. I sorted the data into two groups for each variable using a mean-split and then I examined the plots to interpret the interaction effects. As seen in Figure 4.3, the 2 (above average aspirational capital vs. below average aspirational capital) x 2 (above average value vs. below average value) ANOVA suggested that when STEM major value was below average, students with above average aspirational capital had greater ItP. When STEM major value was above average, then aspirational capital made less of a difference in ItP.

Aspirational capital appeared to have a compensatory effect on ItP when students' STEM major value was below average.

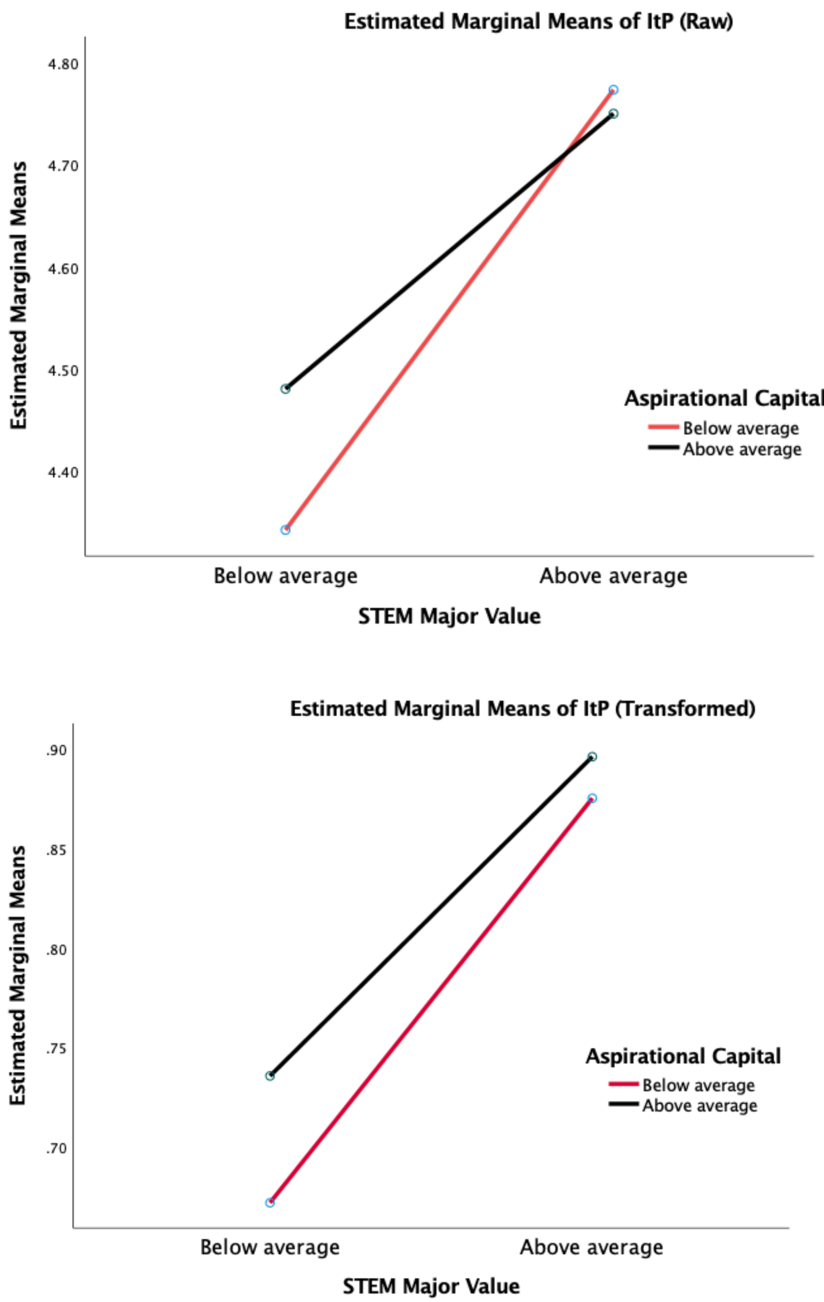


Figure 4.3

Aspirational Capital by STEM Major Value ANOVA Interactions

Model 2 d: Navigational Capital. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of navigational capital resulted in statistically significant models. However, like previous capital models, there was very little change in R^2 from the parent model that did not include navigational capital. In other words, neither the addition of navigational capital, nor the interaction between navigational capital and the EVC variables statistically significantly increased the total percent of variance explained beyond what the previous model explained. See Tables 4.20 and 4.21 for the model and regression summaries. That stated, there was still a statistically significant unique contribution to the total variance by the interaction between navigational capital and STEM major value in the transformed data (β_t = 1.475, p_t = .030).

Table 4.20

Hierarchical Regression Model 2 d: Navigational Capital

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 d-0	Demographics	Expectancy, Value, and Cost	Navigational Capital	-----	----
2 d-1	Demographics	Expectancy, Value, and Cost	Navigational Capital	NC x E	----
2 d-2	Demographics	Expectancy, Value, and Cost	Navigational Capital	NC x V	----
2 d-3	Demographics	Expectancy, Value, and Cost	Navigational Capital	NC x C	----
2 d-4	Demographics	Expectancy, Value, and Cost	Navigational Capital	NC x E, NC x V, and NC x C	----

Note. NC = navigational capital, E = expectancy, V = value, C = cost

Table 4.21

Hierarchical Regression Results for Model 2 d: Navigational Capital

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 1 a-4			.174**				.246***	
Model 2 d-0			.175**	.001			.247***	.000
Navigational Capital	-.027	.058			-.024	.023		
Parent model: Model 2 d-0			.175**				.247***	
Model 2 d-1			.184**	.009			.260***	.013
Navigational Capital x Expectancy	.750	.078			.887	.030		
Model 2 d-2			.197**	.022			.272***	.025
Navigational Capital x Value	1.378	.094			1.475*	.036		
Model 2 d-3			.175*	.000			.247***	.000
Navigational Capital x Cost	.102	.074			.128	.029		
Model 2 d-4			.204**	.030			.283***	.036
Navigational Capital x Expectancy	.321	.104			.506	.040		
Navigational Capital x Value	1.488	.121			1.507	.047		
Navigational Capital x Cost	.562	.083			.655	.032		

*$p < .05$, **$p < .01$, ***$p < .001$

To probe the statistically significant interaction, I conducted a 2 x 2 ANOVA for navigational capital and value to better understand the moderation. Following the same procedure as I did for the aspirational capital by value interaction, I sorted the data into two groups for each variable, one group whose scale score was below average and the other whose scale score was above average. Then I examined the plots to interpret the interaction effects and found an unexpected association. As seen in Figure 4.4, when students' STEM major value was below average, students who also had below average navigational capital had a greater ItP. When STEM major value was above average, there was little difference in ItP across levels of navigational capital.

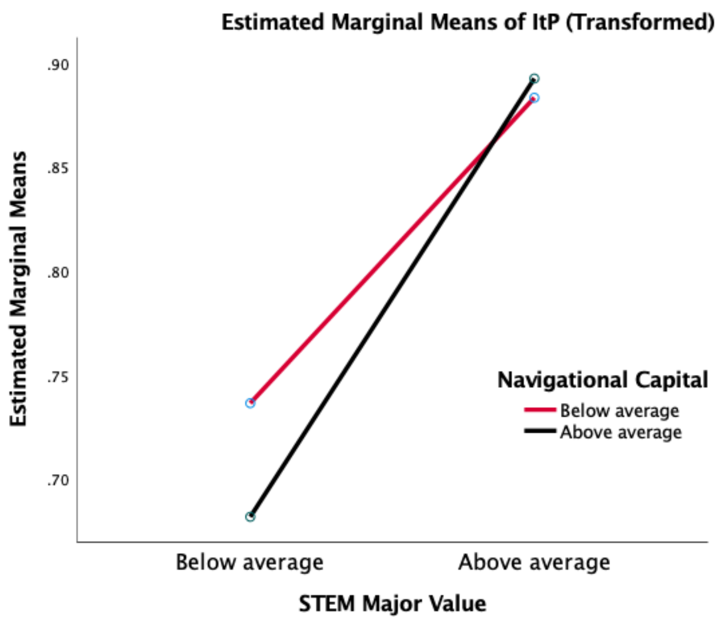


Figure 4.4

Navigational Capital by STEM Major Value ANOVA Interaction

Model 2 e: Composite Capital. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of a composite capital resulted in statistically significant models. Again, like previous capital models, there was very little change in R^2 from the parent model that did not include the composite capital. In other words, neither the addition of composite capital, nor the interaction between composite capital and the EVC variables statistically significantly increased the total percent of variance explained. See Tables 4.22 and 4.23 for the model and regression summaries.

Table 4.22

Hierarchical Regression Model 2 e: Composite Capital

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 e-0	Demographics	Expectancy, Value, and Cost	Composite Capital	-----	----
2 e-1	Demographics	Expectancy, Value, and Cost	Composite Capital	CC x E	----
2 e-3	Demographics	Expectancy, Value, and Cost	Composite Capital	CC x V	----
2 e-3	Demographics	Expectancy, Value, and Cost	Composite Capital	CC x C	----
2 e-4	Demographics	Expectancy, Value, and Cost	Composite Capital	CC x E, CC x V, and CC x C	----

Note. CC = composite capital, E = expectancy, V = value, C = cost

Table 4.23

Hierarchical Regression Results for Model 2 e: Composite Capital

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model: Model 1 a-4			.174**				.246***	
Model 2 e-0			.176**	.002			.248***	.002
Composite Capital	.051	.096			.051	.037		
Parent model: Model 2 e-0			.176**				.248***	
Model 2 e-1			.177**	.001			.250***	.002
Composite Capital x Expectancy	.354	.121			.415	.047		
Model 2 e-2			.176*	.000			.248***	.000
Composite Capital x Value	.244	.156			.110	.061		
Model 2 e-3			.176*	.000			.248***	.000
Composite Capital x Cost	.058	.121			.123	.047		
Model 2 e-4			.177*	.002			.251***	.003
Composite Capital x Expectancy	.404	.153			.616	.059		
Composite Capital x Value	-.001	.192			-.262	.074		
Composite Capital x Cost	.153	.127			.239	.049		

*$p < .05$, **$p < .01$, ***$p < .001$

Model 2 f: Simultaneous CCW Capital Entry. For both the raw and transformed data, taken as a set, the demographic predictors, expectancy, value, and cost (EVC), and the addition of all four CCW capitals composite capital resulted in statistically significant models. Although for most of the 2 f models there was very little change in R^2 from the parent model that did not include any of the CCW capitals, model 2 f-2, $F_r(19, 132) = 2.312$, $p_r = .003$, did produce a statistically significant change in R^2 in the raw data. Model 2 f-2 added each of the CCW capital variables in block three and then each of the CCW capital interaction terms with value in block 4 (see Table 4.24). The addition of the four CCW capital interaction terms accounted for an additional 6% of the total variance, $\Delta F_r(4, 132) = 2.651$, $p_r = .036$, above and beyond model 2 f-0. Moreover, the aspirational capital by value interaction term was again a statistically significant unique contributor to the variance in ItP both in models 2 f-2 ($\beta_r = -3.131$, $p_r = .011$; $\beta_t = -2.752$, $p_t = .028$) and 2 f-4 ($\beta_r = -4.156$, $p_r = .003$; $\beta_t = -3.333$, $p_t = .011$). In model 2 f-4, the aspirational capital by expectancy interaction ($\beta_r = 2.483$, $p_r = .0012$; $\beta_t = 2.042$, $p_t = .032$) and the resistant capital by value interaction ($\beta_r = 2.323$, $p_r = .036$) were also statistically significant unique contributors to the variance in ItP. See Table 4.25 for the summary of regression results.

Table 4.24

Hierarchical Regression Model 2 f: Simultaneous CCW Capital Entry

Model	Block 1	Block 2	Block 3	Block 4 – Interaction Terms	Block 5
2 f-0	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	-----	----
2 f-1	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x E, RC x E, AC x E, NC x E	----
2 f-2	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x V, RC x V, AC x V, NC x V	----
2 f-3	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x C, RC x C, AC x C, NC x C	----
2 f-4	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x E, RC x E, AC x E, NC x E, FC x V, RC x V, AC x V, NC x V, FC x C, RC x C, AC x C, NC x C	----

Note. FC = familial capital, RC = resistant capital, AC = aspirational capital, NC = navigational capital, E = expectancy, V = value, C = cost

Table 4.25

Hierarchical Regression Results for Model 2 f: Simultaneous CCW Capital Entry

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent model:			.174**				.246***	
Model 1 a-4								
Model 2 f-0			.189*	.015			.263***	.017
Familial Capital	-.044	.054			-.015	.021		
Resistant Capital	.117	.100			.009	.039		
Aspirational Capital	.073	.084			.155	.033		
Navigational Capital	-.028	.060			-.032	.023		
Parent model:			.189*				.263***	
Model 2 f-0								
Model 2 f-1			.205*	.015			.278**	.014
Familial Capital x Expectancy	-.434	.073			-.396	.028		
Resistant Capital x Expectancy	-.143	.139			.105	.054		
Aspirational Capital x Expectancy	.370	.093			.170	.036		
Navigational Capital x Expectancy	.902	.085			.907	.033		
Model 2 f-2			.250**	.060*			.314***	.051
Familial Capital x Value	-.259	.089			-.442	.035		
Resistant Capital x Value	1.248	.149			.642	.058		
Aspirational Capital x Value	-3.131*	.184			-2.572*	.071		
Navigational Capital x Value	1.006	.110			1.305	.043		
Model 2 f-3			.198*	.009			.274**	.011
Familial Capital x Cost	.248	.065			.180	.025		
Resistant Capital x Cost	-.810	.121			-.922	.047		
Aspirational Capital x Cost	.456	.104			.603	.040		
Navigational Capital x Cost	.013	.083			.018	.032		
Model 2 f-4			.300**	.110			.353***	.090
Familial Capital x Expectancy	-.196	.102			-.221	.040		
Resistant Capital x Expectancy	-2.398	.197			-1.614	.077		
Aspirational Capital x Expectancy	2.483*	.131			2.042*	.051		

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Navigational Capital x Expectancy	.844	.127			.994	.050		
Familial Capital x Value	-.444	.110			-.679	.043		
Resistant Capital x Value	2.323*	.172			1.398	.067		
Aspirational Capital x Value	-4.156**	.205			-3.333*	.080		
Navigational Capital x Value	1.060	.149			1.253	.058		
Familial Capital x Cost	-.318	.077			-.445	.030		
Resistant Capital x Cost	-.706	.151			-.521	.059		
Aspirational Capital x Cost	.955	.140			.997	.055		
Navigational Capital x Cost	.540	.102			.599	.040		

*$p < .05$, **$p < .01$, ***$p < .001$

The aspirational capital by value interaction was previously explored and in model 2 c. However, I used the same 2 x 2 ANOVA approach to examine more closely the aspirational capital by expectancy interaction and the resistant capital by value interaction. I created two groups for each variable, one below average and one above average. For the aspirational capital by expectancy interaction, the raw data suggested that overall, as expectancy of STEM major success increased, so did ItP, but the increase was more pronounced for students with above average aspirational capital. The plot in the transformed data suggested that when students had a below average expectancy of STEM major success, aspirational capital did not make much of a difference in ItP (and was potentially detrimental for those lower in expectancy when the examining the raw data only). However, when students had above average expectancy of STEM success, then students with above average aspirational capital had a greater ItP. In this model, aspirational capital seemed to have a multiplicative effect (see Figure 4.5). For the resistant capital by STEM major value interaction, the ANOVA plot showed a bigger difference in ItP for students with below average STEM major value for students with above average resistant capital (see Figure 4.6). Visually, this interaction effect was not as pronounced.

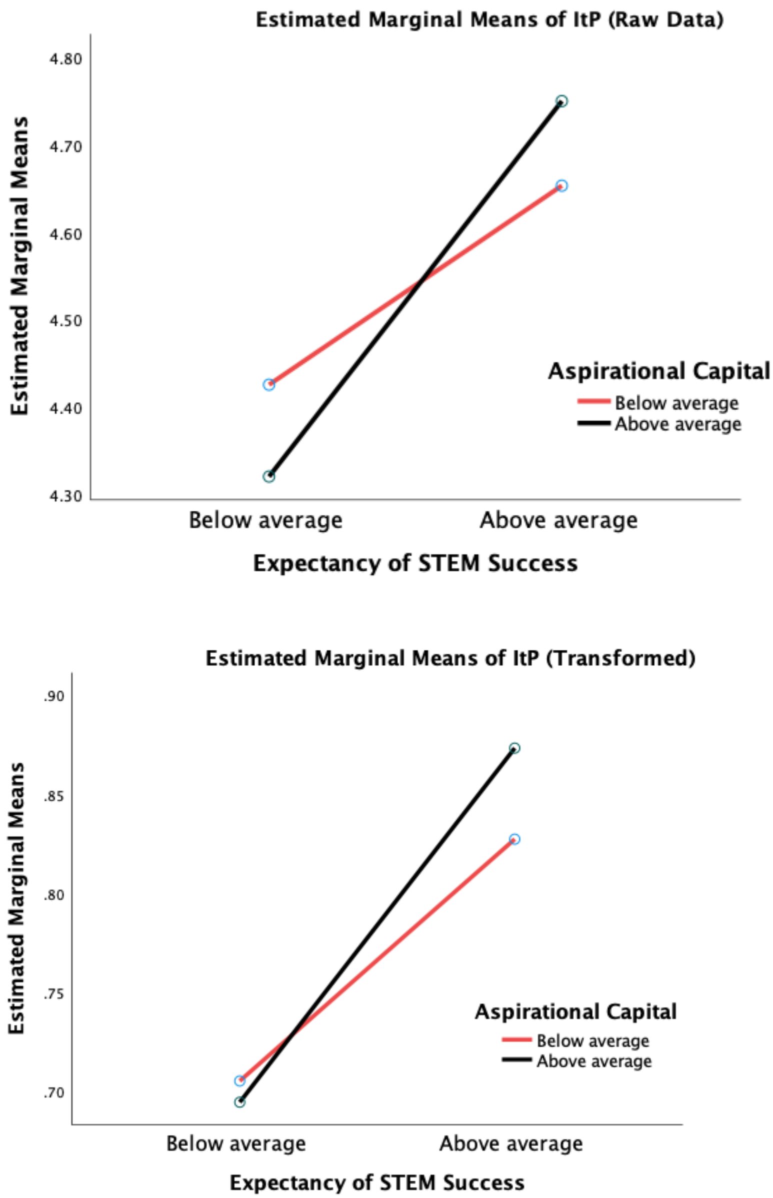


Figure 4.5

Aspirational Capital by Expectancy of STEM Major Success ANOVA Interactions

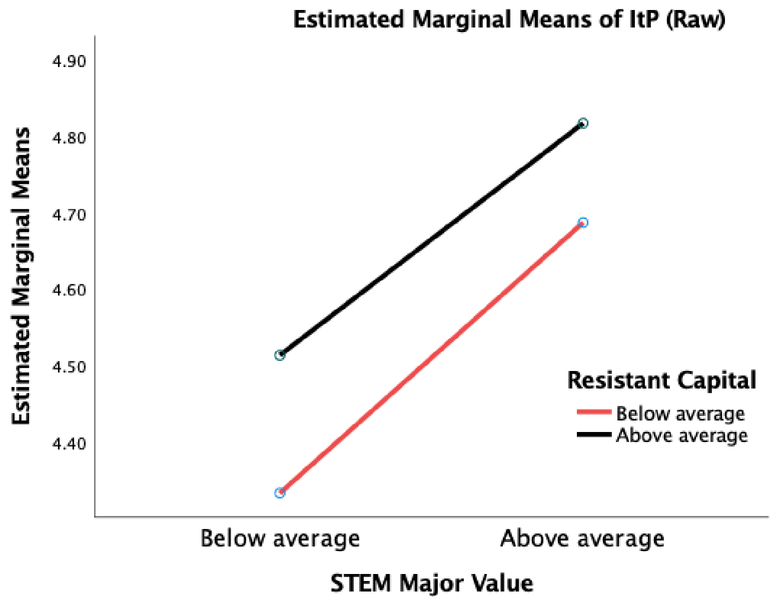


Figure 4.6

Resistant Capital by STEM Major Value ANOVA Interaction

Research Question 3: Do the findings for research question 2 differ depending on gender, socioeconomic status, or first-generation status?

To answer this exploratory research question and construct regression models, I began with parent model 2 f-4. Then, in a fifth block I added interaction terms for gender (woman) and for gender (unknown) with each of the block four interaction terms (see Table 4.26). I repeated this model for first-generation status and for socioeconomic status. In the transformed data, model 3 a, $F_t(39, 112) = 1.744$, $p_t = .013$, and 3 b, $F_t(42, 109) = 1.932$, $p_t = .003$, were statistically significant. Model 3 c, $F_r(50, 101) = 1.499$, $p_r = .044$; $F_t(50, 101) = 1.756$, $p_t = .009$, was statistically significant in both the raw and transformed data. None of the models indicated a statistically significant increase in R^2 and none of the interaction terms indicated a statistically significant unique contribution to the variance in ItP. The regression results are summarized by sub-model in Tables 4.27 through 4.29 due to the large amount of data per model. Note that some interaction effects were excluded from the model due to small cell sample sizes.

Table 4.26

Hierarchical Regression Model 3: Gender, First-generation Status, and Socioeconomic Status

Model	Block 1	Block 2	Block 3	Block 4	Block 5
3 a	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x E, RC x E, AC x E, NC x E, FC x V, RC x V, AC x V, NC x V, FC x C, RC x C, AC x C, NC x C	24 additional interactions: Each of the 12 interactions in Block 4 x gender (woman) and Each of the 12 interactions in Block 4 x gender (unknown)
3 b	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x E, RC x E, AC x E, NC x E, FC x V, RC x V, AC x V, NC x V, FC x C, RC x C, AC x C, NC x C	24 additional interactions: Each of the 12 interactions in Block 4 x first-generation status (not first-gen) and Each of the 12 interactions in Block 4 x first-generation status (first-gen status unknown)
3 c	Demographics	Expectancy, Value, and Cost	FC, RC, AC, NC	FC x E, RC x E, AC x E, NC x E, FC x V, RC x V, AC x V, NC x V, FC x C, RC x C, AC x C, NC x C	24 additional interactions: Each of the 12 interactions in Block 4 x socioeconomic status (not low SES) and Each of the 12 interactions in Block 4 x socioeconomic status (SES status unknown)

Note. FC = familial capital, RC = resistant capital, AC = aspirational capital, NC = navigational capital, E = expectancy, V = value, C = cost

Table 4.27

Hierarchical Regression Results for Model 3 a: Gender

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent Model: Model 2 f-4			.300**				.353***	
Model 3 a			.335	.035			.378*	.025
Familial x Expectancy x Woman	-.309	.216			-.065	.085		
Resistant x Expectancy x Woman	6.051	.344			5.673	.135		
Aspirational x Expectancy x Woman	-4.237	.285			-3.633	.112		
Navigational x Expectancy x Woman	-2.229	.240			-2.271	.094		
Familial x Value x Woman	-.756	.230			-1.136	.090		
Resistant x Value x Woman	-6.039	.407			-5.129	.159		
Aspirational x Value x Woman	6.163	.348			5.318	.136		
Navigational x Value x Woman	1.718	.261			1.559	.103		
Familial x Cost x Woman	1.232	.127			1.266	.050		
Resistant x Cost x Woman	-.752	.223			-.844	.087		
Aspirational x Cost x Woman	-1.180	.188			-1.567	.074		
Navigational x Cost x Woman	.475	.160			.974	.063		
Familial x Expectancy x Gender Unknown	Excl.				Excl.			
Resistant x Expectancy x Gender Unknown	Excl.				Excl.			
Aspirational x Expectancy x Gender Unknown	Excl.				Excl.			
Navigational x Expectancy x Gender Unknown	Excl.				Excl.			
Familial x Value x Gender Unknown	Excl.				Excl.			
Resistant x Value x Gender Unknown	Excl.				Excl.			
Aspirational x Value x Gender Unknown	Excl.				Excl.			
Navigational x Value x Gender Unknown	Excl.				Excl.			
Familial x Cost x Gender Unknown	Excl.				Excl.			

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Resistant x Cost x Gender Unknown	Excl.				Excl.			
Aspirational x Cost x Gender Unknown	Excl.				Excl.			
Navigational x Cost x Gender Unknown	Excl.				Excl.			

Note. Excl.= Variables statistically excluded from the SPSS coefficients table.
*$p < .05$

Table 4.28

Hierarchical Regression Results for Model 3 b: First-generation Status

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent Model: Model 2 f-4			.300**				.353***	
Model 3 b			.361	.061			.427**	.074
Familial x Expectancy x Not First-gen	-3.252	.248			-2.157	.095		
Resistant x Expectancy x Not First-gen	2.705	.342			-1.406	.132		
Aspirational x Expectancy x Not First-gen	-1.017	.288			1.753	.111		
Navigational x Expectancy x Not First-gen	1.264	.226			2.324	.087		
Familial x Expectancy x First-gen Unknown	-.142	.109			.084	.042		
Familial x Value x Not First-gen	5.149	.255			4.012	.098		
Resistant x Value x Not First-gen	-4.695	.430			1.997	.165		
Aspirational x Value x Not First-gen	2.612	.366			-1.608	.141		
Navigational x Value x Not First-gen	-2.657	.254			-4.665	.098		
Familial x Cost x Not First-gen	-1.906	.185			-1.669	.071		
Resistant x Cost x Not First-gen	.279	.281			-1.989	.108		
Aspirational x Cost x Not First-gen	-.493	.229			.627	.088		
Navigational x Cost x Not First-gen	1.206	.168			2.134	.065		
Familial x Cost x First-gen Unknown	-.093	.126			-.430	.048		
Navigational x Cost x First-gen Unknown	-.059	.149			.370	.057		
Resistant x Expectancy x First-gen Unknown	Excl.				Excl.			
Aspirational x Expectancy x First-gen Unknown	Excl.				Excl.			
Navigational x Expectancy x First-gen Unknown	Excl.				Excl.			
Familial x Value x First-gen Unknown	Excl.				Excl.			

Variables	Raw Data β_r	SE_r	R^2_r	ΔR^2_r	Transformed Data β_t	SE_t	R^2_t	ΔR^2_t
Resistant x Value x First-gen Unknown	Excl.				Excl.			
Aspirational x Value x First-gen Unknown	Excl.				Excl.			
Navigational x Value x First-gen Unknown	Excl.				Excl.			
Resistant x Cost x First-gen Unknown	Excl.				Excl.			
Aspirational x Cost x First-gen Unknown	Excl.				Excl.			

Note. Excl.= Variables statistically excluded from the SPSS coefficients table.
$^{**}p < .01$

Table 4.29

Hierarchical Regression Results for Model 3 c: Socioeconomic Status

	Raw Data				Transformed Data			
Variables	β_r	SE_r	R^2_r	ΔR^2_r	β_t	SE_t	R^2_t	ΔR^2_t
Parent Model: Model 2 f-4			.300**				.353***	
Model 3 c			.426*	.126			.465**	.112
Familial x Expectancy x Not low SES	.520	.265			2.037	.104		
Resistant x Expectancy x Not low SES	7.670	.340			3.850	.133		
Aspirational x Expectancy x Not low SES	-8.945	.314			-7.294	.123		
Navigational x Expectancy x Not low SES	-.267	.245			1.205	.096		
Familial x Expectancy x SES Unknown	6.014	.399			5.640	.156		
Resistant x Expectancy x SES Unknown	.091	.552			.010	.216		
Aspirational x Expectancy x SES Unknown	-5.840	.769			-5.566	.301		
Navigational x Expectancy x SES Unknown	-1.010	.658			-.552	.258		
Familial x Value x Not low SES	-.406	.265			-1.362	.104		
Resistant x Value x Not low SES	-9.778	.426			-5.072	.167		
Aspirational x Value x Not low SES	8.573	.398			5.630	.156		
Navigational x Value x Not low SES	2.638	.282			1.309	.111		
Familial x Value x SES Unknown	-6.293	.497			-5.450	.195		
Aspirational x Value x SES Unknown	8.215	.690			7.808	.270		
Navigational x Value x SES Unknown	-2.045	.752			-2.745	.294		
Familial x Cost x Not low SES	-.465	.151			-1.271	.059		
Resistant x Cost x Not low SES	1.129	.279			.953	.109		

Variables	Raw Data β_r	SE_r	R^2_r	ΔR^2_r	Transformed Data β_t	SE_t	R^2_t	ΔR^2_t
Aspirational x Cost x Not low SES	1.076	.261			1.889	.102		
Navigational x Cost x Not low SES	-2.024	.172			-1.920	.067		
Familial x Cost x SES Unknown	.431	.357			-.088	.140		
Resistant x Cost x SES Unknown	-.481	.664			-.357	.260		
Aspirational x Cost x SES Unknown	-2.789	.573			-2.901	.224		
Navigational x Cost x SES Unknown	3.446	.754			3.843	.295		
Resistant x Value x SES Unknown	Excl.				Excl.			

Note. Excl.= Variables statistically excluded from the SPSS coefficients table.
$*p < .05$, $**p < .01$

Chapter Summary

This chapter contains the results of hierarchical regression analyses that answer the research questions. The final sample included 152 self-identified Latina/o/x STEM major participants who completed a survey instrument regarding motivational constructs posited in expectancy-value theory and cultural capital constructs posited in the Community Cultural Wealth (CCW) model. Survey items were structured to measure participants' beliefs about their expectancy of success in their STEM major, their beliefs about the values and costs associated with pursuing a STEM major, and general beliefs about types of CCW capital, all as independent variables. The survey also measured students' intentions to persist (ItP) in their STEM major as the lone dependent variable. Due to the emergent nature of using quantitative methodologies with CCW capital, I conducted an exploratory factor analysis of CCW capital items, reviewed and removed problematic survey items from the analysis, and verified acceptable Cronbach's alpha levels for subscale reliabilities.

I constructed multiple hierarchical regression models to identify systematically the unique contributions of each variable added to the model. I was also able to examine whether related variables, such as CCW capitals, offered unique contribution to the variance in ItP when the variables were added simultaneously. The initial regression (entering only background demographic variables) did not produce a statistically significant overall model explaining the total variance in ItP. That stated, when controlling for all other demographic variables, students with higher socioeconomic status (SES) had higher intention to persist compared to students with lower SES.

Research Question 1

The individual inclusions of expectancy of STEM major success, STEM major value, and STEM major cost to the regression equation each resulted in statistically significant overall models for explaining the variance in students' intentions to persist in their STEM major. The individual additions of these same variables also resulted in a statistically significant increase in the total percent variance explained compared to the model without each variable. Expectancy, value, and cost each made a statistically significant unique contribution to the percent variance explained. Expectancy and value were positively associated with ItP, and cost was negatively associated with ItP. When all three variables were analyzed simultaneously, controlling for value and cost, only expectancy was a statistically significant predictor of ItP.

In addition, I analyzed the individual contribution of CCW capitals prior to positioning them as potentially moderating variables. Broadly, overall regression models were statistically significant in the transformed data, but not in the raw data. The increase in percent variance explained was statistically significant in both raw and transformed data for the individual addition of resistant capital, aspirational capital, composite capital, and the simultaneous entry of all four CCW capitals. Resistant capital, aspirational capital, and composite capital each made a statistically significant unique contribution to the percent variance in ItP when holding all other variables constant. However, when all CCW capitals were added simultaneously (controlling for other CCW variables), only aspirational capital was a statistically significant predictor of ItP.

Research Question 2

To answer this research question, I constructed theoretically guided hierarchical regression models entering demographic variables, expectancy-value variables, CCW capital variables, and interaction terms into a series of regression blocks. Three key pieces of information helped to identify and interpret findings for this research question. First was the change in R square (ΔR^2) which indicated any increase in the total percent variance in ItP explained above and beyond the previous regression model. Second was the standardized beta value (β) which indicated any unique contribution of the CCW capital or an interaction term to the percent variance explained when controlling for all other variables. Statistically significant beta results for interaction terms indicated a moderating effect of a CCW capital on ItP. Third was the visual factorial ANOVA plots for the statistically significant interactions.

Overall, only model 2 f-2 resulted in a statistically significant ΔR^2, which produced a 6% increase in the total variance in ItP explained above and beyond the parent model of demographics, expectancy of STEM major success, STEM major value, and STEM major cost. In this same model, the aspirational capital by STEM major value interaction showed a statistically significant unique contribution to the percent variance in ItP. Although other models were not statistically significant overall, the aspirational capital by STEM major value interaction was a statistically significant unique contributor in models 2 c-2, 2 c-4, and 2 f-4. When analyzed further using a 2 x 2 ANOVA, plots revealed that when STEM major value was below average, students with above average aspirational capital had greater ItP suggesting aspirational capital had a compensatory effect on ItP when students' STEM major value was below average.

Three additional interaction terms added statistically significant unique contributions to percent variance explained in ItP: aspirational capital by expectancy of STEM major success, resistant capital by STEM major value, and navigational capital by STEM major value. As expectancy of STEM major success increased, so did ItP, but the increase was more pronounced for students with above average aspirational capital, indicating a multiplicative effect. Resistant capital appeared to have a compensatory effect on ItP for students with below average STEM major value. Navigational capital generated an unexpected association with ItP in that above average navigational capital was associated with lower ItP for students with below average STEM major value.

Research Question 3

Using a similar approach as RQ 2, I sequenced variables into hierarchical regression blocks: 1) demographics; 2) expectancy, value, and cost; 3) each of the four CCW capitals; and 4) each of the CCW capital interactions with each of the expectancy-value variables. Then, using gender as an example, block five contained 24 additional interaction terms: one for the interaction between each of the block four terms and *woman*, and one for each of the block four terms and *gender unknown* (as *man* was the gender reference). I used this same approach for first-generation status and socioeconomic status. None of the three models produced a statistically significant ΔR^2 or statistically significant interaction terms.

Chapter Conclusion

Findings from these analyses contain more than statistical significance, they also provide implications for both motivation theory along with institutional and instructional practice. Chapter five will discuss these findings related to existing literature, identify study limitations, and make recommendations for future research.

5. DISCUSSION

The concept of servingness at Hispanic-serving institutions has emerged as needing to mean more than a federal definition tied to a percentage of undergraduate enrollment. In particular, one of the focus areas for HSIs is the strengthening of educational access and career opportunities in STEM (science, technology, engineering, and mathematics). Nationally, there is continued underrepresentation of the Latina/o/x population in STEM careers. One way to address the representation gap in STEM jobs is to take a step back and examine factors that influence persistence of Latina/o/x students in college, while they are pursuing their STEM majors. I chose specifically to examine motivational influences, namely the intention to persist in a STEM major. The literature is rich with theoretically grounded empirical information regarding motivational constructs. To guide this study, I reviewed the literature related to expectancy-value theory, a major motivation theory in educational psychology. Broadly, students' expectations of success positively influence their achievement choices, as do the values students place on a present task. On the other hand, costs that students associate with a task such as lost opportunities or psychological stressors generally have a negative influence on students' decisions to move forward with the task. In my study, I considered how the nature of the relationship between motivation constructs and achievement outcomes may be moderated by, or depend on, students' culturalized assets. This is a timely research question because in 2020, Eccles and Wigfield renamed Expectancy-Value Theory to Situated Expectancy-Value Theory. In other words, Eccles and Wigfield contextualized that achievement motivation is situationally specific and culturally bound.

The assets I included in this study were four of the capitals described in Tara Yosso's community cultural wealth model including familial capital, aspirational capital, navigational capital, and resistant capital. The literature indicated that types of CCW capital tended to operate in tandem, not in isolation, what one author called "marginalization as motivation" (Liou et al., 2009). Therefore, the purpose of this quantitative study was to explore the relationships among expectancy-value (EV) motivation constructs, CCW capital constructs, and intent to persist (ItP) in their STEM major among Latina/o/x students. Addressing my research questions, I uncovered a number of interesting findings. For RQ 1, findings support prior literature regarding associations between expectancy-value constructs and STEM-related achievement outcomes. In general, expectancy and value were positively associated with STEM persistence and cost was negatively associated with STEM persistence. Altogether, expectancy appeared to be the most robust motivational predictor, controlling for value and cost constructs. Additionally, findings enhance the literature in that resistant capital, aspirational capital, and composite capital are also each positively associated with STEM persistence, with aspirational capital emerging as the most salient. For RQ 2, the findings extend the literature by showing that the associations between EV variables and ItP are moderated by several types of CCW capital, notably aspirational capital. For RQ 3, my results suggest that there is no evidence for differences in moderation based on gender, SES, or first-generation status in this Latina/o/x sample. This remainder of this chapter includes a discussion of these findings related to the literature on motivation and CCW capital constructs in STEM persistence, the implications for students and instructors, and the implications for theory. The chapter concludes with a discussion of the limitations of the study, areas for future research, and a chapter summary.

Predictors of Intent to Persist in STEM

Background Variables

In using a hierarchical regression analysis with multiple blocks, as in this study, it is important to pause and review the regression results at each stage of the analysis so that each new block is meaningfully interpreted in relation to the previous blocks as well as the individual contributions of regression predictors. To that end, I begin with the percent variance explained just by the background variables. Taken as a whole, students' background variables explained very little of the total variance in ItP and was not statistically significant. At a basic level, this supports the general notion that many factors contribute to Latina/o/x students' ItP that are not captured by a few sociodemographic variables. That said, socioeconomic status (SES) was a still a statistically significant unique contributor to the total variance explained in ItP when holding the other background variables constant. Latina/o/x students with higher SES, on average, had a slightly higher ItP than students with lower SES.

Expectancy-Value-Cost Variables

The findings from RQ 1 align with prior literature regarding expectancy, value, and cost. First, the statistically significant positive association of expectancy of STEM major success with STEM ItP (e.g., Simon, 2015) highlighted the importance of student self-belief regarding success and the role it plays in achievement outcomes, operating under the assumption that intent to persist is an essential precursor to degree attainment. It also extends findings from Moakler and Kim's (2014) study in which expectancy was a statistically significant predictor for college freshmen choosing a STEM major. Not only can self-belief in success predict choosing a STEM major, but the current study shows that expectancy of success is also associated with intentions toward persisting in a STEM major.

Second, findings from my study support prior literature that the positive values students hold regarding STEM are positively associated with STEM achievement-related outcomes. This finding is aligned with what Fong and Kremer (2020) found, in which high school students' math attainment value predicted students' intentions to major in a STEM field. This study extends the literature by again showing that value can not only predict choosing a STEM major, but also be associated with intentions toward persisting in a STEM major. Findings also align with results from Maltese and Tai (2011), who showed how 8^{th} graders' STEM utility value predicted STEM degree attainment. In other words, when aspects such as attainment value, interest value, and utility value are higher, then STEM achievement-related outcomes are greater.

Third, findings from this study strengthen the empirical understanding of the negative associations between STEM costs and STEM achievement-related outcomes. In other words, when the STEM psychological, opportunity, and effort costs are higher, then STEM-related outcomes are lower, including intentions to persist (e.g., Perez, 2014). This was particularly evident in the Robinson et al. (2019) study of engineering majors in which costs increased over a two-year period and the higher the rate of increase of cost, the lower their persistence in engineering.

Finally, it is important to highlight that even though each of the three main constructs were statistically significant on their own, when they were simultaneously added to the regression block, only expectancy of STEM major success remained uniquely statistically significant. This prominence is not a surprise because the literature has numerous examples of how expectancy (and related terms of academic self-efficacy or academic self-concept) is a consistent predictor for achievement outcomes (e.g., Saw & Chang, 2018), including persistence (e.g., Simon et al., 2015). This finding on expectancy with Latina/o/x STEM majors extends Safavian's (2019) findings in which expectancy was associated with the likelihood of Hispanic high school students to take and complete more math courses.

Interactions and Moderating Effects

The alignment of findings from RQ 1 with prior literature stresses the importance of asking RQ 2. In other words, if capital (of any kind) is something to be leveraged or transformed or used for gain, then does leveraging or transforming or using CCW capital provide benefit or gain in STEM persistence? More directly, if expectancy and value are positively associated with STEM-related outcomes, then can CCW capital enhance that association? If cost is negatively associated with STEM-related outcomes, can CCW capital reduce that association through compensation or mitigation? This study's findings suggested that the answer to these questions may be yes.

CCW Capitals. In addition to analyzing interaction effects of CCW capitals with EV constructs, I analyzed the associations between CCW capital variables and ItP on their own as an extension to RQ 1. Regarding the associations with ItP, CCW capitals proved to be statistically significant both on their own as well as when they interacted with EV variables.

Aspirational Capital. On its own (model 1 b-3), the addition of aspirational capital to the regression was statistically significant showing increase in percent variance in ItP explained. Further, the standardized beta (β) values suggest a medium to large effect. Further, when all four capitals were added simultaneously to the regression (model 1 b-6), aspirational capital was the only one that was a statistically significant contributor with a medium-size coefficient. When added to the regression to explore interaction effects, an aspirational capital interaction was notably statistically significant five times across four models (models 2 c-2, 2 c-4, 2 f-2, and 2 f-4). Four of the five statistically significant interactions were with STEM major value and the fifth was with expectancy of STEM success. The ANOVA plots for these interactions offered insight into the role aspirational capital played. For students with below average STEM major value, aspirational capital had a compensatory effect on ItP. To illustrate this, consider the following hypothetical narrative, "I'm a Latina/o/x STEM major and when I think about my interest in STEM, how useful I think it is, and what it means to my identity, my overall sense of STEM major importance is lower than some of my peers. But compared to my peers who also have lower STEM values like me, my intentions to persist in my STEM major are *higher* than theirs perhaps in part due to knowing that I have higher than average aspirational capital." This moderation suggests that the act of visioning and imagining a positive future beyond the present circumstances may contribute to motivation-related decisions such as persistence. The interaction of aspirational capital with value is particularly notable because students may perceive content from STEM courses of little value, but aspirational capital can serve as a buffer for low interest or task value in the subject. This pattern is also reflected in the findings from a study by Moore and Burrus (2019) who found that STEM attitude (as a proxy for STEM interest) predicted STEM major and career over gender or achievement scores. Perhaps aspirations or aspirational capital could also be conceptualized as an attitude, one of hope, and when these two attitudes—STEM attitude and hopeful attitude— interact, there is a positive influence on persistence.

Aspirational capital also interacted with expectancy of STEM major success. The interaction effect was observed for students with above average expectancy. Again, consider the following narrative, "I'm a Latina/o/x STEM major and I have high expectations of STEM major success (higher than half of my peers). I also have big hopes and dreams for my future, even if there are barriers. With this combination of expectations and aspirations, my intentions to persist as a STEM major are high, noticeably higher than my peers who expect to be successful in STEM like me, but they don't have as much aspiration." In this scenario, perhaps having big hopes and dreams is like booster fuel that strengthens intentions to persist, especially when expectations for success are high. The aspirational capital and expectancy beliefs work in concert together to maximize support toward intentions to persist in STEM.

Resistant Capital. On its own (model 1 b-2), the addition of resistant capital was a statistically significant unique contributor to the variance in ItP, raised the total percent variance explained, and had a medium- to large-size β coefficient (Keith, 2019). This suggests that when Latina/o/x STEM major students have behaviors and attitudes that challenge the oppressive realities they face currently and sociohistorically, these behaviors and attitudes may statistically significantly influence their intentions to persist.

This association between resistant capital and persistence, while making reasonable conceptual sense before this study, now has quantifiable data to support it.

Regarding interaction effects, resistant capital seemed to make a difference for students with below average STEM major value by showing that Latina/o/x STEM major students with a greater sense of resistant capital had higher intentions to persist than those with a lesser sense of resistant capital. This finding for resistant capital, especially given the importance of aspirational capital, extends the literature showing these two specific capitals working in tandem in a variety of circumstances and spaces, manifested in ways such as motivation, self-affirming narratives, and perseverance (Espino, 2014; Liou et al., 2009; Sánchez-Connelly, 2018). Like aspirational capital's moderating role, resistant capital was linked with persistence intentions when STEM value was low, suggesting a buffering effect of capital that challenges inequality. As Matthews (2018) found that Black and Latino adolescents saw mathematics attainment value as oppositional when trying to protect public racial regard, a corresponding pattern emerged from this study to highlight the combination of resistant capital and STEM task value. Leveraging resistant capital in light of the structural barriers present in STEM postsecondary contexts for students of color is a potentially powerful way to harness students' assets.

Navigational Capital. Navigational capital did not seem to be statistically significant on its own regarding associations with ItP, yet it made a difference when interacting with STEM major value. However, the nature of the interaction was unexpected. When Latina/o/x students had below average STEM major value, the students with below average navigational capital had *higher* intentions to persist. Said differently, students with lower STEM major value and greater navigational capital had lower intentions to persist. In considering why that might be, perhaps if students believe that they have greater navigational capital and lower STEM major value, they do not need to commit to the intentions to persist because they have confidence in skills or abilities to navigate elsewhere in the institution and do something different. Yosso (2005) conceptualized navigational capital as “individual agency with institutional constraints” in spaces not created with communities of color in mind. However, this study was conducted at a Hispanic-serving institution, one that has been making strides in serving students, including mentoring and academic coaching. Perhaps this institution is seeing fruits of this labor evidenced by positive perceptions of students’ navigational capital. Although keeping Latina/o/x students in the STEM pipeline is important, it is also essential that students believe they feel a sense of control over their academic options and maybe navigational capital supports this type of control. This study’s unexpected finding regarding navigational capital suggests the need for more research focused in this area, especially considering how Samuelson and Litzler (2016) observed how more than 60% of engineering majors of color referenced both navigational and aspirational capitals as central to their persistence.

Familial Capital. There were no statistically significant findings related to familial capital in this study which was surprising given the literature related to family and STEM such as Latina/o/x STEM-related family dialogue at a young age predicting future STEM identity (e.g., Dou et al., 2019; Dou & Cian, 2020) and family support predicting science ability self-concept (e.g., Simpkins, et al., 2020). The lack of statistically significant findings regarding familial capital viewed alongside the importance of family-related constructs in the literature suggests the need for further research to consider whether this study's survey instrument did not meaningfully capture the construct of familial capital, or whether the construct was simply not statistically significant in this context and parameters of this study. Interestingly, a brief examination of the open-ended responses suggested that the role of family members was salient in students' decisions to choose STEM majors. Combining students' open-ended responses with their survey responses could be an exciting mixed methods approach to unpack further some of these phenomena.

Composite Capital. The existing literature on CCW capitals presented findings on the individual types of capital as conceptualized in Yosso's model, but the literature also revealed time and again that capitals were evidenced working in tandem with other capitals (e.g., Araujo, 2012; Ortiz et al., 2019). This led me to consider whether a composite measure of CCW capitals, an average value of each of the four capitals in this study, would reveal any statistically significant findings regarding ItP. I found that on its own, composite capital value was, indeed, a statistically significant contributor to the variance in ItP above and beyond demographic characteristics (model 1 b-5), with a medium effect size β coefficient. The addition of the composite capital variable increased the variance in ItP above and beyond demographics alone. Composite capital was not found to be statistically significant when interacting with expectancy, value, or cost, but the individual finding still suggests the need for additional quantitative research regarding CCW capitals from a collective view, especially given that this study only measured four of the six capitals from Yosso's original work. Scholars and practitioners may also benefit from exploring the addition of social capital and linguistic capital both to the composite capital scale and in relation to Latina/o/x STEM persistence.

Implications For Practice

Findings from this study may be of interest as topics for faculty, staff, and students in a variety of settings. First, my findings are a reminder that expectancy-value constructs are still powerful contributors to achievement choices such as intentions to persist. Therefore, faculty, staff, and student leaders should be intentional about fostering students' expectations for being successful in STEM, cultivating students' STEM values, and proactively addressing real and perceived costs in pursuing a STEM major. That said, findings from model 1a suggest that it may be most useful to give particular time and attention to supporting students' expectancies of success. Additionally, aspirational capital, resistant capital, and composite capital were also each statistically significant contributors to intentions to persist (model 1b). Given the interactive role of capitals with motivation constructs and persistence, instructors and staff could try to support EV constructs and validate capitals in Latina/o/x students. Evidence from this study validates the importance of these capitals, which should be championed by campus faculty and staff, especially the power of aspirational and resistant capital. Support for learners in these areas may be shown in a variety of formal and informal developmental education spaces through academic advisors, learning assistance center staff, tutors, program staff, instructors, and teaching assistants, for example. The next few paragraphs offer examples for how this may look in practice.

First, most students meet with an academic advisor one to two times per year to discuss course selection for the upcoming semester. This meeting is important because it is a time when students can discuss whether they want to continue in their current major or perhaps select something new. An advisor's dialogue can include inviting their STEM major advisee to revisit their aspirations, which can positively contribute to their intentions to persist in STEM. That being said, it is important to recognize that cultural capital wealth is an asset students can possess; one person cannot give another person aspirations (which might be construed as deficit-oriented), but an advisor can fan the aspirational flames. During this same dialogue, an advisor may elicit the extent to which an advisee desires to change the status quo regarding societal oppression—their resistant capital—which was also found to be associated with higher intentions to persist in a STEM major, more so for students with a below average sense of STEM major value. The advisor can validate the student's desire to resist and maybe even help to identify and remove barriers to the student's STEM success.

Staff who work with students in the federal TRIO programs may also want to engage in dialogues with students. TRIO programs provide support to students from disadvantaged backgrounds (USDOE, 2021) through Upward Bound, Talent Search, and Student Support Services (SSS). Connections between staff and students in each of these programs is an opportunity to foster expectations of success as well as CCW capitals, especially aspirational capital. For example, some TRIO programs focus on the success of students in math and science, such as this study site's SSS STEM program designed to introduce students with STEM majors and minors to STEM careers and opportunities. This is important because in this study, aspirational capital was shown to have a multiplicative influence on expectancy of STEM major success regarding STEM major persistence. The TRIO Upward Bound Math-Science program, which serves low income and first-generation high school students, seeks to strengthen the math and science skills of those who participate. This type of program could boost expectancy of success, a motivation variable that accounted for an additional 10 – 13% of the variance in ItP beyond demographics in this study. Outside of the institution's TRIO program, SCU offers a STEM Impact Program which seeks to enhance and strengthen the STEM success pipeline through high-impact practices and outreach. For example, the SURE Program (STEM Undergraduate Research Experience) may foster expectancy of success, aspirational capital, and resistant capital through participation in ten-week intensive research experiences, mentored by SCU's faculty from the College of Science and Engineering.

Another type of outlet for students to develop capitals such as aspirational capital, navigational capital, and resistant capital might be in campus organizations, particularly those created for STEM or historically marginalized groups. A few examples of relevant organizations at this study's site are the American Chemical Society, Healthcare Allies, Latinas Unidas, MAES-Latinos in Science and Engineering, Minority Association for Pre-Health Professionals, SACNAS (Advancing Chicanos/Hispanics & Native Americans in Science), and the Society of Professional Hispanic Engineers. Participation in these organizations may strengthen aspirations and resistance through a sense of belonging and community with others who have similar aspirations. My findings point to the continuation of these services and programs to build upon the motivations and capitals of Latina/o/x STEM interests and intentions to persist.

The process of fostering EV and CCW capital constructs could include instructors, staff, and student leaders explicitly naming and reinforcing student language related to EV constructs and types of CCW capitals, especially if students do not recognize them in themselves. Consider this hypothetical scenario's exchange: At the end of a tutoring session, a STEM major student getting help in chemistry perhaps thanks the tutor and expresses feelings of greater confidence with the content. The tutor might respond by echoing the sentiment and reinforcing the important role of effort and determination in personal motivation. Another scenario might be that an instructor for a learning frameworks course infuses a class discourse on motivation and self-regulation with reminders that having and pursuing aspirations, even in the face of barriers, can boost motivation. As part of the class interaction, perhaps there are a few moments in which students articulate and share their hopes, visions, and dreams for their future with one another. Still another opportunity may be in the science laboratory. Teaching assistants can embed intervention within this academic space by offering encouragement to students which may affirm sense of belonging, reduce stereotype threat or imposter phenomenon, and strengthen CCW capitals such as aspirational capital and resistant capital (see Micari et al., 2021).

Conversations or interactions such as the ones listed in this section may already be happening across institutional spaces, but it is the intentionality of such that can make the difference in supporting motivational constructs and CCW capitals by chance versus supporting them on purpose. Even small adjustments in the content of conversation between staff and students or instructors and students may water the seeds of persistence. Intentionality speaks to purposefulness and circles back to the idea of servingness at Hispanic-serving institutions. Recall from chapter 1 that a historical view regards HSIs as *either* being to provide broad access *or* increase graduation rates. However, findings from this study support an alternate *both-and* view by showing that institutions can *both* increase access *and* potentially increase graduation rates, particularly in STEM, through a better understanding of the synergy between Latina/o/x students' CCW capital assets and traditional EV constructs. Intentionally and purposefully validating asset-based constructs known to make a positive difference in STEM persistence is an act of service and is an outward manifestation of a developmental education mindset in which students are supported both academically and socioemotionally.

Implications for Theory

Seeing the Big Picture in SEVT

In 2020, Eccles and Wigfield released a name change to the original expectancy-value theory of motivation by adding the term *situated*. This qualifier attempts to capture the authors' position that achievement motivation is "culturally bound and situationally specific." As noted in Chapter 1, the original EV model is complex, but the vast majority of EV-based studies focus narrowly on the constructs of expectancy and subjective task value, which are nearest in proximity to the actual motivation-related choice. Yet, this study demonstrates the saliency of their model of motivation being *culturally bound* and *situationally specific*. For example, I found that for Latina/o/x STEM majors, aspirational capital on its own can account for approximately a five to eight percent increase in the variance in intentions to persist, holding background variables constant. Aspirational capital also had a compensatory effect on ItP when perceived STEM values are below average and a multiplicative effect on ItP when expectations of STEM major success were above average. Latina/o/x students with above average resistant capital had greater ItP than students with below average resistant capital *when* STEM major value was below average. These moderating relationships support Eccles and Wigfield's position that learners' decisions are shaped by meaningful individual differences and the cultural contexts of learners (Eccles & Wigfield, 2020).

This study's findings highlight the importance of zooming out from the oft narrowly focused research on EVT constructs in closest proximity to the achievement-related choices. Findings also reinforced Eccles's articulation that the EVT model was not intended to be linear and disconnected because achievement decisions occur *within* cultural and social structures, not apart from them (IPPE, 2019). Further, findings lend support to my consideration in Chapter 1 that types of cultural capital, such as the ones in this study, may be a substantive component of the cultural milieu aspect in the EVT model. Expectancy-value variables are salient, but this study shows that they function together with culturalized assets, which in turn together influence achievement choices such as intentions to persist.

Implications for EV Measurement Scales. In the EVT model, subjective task value is generally conceptualized as a single measure of importance that accounts for the presence of positively and negatively related aspects of the achievement choice at hand. Historically, the model has listed three aspects of value that contribute positively (attainment value, interest value, and utility value) and one aspect that contributes negatively (relative cost) (Eccles et al., 1983). However, not all scholars believe that relative cost should be so broad. Barron and Hulleman (2015) asserted that prior literature suggested three aspects of cost: effort cost, psychological cost (particularly anxiety), and opportunity cost. However, factor analyses from this study did not readily support the level of theoretical nuance of three positive and three negative aspects. Positive aspects of value cross loaded together, even through a variety of iterations of removing one item or another. Similar results occurred with aspects of cost. The factor structure with the greatest validity and reliability was one in which there were only three factors: one for expectancy, one for value, and one for cost. Although there may be conceptually distinct aspects to value and cost, seven distinct factors (one expectancy, three values, and three costs) were not supported in the current study.

Conceptualizing and Measuring Cultural Capital

Historically, cultural capital has been defined by social assets that promoted social mobility in middle and upper socioeconomic classes such as education, style of speech, and physical appearance (Throsby, 1999). Some scholars hold that in traditional schools, cultural capital is only validated when it resembles that of the dominant culture and that some educational authorities are either unable or unwilling to validate capital different than their own (Lareau, 2000; Khalifa, 2010). Given the findings from this study that quantitatively show types of CCW capital as statistically significant contributors to ItP and moderators to associations with EV constructs, I suggest that more needs to be done to modernize the definition of *cultural capital* away from an assumed historical association with Bourdieu and toward a more inclusive conceptualization. Already in the literature is the alternative term *non-dominant cultural capital* (NDCC) in which culturally contextualized assets are used to authenticate membership in various nondominant culture communities. Carter (2003) related NDCC to “Black” cultural capital, but perhaps the concept could more broadly apply to other identity-based groups regarding the practices of membership authentication. In 2005, Yosso challenged traditional interpretations of cultural capital through a critical race theory lens and generated the Community Cultural Wealth Model highlighting that wealth is an accumulation of shared assets not often recognized or acknowledged. Findings from this study provide quantitative support to the position that additional types of capital, namely aspirational capital, navigational capital, and resistant capital, should be recognized and acknowledged as valid and valuable because, as Carter (2003) noted, “cultural capital is context-specific, and its currency varies across different social spaces” (p. 137). With continued inclusion of CCW types of capital in future literature, such as the capitals in this study, there would eventually be a normalization of the capitals as the new standard conceptualization of cultural capital.

Limitations and Future Directions

This study examined the relationship between CCW capitals and motivation constructs as they related to Latina/o/x students’ intentions to persist in their STEM major at an HSI. While I believe that the study design was sound, there were limitations to the study that create boundaries for generalizations and precipitate recommendations for additional research.

Survey Instrument

Broadly, self-report tools, such as this survey, have a limit to the integrity of the data as participants may have opted for socially desirable responses or simply not known the accuracy of their response. Future research would benefit by gathering data on actual persistence and theoretical constructs such as EV and CCW capitals with additional measures to corroborate findings.

To date, scholars studying CCW capitals have primarily utilized qualitative methods to take a close look at unique contexts in which CCW capitals are evidenced in participants’ words or actions. In contrast, this study offers emergent support for quantifying perceived capitals. However, more research is needed to create valid and reliable CCW capital subscale items. For example, several items adapted from a prior study of CCW capitals (Sablan, 2019) needed to be removed from the instrument due to poor reliability and poor alignment with other items expected to load onto a common factor. This removal resulted in two subscales with only two items each: aspirational capital and navigational capital. For example, with aspirational capital, the language from two items was more past-present oriented (e.g., "I have pursued my goals despite barriers to my schooling.") and two items were future-oriented (e.g., "I am hopeful for my future."). With navigational capital, two items included language that was more person-oriented (e.g., "I have sought out mentors in my school who share my interests.") and two items included language that was more resource-oriented (e.g., "I know how to find resources at my college."). Future research could focus solely on developing a more robust CCW scale. Additionally, there were no prior subscales for linguistic capital or social capital to use in this study that met validity or reliability standards. Based on the literature and based on this study's findings, social capital, in particular, may also play a role in moderating achievement motivation outcomes. For example, if students with above average resistant capital have higher ItP than students with below average resistant capital, does having a sense of social capital enhance this difference? Given that literature indicates CCW capitals often work in tandem, it is possible that some forms of capital simply would not factor neatly, but additional research could contribute to this understanding. Further, the Sablan (2019) sample for assessing CCW capital items included students who identified as Native Hawaiian, Pacific Islander, and Asian. My study included students who identified as Latina/o/x. More research needs to be done to consider how students from additional populations interpret and respond to CCW items.

In addition to the development of survey items for CCW capital, there is a need to reconsider the determination of socioeconomic status (SES). As SES was the only background characteristic to show a statistically significant unique contribution to the variance in ItP in Model 0, the manner of determining this status is particularly important. Since the inquiry into socioeconomic status is sensitive and nuanced, the American Psychological Association (APA, 2015) offered options from Diemer et al. (2013). These include measures of occupational prestige, resource-based measures (e.g., combined total family income or highest year of school completed), absolute poverty measures (e.g., federal poverty thresholds or school indicators of poverty), relative poverty measures (e.g., indications of unmet needs or levels of psychological stress due to financial difficulties), and subjective social status measures (e.g., selecting “working class” or “middle class”). For the current study, I used free and reduced lunch status in high school as a proxy for SES, popular in education research, but future research may benefit from a more thorough approach to assessing SES (see Harwell & LeBeau, 2010) such as the inclusion of one or more additional measures, such as those just listed.

Nuanced Demographic Disaggregation

My efforts to be culturally sensitive in this dissertation were limited as there are yet opportunities to further explore potentially meaningful differences within Latin populations. Although 78% of participants self-identified as Hispanic and nearly 40% self-identified as Latina/o, 48% marked more than one response that included options for Mexican American (35%), Central American (13%), Chicana/o (5%), Cuban (4%), Puerto Rican (3%), South American (3%), and Mexican (1%). Based on the sample size in this study, the disaggregated sample sizes would have been too small to have sufficient statistical power. Future research with a larger sample and disaggregated data may offer interesting results as people who identify as Hispanic or Latina/o/x can originate from a broad geographic range with unique cultural characteristics. That said, the nature of identity continues to be complex as noted in the list used for this study which included pan-ethnic terms (e.g., Hispanic, Latino, or Chicana), pan-regional terms (e.g., South American or Central American), and national origins (e.g., Puerto Rican or Cuban). There continues to be no consensus for how people of Hispanic or Latin heritage identify, perhaps influenced by the blurred lines between race and ethnicity complicated by historical racism and colonialism.

Sample Size

The original intent of the study was to delimit the study to first-year students as a built-in control for year in school; however, the participant response rate was such that the final sample size would not provide a statistically sufficient ratio of participants to independent variables. I addressed this by including year in school as a background variable. I also improved the participant to IV ratio when I reduced the number of IVs by deciding to consolidate the types of values and the types of costs into composite variables. Although achieving a better ratio was not the impetus for consolidating variables, it did provide the added benefit, beyond construct validity and reliability, of having fewer IVs thereby improving statistical power. Future research would benefit from having a larger sample size in which year in school could perhaps be a comparison variable. It is possible that the farther along a student is in their STEM major, the more committed they are to persisting to graduation in STEM regardless of CCW capitals and motivation constructs because they have already invested so much of their resources such as time, effort, and money; however, I found that intent to persist in STEM did not statistically vary between students of different years.

Campus Context and Persistence

Participants' average intention to persist in a STEM major was a 4.58 on a scale of 1 to 5, and although this is a bright finding on its own, it left limited room for analyzing differences among participants. One direction for future research could be to use a wider scale for measuring intentions to persist such as 1 to 7 or even greater, which may help to better distribute responses. Beyond changing the scale, this study measured intentions to persist, recognizing that countless factors play a role in actual persistence. Nevertheless, a future study may opt to collect actual student persistence in a STEM major from students' first year through graduation and then explore the associations of CCW capital and motivational constructs with actual persistence or STEM degree attainment. Further, it would be useful to note how students' ItP compare to their actual persistence.

Another option for better understanding ItP would be to measure ItP at a non-HSI location and compare findings. Recall from chapter 2 that one of the explicit goals of an HSI is to increase achievement outcomes in STEM. This study site has been an HSI since 2010, so it is possible that structures and processes are in place such that STEM-related student outcomes continue to strengthen, and students are thriving.

It is important to note that the EVT motivation variables were domain-specific (STEM-specific) but the CCW variables were domain-general. While I hypothesized that

CCW capitals regarding one's educational pursuits in general could influence the way STEM-specific motivation influences intent to persist in a STEM major, it might be worth investigating in the future research how a STEM-specific set of CCW variables may operate in this context. Therefore, a third option would be to replicate this study at the same or similar site in a non-STEM area such as business or liberal arts and compare findings. If the ItP average is statistically significantly different than in STEM, perhaps there are other notable differences in motivation constructs or CCW capitals that help to shed light on why that is true.

Next, this study could be extended by comparing the findings of Latina/o/x students' ItP in STEM with those of other students of color. This would shed light on whether the high ItP average is unique to Latina/o/x students or is seen across student groups. Whether differences in the ItP average are statistically significant or not, the additional data regarding any differences in motivation and CCW capitals across the groups could be of note.

An additional variation for comparing results across institution types is to consider the difference between the university setting and the community college setting. The 2019-2020 list of HSIs included 569 institutions, of which 26% were 4-year public, 30% were 4-year private, 41% were 2-year public, and 3% were 2-year private (HACU, n.d.b.). The term HSI is widely used to include both 2-year and 4-year institutions, but it may be useful to begin using terms such as *HSU* for Hispanic-Serving University and *HSCC* for Hispanic-Serving Community College to provide greater specificity in terminology.

Lastly, it may be useful to replicate this study or a similar study in a post-pandemic context and compare findings. It is possible that changes to instructional delivery modes due to COVID-19 had a negative influence on student intentions to persist in STEM. It is also possible that students' desires to help others and "give back" to their communities as a result of the pandemic led to increased intentions to persist.

Methodologies

The high ItP average at this study's site coupled with statistically significant findings regarding several types of CCW capital suggests an opportunity for qualitative exploration into the dynamics of capital conversion. Nuñez (2009) called for greater research into the conversion process. Findings from this study offer a focused launch point for a qualitative extension into how students manifest or engage different types of CCW capitals. For example, a longitudinal multiple case study using a variety of data sources may be able to identify the attitudes and behaviors regarding aspirational or resistant capitals (or other types of CCW capital) and their relationship with persistence behaviors in STEM.

Chapter Summary

In sum, there are several key findings from this sociocultural approach regarding the associations between EV variables, CCW capitals, and STEM major persistence for Latina/o/x/ students. First, we know that EV constructs are still meaningful predictors for motivation-related behaviors in STEM such as intentions to persist. Second, we also now know that aspirational capital, resistant capital, and composite capital statistically significantly contribute to the variance in intention to persist in a STEM major. This is important because historically, research in educational psychology has struggled to conceptualize and measure culture adequately (Matthews & López, 2020), but this study offers progress toward trying to do so. Third, we now know that the influences of expectancy and value on Latina/o/x students' intentions to persist in their STEM major are sensitive to the levels of CCW capitals, especially aspirational capital. Fourth, we know that these specific findings do not differ by gender, first-generation status, or socioeconomic status. Finding that CCW capitals interact with EV constructs enhances historic understandings of the EV model by directly connecting culturalized assets to motivation behaviors. However, more research is needed with race-reimaged studies of EV theory, particularly if including CCW capitals. The literature would benefit from a more thorough development of CCW scales and exploration of item interpretation by different historically minoritized populations. Findings suggest that HSIs may choose to develop their operationalization of servingness by being purposeful and intentional about nurturing CCW capitals in their Latina/o/x STEM major students through a variety of institutional programs, instructors, staff, and student leaders.

Momentum for Race-reimaged Research

There is a growing call for research that moves beyond simply having race and ethnicity (R/E) as categorical variables in which complex sociocultural experiences are treated as operating in monolithic ways (Matthews & López, 2020). This study is one in a growing collection of race-reimaged research in which "traditional constructs (e.g., self-efficacy, self-regulation, achievement motivation, etc.) ...are reconceptualized to include racially influenced, sociocultural perspectives (e.g., history, context, multiple identities, etc.)." (DeCuir-Gunby & Schutz, 2014, p. 244). Instead of comparing EV-related outcomes across R/E groups, I focused solely on the Latina/o/x population and explored the interactions of CCW capitals with traditional EV variables. By using a race-reimaged approach, I was able not only to recognize that individual psychological processes do not happen in a vacuum, but also enrich an understanding of EV theory by integrating cultural capital and assets that students of color may possess. Given this enriched understanding, an important contribution of this study was the bold and unique weaving of two theories often siloed from one another and the disruption of the pattern of achievement motivation research that has historically used White-majority samples, which consequently neglects the central role of culturalized perspectives. I encourage future research to consider extending this disruption through unique, new mergings of motivation theory with cultural theory centered around the assets of racially minoritized individuals.

APPENDIX SECTION

Appendix A

Meta-Review of CCWM-STEM Studies

Study Characteristics	Number of Studies
Methodology Approach	
Qualitative	25
Quantitative	2
Mixed Methods	6
Type of Capital Included	
Aspirational capital	28
Familial capital	24
Linguistic capital	15
Navigational capital	26
Resistant capital	24
Social capital	25
All six types	12
Three to five types	17
Only one type	4
STEM Discipline	
Engineering focus	15
STEM focus	13
Included engineering	8
Unclear about specific disciplines	5
Mathematics	3
Science and Mathematics	2
Setting	
Elementary school	2
Middle school	3
High school	3
2-year institutions	2
4-year institutions	27
STEM workforce	1
Specific Sites	
HBCU	2
HSI	3
Population	
Latinx students	16
Black students	12
First-generation students	4
Transfer students	2
Deaf students	1
After-school program participants	2

Note. Summarization of Denton et al. (2019)

Appendix B

List of All Courses Included in Study Recruitment

Course Prefix and Number	Course Name
AG 1110	Careers in Agriculture
AG 1445	Basic Animal Science
AG 2373	Introduction to Agricultural Engineering
AG 2373	Introduction to Ag Engineering
AG 2379	General Horticulture
AG 3301	Principles of Livestock Genetics
AG 3308	Organic Gardening
AG 3314	Animal Health and Disease Control
AG 3325	Animal Nutrition
AG 3331	Reproduction in Farm Animals
AG 3426	Soil Science I
BIO 1330	Functional Biology
BIO 1331	Organismal Biology
BIO 2400	Microbiology
BIO 2411	Intermediate Zoology
BIO 2450	Genetics
BIO 2451	Human Anatomy and Physiology 1
BIO 2452	Human Anatomy and Physiology 2
BIO 3301	Biology of Sex and Reproduction
BIO 3371	Marine Resources
BIO 3421	Vertebrate Physiology
BIO 3442	Virology
CE 2340	Infrastructure Materials
CE 2350	Structural Analysis
CE 3320	Environmental Engineering
CHEM 1341	General Chemistry I
CHEM 1342	General Chemistry II
CHEM 2341	Organic Chemistry I
CHEM 2342	Organic Chemistry II
CHEM 2350	Biochemistry and Metabolism
CHEM 3340	Physical Chemistry 2
CHEM 3340	Physical Chemistry 2
CHEM 3380	Analytical Biochemistry
CHEM 3410	Quantitative Analysis

Course Prefix and Number	Course Name
CIM 3420	Fundamentals of Concrete: Properties and Testing
CLS 3323	Clinical Microscopy and Analysis of Body Fluids
CLS 3412	Hematology/Coagulation 1
CLS 3424	Clinical Immunology
CS 1319	Fundamentals of Computer Science
CS 1428	Foundations of Computer Science I
CS 2308	Foundations of Computer Science II
CS 2318	Assembly Language
CS 3339	Computer Architecture
CS 3358	Data Structures and Algorithms
CS 3398	Software Engineering
EE 2400	Circuits 1
EE 2420	Digital Logic
EE 3340	Electromagnetics
EE 3350	Electronics 1
EE 3355	Solid State Devices
EE 3370	Signals and Systems
EE 3400	Circuits 2
EE 3420	Microprocessors
ENGR 2300	Materials Engineering
ENGR 2301	Mechanics for Engineers
ENGR 3311	Mechanics of Materials
ENGR 3373	Circuits and Devices
ESS 3317	Exercise Physiology
GEO 2426	Fundamentals of Geographic Information Systems
GEO 3301	Research Methods in Geography
GEO 3313	Natural Resource Use and Management
GEO 3321	Energy Resource Management
GEO 3416	Remote Sensing and Earth Observation
GEO 3426	Advanced GIS
HIM 2360	Medical Terminology
MATH 2471	Calculus I
MATH 2472	Calculus II
MATH 2393	Calculus III
MATH 3305	Introduction to Probability and Statistics
MATH 3306	Introduction to Statistical Methods
MATH 3315	Modern Geometry
MATH 3323	Differential Equations

Course Prefix and Number	Course Name
MATH 3325	Number Systems
MATH 3330	Introduction to Advanced Mathematics
MATH 3376	Applied Linear Algebra
MATH 3377	Linear Algebra
MATH 3380	Analysis 1
MATH 3383	Numerical Analysis 1
MATH 3398	Discrete Mathematics 2
MFGE 2332	Material Selection and Manufacturing Processes
MFGE 3316	Computer Aided Design and Manufacturing
NUTR 1362	Food Systems
NUTR 2360	Nutrition Science
NUTR 3364	The Science of Nutrition and Exercise
NUTR 3367	Nutrition and Physiology
PHYS 1430	Mechanics
PHYS 2425	Electricity and Magnetism
PHYS 2435	Waves and Heat
PHYS 3301	Musical Acoustics
PHYS 3311	Mechanics 1
PHYS 3312	Modern Physics
PHYS 3315	Thermodynamics
TECH 2344	Power Technology
TECH 2351	Statics and Strength of Materials
TECH 2370	Electricity/Electronics Fundamentals
TECH 3344	Applied Thermofluids
TECH 3364	Quality Assurance
TECH 3370	Electronics
TECH 3373	Communication Systems

Appendix C–1

Recruitment Email 1 to Instructors and Students

From:	Christie Lawson (cas121@txstate.edu)
To:	Instructor Name (individual, customized emails)
Subject:	Research Participation Invitation: STEM Motivation

This email message is an approved request for participation in research that has been approved by the Texas State Institutional Review Board (IRB).

Dear Dr. Kemma Stree – Course: BIO 1330 (Functional Biology)

My name is Christie Lawson. I am a doctoral student in the College of Education interested in learning more about the motivations of first- and second-year students who are STEM (Science, Technology, Engineering, and Mathematics) majors. This includes students in the College of Science and Engineering and the College of Health Professions.

- Student participation requires completing a one-time survey taking no longer than about 15 minutes.
- All student participation is voluntary.
- All student participation will remain both anonymous and confidential.
- Students may benefit from participation through the process of reflecting on their motivations regarding STEM courses and STEM majors.
- As incentive, students who participate may choose to enter for a $20 Amazon gift card drawing. Actually, I'll be drawing 10 names which increases the chances of being randomly selected.

Will you please forward this email to the students in your BIO 1330 classes? Your direct involvement may increase the chances that students elect to participate versus a blanket email from me to the entire institution.

Click here to access the survey.

To ask questions about this research please contact Christie Lawson or her faculty advisor:
Christie Lawson, Doctoral Student: 210-724-5515, cas121@txstate.edu
Dr. Carlton J. Fong, Dissertation Chair: 512-245-5042, cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to:
Dr. Denise Gobert, IRB Chair 512-716-2652, dgobert@txstate.edu
Monica Gonzales, IRB Specialist 512-245-2334, meg201@txstate.edu

Sincerely,
Christie Lawson
cas121@txstate.edu

Appendix C–2

Follow-Up Email 1 to Instructors and Students

From: Christie Lawson (cas121@txstate.edu)
To: Instructor Name (individual, customized emails)
Subject: Research Participation Invitation: STEM Motivation

This email message is an approved request for participation in research that has been approved by the Texas State Institutional Review Board (IRB).

Dear Dr. Kemma Stree – BIO 1330 (Functional Biology)

I am following up on an email from *date* regarding support for a study on the motivational processes associated with STEM student persistence here at Texas State University, which has proportional student demographic representation in STEM majors as compared to the overall undergraduate population demographics.

Sufficient sample size is critical in quantitative studies such as mine. There has been a noticeable increase in the number of participants shortly after other instructors sent out the survey to students or posted it to their Canvas announcements. Your support, combined with that of other STEM/STEM-related instructors I have reached out to, can make a big difference in data collection.

If you have already forwarded this email to students, I am grateful!
If you not yet forwarded the survey to the students in your BIO 1330 Functional Biology classes, will you consider doing that at this time?

- Student participation requires completing a one-time survey taking no longer than about 15 minutes.
- All student participation is voluntary.
- All student participation will remain both anonymous and confidential.
- Students may benefit from participation through the process of reflecting on their motivations regarding STEM courses and STEM majors.
- As incentive, students who participate may choose to enter for a $20 Amazon gift card drawing. Actually, I'll be drawing 10 names which increases the chances of being randomly selected.

Students click here to access the survey.

To ask questions about this research please contact Christie Lawson or her faculty advisor:
Christie Lawson, Doctoral Student: 210-724-5515, cas121@txstate.edu
Dr. Carlton J. Fong, Dissertation Chair: 512-245-5042, cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to:
Dr. Denise Gobert, IRB Chair 512-716-2652, dgobert@txstate.edu
Monica Gonzales, IRB Specialist 512-245-2334, meg201@txstate.edu

Sincerely,
Christie A. Lawson, M.Ed.
Doctoral Student

Appendix C–3

Recruitment Email 2 to Instructors and Students

From: Christie Lawson (cas121@txstate.edu)
To: Instructor Name (individual, customized emails)
Subject: Research Participation Invitation: STEM Motivation

This email message is an approved request for participation in research that has been approved by the Texas State Institutional Review Board (IRB).

Dear Dr. Justin Tyme – CHEM 3410 (Quantitative Analysis)

My name is Christie Lawson and I am in the dissertation phase of my studies in the College of Education here at Texas State University. I am studying the motivational processes associated with STEM student persistence here at Texas State University, which has proportional student demographic representation in STEM majors as compared to the overall undergraduate population demographics. This makes Texas State University a unique and important study site.

Sufficient sample size is critical in quantitative studies such as mine. In my experience, there is a noticeable increase in the number of student participants when students see instructor support for the study. Your support, combined with that of other STEM/STEM-related instructors I have reached out to, can make a big difference in data collection and analysis.

Will you forward this email (or post in your Canvas announcements) to the students in your CHEM 3410 Quantitative Analysis classes at this time?

- Student participation requires completing a one-time survey taking no longer than about 15 minutes.
- All student participation is voluntary.
- All student participation will remain both anonymous and confidential.
- Students may benefit from participation through the process of reflecting on their motivations regarding STEM courses and STEM majors.
- As incentive, students who participate may choose to enter for a $20 Amazon gift card drawing. I'll be drawing 10 names which increases the chances of being randomly selected.

Students click here to access the survey.
If the hyperlink is not cooperative, students may also copy and paste this link into any browser:
https://txstate.co1.qualtrics.com/jfe/form/SV_3QPaCIl4Lhypozz

To ask questions about this research please contact Christie Lawson or her faculty advisor:
Christie Lawson, Doctoral Student: 210-724-5515, cas121@txstate.edu
Dr. Carlton J. Fong, Dissertation Chair: 512-245-5042, cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to:
Dr. Denise Gobert, IRB Chair 512-716-2652, dgobert@txstate.edu
Monica Gonzales, IRB Specialist 512-245-2334, meg201@txstate.edu

Sincerely,
Christie A. Lawson, M.Ed.
Doctoral Student

Appendix C–4

Follow-Up Email 2 to Instructors and Students

From: Christie Lawson (cas121@txstate.edu)
To: Instructor Name (individual, customized emails)
Subject: Research Participation Invitation: STEM Motivation

This email message is an approved request for participation in research that has been approved by the Texas State Institutional Review Board (IRB).

Dear Dr. Justin Tyme – CHEM 3410 (Quantitative Analysis)

I am following up on an email from *date* regarding support for a study on the motivational processes associated with STEM student persistence here at Texas State University.

If you have already forwarded this email to students, I am grateful!
If you have not yet forwarded the survey to the students in your CHEM 3410 classes (or posted to Canvas), will you consider doing that at this time?
There has been a noticeable increase in the number of participants shortly after other instructors sent out the survey to students or posted it to their Canvas announcements. Your support, combined with that of other STEM/STEM-related instructors I have reached out to, can make a big difference in data collection.

- Student participation requires completing a one-time survey taking no longer than about 15 minutes.
- All student participation is voluntary.
- All student participation will remain both anonymous and confidential.
- Students may benefit from participation through the process of reflecting on their motivations regarding STEM courses and STEM majors.
- As incentive, students who participate may choose to enter for a $20 Amazon gift card drawing. Actually, I'll be drawing 10 names which increases the chances of being randomly selected.

Students click here to access the survey.
Or students can copy and paste this link in to a web browser:
https://txstate.co1.qualtrics.com/jfe/form/SV_3QPaCIl4Lhypozz

To ask questions about this research please contact Christie Lawson or her faculty advisor:
Christie Lawson, Doctoral Student: 210-724-5515, cas121@txstate.edu
Dr. Carlton J. Fong, Dissertation Chair: 512-245-5042, cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to:
Dr. Denise Gobert, IRB Chair 512-716-2652, dgobert@txstate.edu
Monica Gonzales, IRB Specialist 512-245-2334, meg201@txstate.edu

Sincerely,
Christie A. Lawson, M.Ed.
Doctoral Student

Appendix C–5

Email to Student Winners of the Random Drawing

From: Christie Lawson (cas121@txstate.edu)
To: Participant@emailaddress
Subject: Research Drawing Winner

Happy Monday,
Thank you for participating in my dissertation research study. Your entry was one of ten randomly selected to win a $20 Amazon gift card. Please confirm that you would still like to receive this appreciation gift card. It will be delivered via email. If you prefer that I use an email address other than this one, please let me know.

Sincerely,
Christie Lawson

Christie A. Lawson, M. Ed.
Doctoral Student – Developmental Education
Graduate Research Assistant
Instructor – US 1100

Appendix D

Survey Item Citations and Wording Modifications

Table D1

EVT Item Citations

Items	Robinson et al. (2019) Source
Expectancy of Success (ES)	Mamaril, N. A., Usher, E. L., Li, C. R., Economy, D. R., & Kennedy, M. S. (2016). Measuring undergraduate students' engineering self-efficacy: A validation study. *Journal of Engineering Education, 105*(2), 366–395. https://doi.org/10.1002/jee.20121
Attainment Value (AttV)	Conley, A. (2012). Patterns of motivation beliefs: Combining achievement goal and expectancy-value perspectives. *Journal of Educational Psychology, 104*(1), 32–47. https://doi.org/10.1037/a0026042
	Pugh, K., Linnenbrink-Garcia, L., Koskey, K. L. K., Stewart, V. C., & Manzey, C. (2009). Motivation, learning, and transformative experience: A study of deep engagement in science. *Science Education, 94*(1), 1–28. https://doi.org/10.1002/sec.20344
Interest Value (IntV)	Conley, A. (2012). Patterns of motivation beliefs: Combining achievement goal and expectancy-value perspectives. *Journal of Educational Psychology, 104*(1), 32–47. https://doi.org/10.1037/a0026042
Utility Value (UtV)	Conley, A. (2012). Patterns of motivation beliefs: Combining achievement goal and expectancy-value perspectives. *Journal of Educational Psychology, 104*(1), 32–47. https://doi.org/10.1037/a0026042
Effort Cost (EffC)	Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315–329. https://doi.org/10.1037/a0034027
Opportunity Cost (OppC)	Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315–329. https://doi.org/10.1037/a0034027
Psychological Cost (PsyC)	Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology, 106*(1), 315–329. https://doi.org/10.1037/a0034027

Table D2

Side-by-Side Comparison of Modified EVT Survey Items

Sub Scale	Original Wording (Robinson et al., 2019)	Current Wording
ES	I will be able to master the content in even the most challenging engineering course if I try.	I am certain I can learn required STEM content, even in the most challenging courses.
ES	I'm certain I can master the content in the engineering-related courses I am taking this semester.	I am confident that I can master the content in the STEM-related courses required for my degree.
ES	I will be able to do a good job on almost all of my engineering coursework if I do not give up.	I will be able to do a good job on almost all of my STEM coursework if I do not give up.
ES	I'm certain I can earn a good grade in my engineering-related courses.	I am confident that I can earn a good grade in my STEM-related courses.
AttV	Being someone who is good at engineering is important to me.	Being someone who is good in STEM is important to me.
AttV	Being good in engineering is an important part of who I am.	Being successful in STEM is an important part of who I am.
AttV	I consider myself an engineering person.	I consider myself a STEM person.
AttV	Being involved in engineering is a key part of who I am.	Being involved in my STEM field is a key part of who I am.
IntV	I am fascinated by engineering.	I am fascinated by ideas in STEM.
IntV	I enjoy doing engineering.	I enjoy doing STEM-type activities.
IntV	I enjoy the subject of engineering.	I enjoy my STEM-related courses.
		STEM subjects are interesting to learn about. *This item is original to this study.*
UtV	Engineering is valuable because it will help me in the future.	This STEM degree is valuable because it will prepare me for future/additional education.
UtV	Engineering is practical for me to know.	STEM knowledge is practical for me to know.
UtV	Being good in engineering will be important for my future (like when I get a job or go to graduate school).	This STEM degree will help me get a good job in the future.
EffC	Studying engineering will require more effort than I'm willing to put in.	Achieving this STEM degree will require more effort than I am willing to put in.
EffC	I am not sure if I've got the energy to do well in engineering.	I am not sure if I have the energy to do well in this STEM major.
EffC	For me, studying engineering may not be worth the effort.	I am unsure if completing this STEM degree will be worth the effort.
OppC	I'm concerned that I have to give up a lot to do well in engineering.	I am concerned that I will have to give up a lot to do well in my STEM major.
OppC	I'm concerned that success in engineering requires that I give up other activities I enjoy.	I am concerned that success in my STEM degree requires that I give up other activities I enjoy.
OppC	I'm concerned about losing track of valuable relationships because of the work required for engineering.	I am concerned about losing track of valuable relationships because of the work required for this STEM degree.
PsyC	I'm concerned about being embarrassed if my work in engineering is inferior to that of my peers.	I am concerned about being embarrassed if my STEM work is not as good as that of my peers.
PsyC	I'm concerned that my self-esteem will suffer if I am unsuccessful in engineering.	I am concerned that my self-esteem will suffer if I am unsuccessful in this STEM major.

Sub Scale	Original Wording (Robinson et al., 2019)	Current Wording
PsyC	I worry that others will think I am a failure if I do not do well in engineering.	I worry that others will think I am a failure if I do not do well in this STEM major.
PsyC	I'm anxious that I won't be able to handle the stress that goes along with studying engineering.	I am anxious that I won't be able to handle the stress that goes along with completing my STEM degree.

Appendix E

Complete Survey Instrument with Item Labels

TEXAS STATE UNIVERSITY
The rising STAR of Texas

Christie Lawson, a graduate student at Texas State University, is conducting a research study to learn more about achievement motivation for students who are majoring in a STEM field (Science, Technology, Engineering, and Mathematics).

STEM includes many types of majors. If you are unsure if your major is a STEM major, you can still participate in the survey.

- Participation is voluntary and you may exit the survey at any time. The survey will take approximately 15 minutes or less to complete. You must be at least 18 years old to participate.
- This study involves no foreseeable risks. You are encouraged to answer all items and select a response that best reflects your beliefs, not one that you think you should select for the research or for anyone else's benefit. However, if there are any items that make you uncomfortable or that you would prefer to skip, please leave the answer blank. Your responses are anonymous.
- You may benefit from participation through the process of reflecting on your motivations regarding STEM courses and STEM majors.
- Reasonable efforts will be made to keep the personal information in your research record private and confidential. Any identifiable information obtained in connection with this study will remain confidential and will be disclosed only with your permission or as required by law.
- The members of the research team and the Texas State University Office of Research Compliance (ORC) may access the data. The ORC monitors research studies to protect the rights and welfare of research participants.
- Your name will not be used in any written reports or publications which result from this research. Data will be kept for three years (per federal regulations) after the study is completed and then destroyed.
- At the end of the survey, you may choose to enter into a random drawing to win a $20 Amazon gift card. There will be 10 drawings (10 winners). Email entry will not be linked to any of your survey responses.

If you have any questions or concerns, feel free to contact Christie Lawson or her faculty advisor:

- Christie Lawson, Doctoral Student.
    - Curriculum and Instruction: Developmental Education
    - 210-724-5515
    - cas121@txstate.edu
- Dr. Carlton J. Fong, Dissertation Chair
    - Curriculum and Instruction: Developmental Education.
    - cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Denise Gobert 512-716-2652 (dgobert@txstate.edu) or to Monica Gonzales, IRB regulatory manager 512-245-2334 (meg201@txstate.edu).

If you would prefer not to participate, please do not fill out a survey.

CONSENT

- I consent to participate in this survey.
- I do not consent to participate in this survey.

The next two questions ask about your major.

D1
STEM is Science, Technology, Engineering, and Mathematics.
If you are a STEM major, which of the following best describes your STEM major?

- Agricultural Sciences: General Agriculture, Animal Science, Agribusiness and Management, Horticulture, Agricultural Mechanics
- Biology: General Biology, Aquatic Biology, Microbiology, Wildlife Biology
- Chemistry, Biochemistry
- Computer Science
- Engineering: Civil, Electrical, Industrial, Manufacturing
- Engineering Technology: General Engineering Technology, Concrete Industry Management, Construction Science and Management, Technology Management
- Exercise and Sports Science
- Family and Consumer Science: Nutrition and Foods (Dietetics)
- Geography: Geographic Information Science, Resource and Environmental Studies, Water Resources
- Health Science: General Health Science, Clinical Laboratory Science, Radiation Therapy, Respiratory Care
- Mathematics
- Nursing
- Physics
- Pre-Professional: Pre-Medical, Pre-Pharmacy, Pre-Dental, Pre-Veterinary
- Other STEM major not listed. (Please specify):
- I am not a STEM major.

D2
STEM is Science, Technology, Engineering, and Mathematics.
If you are a STEM major, which college is your STEM major in?

- College of Science and Engineering
- College of Health Professions
- College of Applied Arts
- College of Liberal Arts
- College of Education
- I am not a STEM major.

The following set of items are about your beliefs regarding STEM, your STEM courses, and being a STEM major.

ES 1
I am certain I can learn required STEM content, even in the most challenging STEM-major courses.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ES 2
I am confident that I can master the content in the STEM-related courses for my degree.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ES 3
I will be able to do a good job on almost all of my STEM-major coursework if I do not give up.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ES 4
I am confident that I can earn a good grade in my STEM-major courses.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

IntV_1
I am fascinated by ideas in STEM.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

IntV_2
I enjoy doing STEM-type activities.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

IntV_3
STEM subjects are interesting to learn about.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

IntV_4
I enjoy my STEM-related courses.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AttV_1
Being someone who is good in STEM is important to me.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AttV_2
Being someone who is successful in STEM is an important part of who I am.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AttV_3
I consider myself to be a STEM person.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AttV_4
Being involved in a STEM field is a key part of who I am.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

UtV_1
This STEM degree is valuable because it will prepare me for future/additional education.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

UtV_2
STEM knowledge is practical for me to know.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

UtV_3
This STEM degree will help me get a good job in the future.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

EffC_1
Achieving this STEM degree will require more effort than I am willing to put in.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

EffC_2
I am not sure if I have the energy to do well in this STEM major.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

EffC_3
I am unsure if completing this STEM degree will be worth the effort.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

OppC_1
I am concerned that I will have to give up a lot to do well in my STEM major.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

OppC_2
I am concerned that success in my STEM degree requires that I give up other activities I enjoy.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

OppC_3
I am concerned about losing track of valuable relationships because of the work required for this STEM degree.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

PsyC_1
I am concerned about being embarrassed if my STEM work is not as good as that of my peers.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

PsyC_2
I am concerned that my self-esteem will suffer if I am unsuccessful in a STEM major.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

PsyC_3
I worry that others will think I am a failure if I do not do well in a STEM major.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

PsyC_4
I am anxious that I won't be able to handle the stress that goes along with completing a STEM degree.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

The following items focus on your beliefs about your goals, relationships, and skills.

AspC_1
I have pursued my goals despite barriers to my schooling.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AspC_2
I believe that my dreams for my future are possible.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AspC_3
I am hopeful for my future.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

AspC_4
I consider myself an ambitious person.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

FamC_1
I have strong role models in my family.
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

FamC_2
I am connected to my extended family members (such as aunts, uncles, cousins, and others beyond my parents and siblings).
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

FamC_3
A family member or members have passed down lessons to me that I can use in my schooling.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

FamC_4
I learn a lot of valuable knowledge from my family members.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

NavC_1
I know how to find resources at my college.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

NavC_2
I am confident in my ability to network on my campus.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

NavC_3
Even when presented with obstacles, I am able to access resources at my college.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

NavC_4
I have sought out mentors in my school who share my interests.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ResC_1
I want to make a difference in the broader society.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ResC_2
I want to make a difference in my racial/ethnic/cultural community.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ResC_3
I believe I will be able to make a difference in society, even if there are racial barriers.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ResC_4
I believe I can contribute to society in spite of racial/ethnic discrimination.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

The next item is about your college intentions, in general.

ItP_5
I plan on continuing my college education in Fall 2021.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

The next few items are about your intentions regarding your college major.

ItP_1
I intend to continue pursuing a STEM major after this semester.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ItP_2
I plan to continue taking courses for a STEM major.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

ItP_3 (Reverse code item)
I am thinking about switching my STEM major to a non-STEM major.

- Strongly Agree
- Agree
- Neither Agree nor Disagree
- Disagree
- Strongly Disagree

ItP_4
I will obtain a STEM-related degree.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

The next few items allow you to write your answers openly.

OE_1
Are you involved in any campus programs or organizations focused on student success in STEM? If yes, please briefly describe:

OE_2
Has the COVID-19 pandemic positively or negatively impacted your decision to stay in college? If so, please briefly explain:

OE_3
Has the COVID-19 pandemic positively or negatively impacted your decision to pursue a STEM degree? If so, please briefly explain:

OE_4
Are there aspects of your cultural or family background that play a role in your decision to pursue a STEM degree? If so, please briefly explain:

This last set of items will help me to better understand more about you.

D_Class
In what semester did you start taking classes at this institution?

- Spring 2021
- Fall 2020
- Summer 2020
- Spring 2020
- Fall 2019
- Before Fall 2019

D_GPA
What is your current GPA?

- 0.0 – 0.5
- 0.6 – 1.0
- 1.1 – 1.5
- 1.6 – 2.0
- 2.1 – 2.5
- 2.6 – 3.0
- 3.1 – 3.5
- 3.6 – 4.0
- I do not have a GPA yet.
- I do not know my GPA.

D_GEND
How do you identify?

- Man/Transgender Man
- Woman/Transgender Woman
- Other (Please write in):
- I prefer not to respond.

D_Ethn
With which of the following ethnic/cultural groups do you identify?
Mark all that apply.

- Hispanic
- Latina/o
- Mexican American
- Chicana/o
- Cuban
- Puerto Rican
- Central American
- South American
- None of these
- Other (Please write in):

D_Race
With which of the following racial groups do you identify?
Mark all that apply.

- African American / Black
- American Indian or Alaska Native
- Asian
- Native Hawaiian / Pacific Islander
- White
- None of these
- Other (Please write in):
- I prefer not to respond.

D_FirstGen
Are you a first-generation college student in your family?

- Yes
- No
- I'm not sure.

D_SES
In high school, were you eligible for free or reduced breakfast / lunch?

- Yes
- No
- I'm not sure.

D_House
What is your current living arrangement?

- I live on campus.
- I live off campus with family.
- I live off campus, but not with family.
- I prefer not to respond.

D_InterSt
Are you an international student?

- Yes
- No

Thank you for participating in this study. You may enter your email address for a chance to win a $20 Amazon gift card. Your email address will not be connected to your survey responses.

CLICK HERE (Takes participant to a separate Qualtrics entry)

> Thank you for participating in the research study survey. Enter your email address for a chance to win a $20 Amazon gift cards. There will be 10 winners.
>
> This email address is kept separate from all data you entered into the survey and will be used only to contact you if your name is selected. Winners will be notified not later than May 15, 2021.
>
> Your email address will not be given or sold to anyone for any reason.

Appendix F

Psychometric Properties for Expectancy, Value, and Cost

Exploratory Factor Analysis: Expectancy-Value Items

In the literature, expectancy-value theory has two broad constructs (expectancy of success and subjective task value) but as many as seven nuanced constructs (expectancy of success, three types of value, and three types of cost). I conducted this EFA in multiple iterations to determine the most statistically sound use of the data. Analysis of the interest, attainment, and utility value items revealed cross-loading of several items across types of value. Cross-loading also occurred when analyzing the items for effort, opportunity, and psychological costs. This was not entirely unexpected because the types of values and types of costs are closely related within each subscale, and collinearity can be a challenge in determining distinct factors. Both theoretically and empirically, not only are types of values highly related to one another and types of costs highly related to one another, but expectancy, values, and costs can also be highly correlated to one another. For this reason, there is support in the literature for creating a composite value score and a composite cost score (e.g., Lazarides, 2020). Given the cross-loadings as well as the smaller-than-desired sample size, I created composite variable scores for both values and costs by forcing all 11 value items onto one value subscale and all 10 cost items onto one cost subscale. I conducted a final EFA with all expectancy-value items together using a forced three-factor structure. Although there were still cross-loadings (see Table F1) and the percent variance explained was below a desired 60% (see Table F2), the resulting reliability coefficients for the expectancy subscale ($\alpha = .77$), values subscale ($\alpha = .82$), and costs subscale ($\alpha = .83$) were acceptable, meeting desirable research standards. The

Kaiser-Myer-Olkin measure of sampling adequacy indicated that the strength of the relationships among variables was high (KMO = .806). Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was statistically significant (χ^2 (300) = 1453.94, $p < .001$). Creating composite subscales reduced the overall number of IVs, reduced theoretical cross-loadings, and increased the ratio of IVs to participants. All subsequent references to *value* and *cost* as variables refer to the composite subscale.

Table F1

Pattern Matrix for a Forced Three-Factor Expectancy-Value Structure

	Component		
Item	1	2	3
ES_1			**.658**
ES_2			**.812**
ES_3			**.694**
ES_4			**.797**
IntV_1	**.620**		
IntV_2	**.517**		
IntV_3	**.456**		.435
IntV_4	**.305**		.412
AttV_1	**.632**		
AttV_2	**.698**		
AttV_3	**.649**		
AttV_4	**.735**		
UtV_1	**.563**	.211	
UtV_2	**.552**		
UtV_3	**.327**		
EffC_1		**.347**	
EffC_2		**.401**	-.469
EffC_3	-.303	**.329**	
OppC_1		**.784**	.202
OppC_2		**.758**	
OppC_3		**.830**	
PsyC_1		**.529**	
PsyC_2	.331	**.601**	-.275
PsyC_3	.315	**.579**	-.238
PsyC_4		**.647**	

Note. Extraction method: Principal component analysis. Rotation method: Promax with Kaiser normalization. Rotation converged in 5 iterations. Loading values below .20 were suppressed.

Table F2

Percent Variance Explained for Expectancy-Value

Component	Initial Eigenvalues			Extraction Sum of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6.175	24.702	24.702	6.175	24.702	24.702	4.581
2	3.377	13.508	38.210	3.377	13.508	38.210	4.584
3	1.739	6.954	45.165	1.739	6.954	45.165	4.498
4	1.602	6.409	51.573				
5	1.167	4.667	56.240				
6	1.115	4.462	60.702				
7	1.000	4.002	64.703				
8	.927	3.708	68.411				
9	.831	3.325	71.736				
10	.741	2.965	74.700				
11	.720	2.879	77.579				
12	.669	2.676	80.256				
13	.647	2.586	82.842				
14	.556	2.223	85.064				
15	.475	1.902	86.966				
16	.444	1.775	88.742				
17	.430	1.721	90.462				
18	.397	1.589	92.051				
19	.354	1.417	93.468				
20	.335	1.339	94.807				
21	.316	1.262	96.070				
22	.300	1.201	97.270				
23	.247	.986	98.257				
24	.231	.923	99.180				
25	.205	.820	100.000				

Note. Extraction method: Principal component analysis.
[a]When components are correlated, sums of squared loadings cannot be added to obtain a variance.

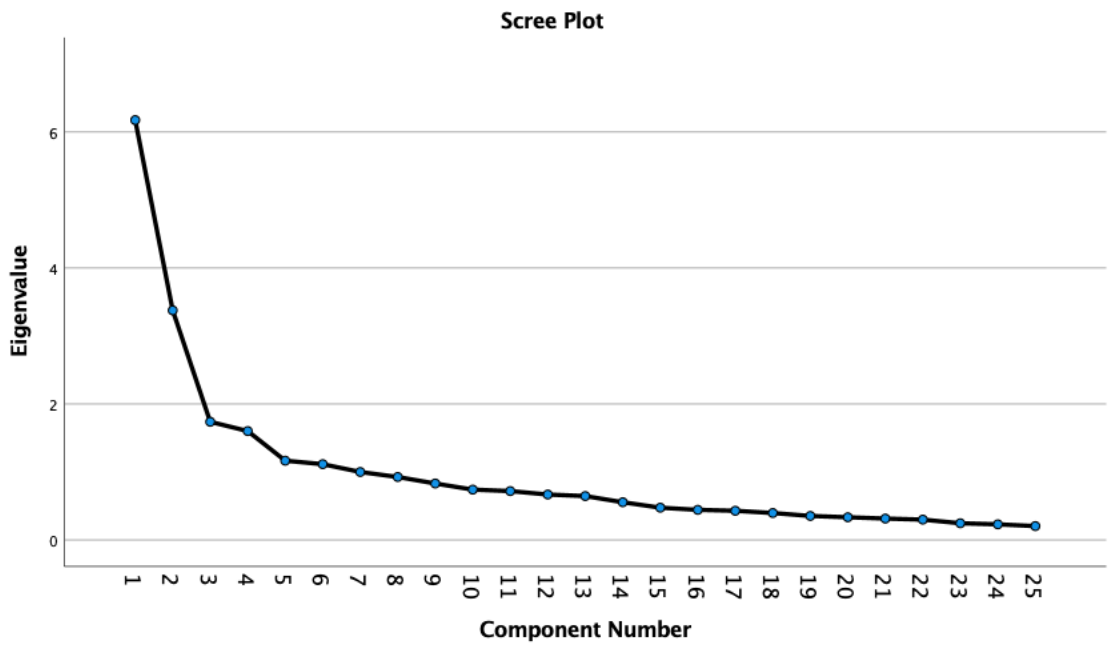


Figure F1

Scree Plot for Expectancy, Value, and Cost

Appendix G

Institutional Review Board Approval Letter

TEXAS STATE UNIVERSITY

The rising STAR of Texas

In future correspondence please refer to 7730

March 22, 2021

Christie Lawson
Texas State University
601 University Dr.
San Marcos, TX 78666

Dear Christie:

Your application titled, 'Undergraduate Latin* Student Motivation: Moderating Influences of Cultural Capital on STEM Persistence at an HSI' was reviewed by the Texas State University IRB and approved. It was determined there are: (1) research procedures consistent with a sound research design and they did not expose the subjects to unnecessary risk. (2) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (3) selection of subjects are equitable; and (4) the purposes of the research and the research setting are amenable to subjects' welfare and produced desired outcomes; indications of coercion or prejudice are absent, and participation is clearly voluntary.

In addition, the IRB found you will orient participants as follows: (1) signed informed consent is not required as participation implies consent; 2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data; (3) Appropriate safeguards are included to protect the rights and welfare of the subjects; (4) Participants will not receive compensation.

This project was approved at the Exempt Review Level
This project does not involve in person research activities with participants

Check the IRB website frequently for guidance on how to protect participants. It is the expectation that all researchers follow current federal and state guidelines. Approved research activities did not indicate face-to-face research with human subjects.

The institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments, please re-apply. Copies of your request for human subject's review, your application, and this approval are maintained in the Office of Research Integrity and Compliance.

Report any changes to this approved protocol to this office. Notify the IRB of any unanticipated events, serious adverse events, and breach of confidentiality within 3 days.

Sincerely,

Monica Gonzales

Monica Gonzales
IRB Compliance Specialist
Research Integrity and Compliance
Texas State University

CC: Dr. Carlton Fong

OFFICE OF RESEARCH AND SPONSORED PROGRAMS
601 University Drive | JCK #489 | San Marcos, Texas 78666-4616
Phone: 512.245.2314 | *fax:* 512.245.3847 | WWW.TXSTATE.EDU

This letter is an electronic communication from Texas State University-San Marcos, a member of The Texas State University System.

Christie Lawson, a graduate student at Texas State University, is conducting a research study to learn more about achievement motivation for students who are majoring in a STEM field (Science, Technology, Engineering, and Mathematics). At your institution, this includes majors in the College of Science and Engineering as well as the College of Health Professions.

- Participation is voluntary and you may exit the survey at any time. The survey will take approximately 15 minutes or less to complete. You must be at least 18 years old to participate.
- This study involves no foreseeable risks. You are encouraged to answer all items and select a response that best reflects your beliefs, not one that you think you should select for the research or for anyone else's benefit. However, if there are any items that make you uncomfortable or that you would prefer to skip, please leave the answer blank. Your responses are anonymous.
- You may benefit from participation through the process of reflecting on your motivations regarding STEM courses and STEM majors.
- Reasonable efforts will be made to keep the personal information in your research record private and confidential. Any identifiable information obtained in connection with this study will remain confidential and will be disclosed only with your permission or as required by law.
- The members of the research team and the Texas State University Office of Research Compliance (ORC) may access the data. The ORC monitors research studies to protect the rights and welfare of research participants.
- Your name will not be used in any written reports or publications which result from this research. Data will be kept for three years (per federal regulations) after the study is completed and then destroyed.
- At the end of the survey, you may choose to enter into a random drawing to win a $20 Amazon gift card. There will be ten drawings (10 winners). This entry is not linked to any of your survey responses.

If you have any questions or concerns feel free to contact Christie Lawson or her faculty advisor:

- Christie Lawson, Doctoral Student
  - Curriculum and Instruction: Developmental Education
  - 210-724-5515
  - cas121@txstate.edu
- Dr. Carlton J. Fong, Dissertation Chair
  - Curriculum and Instruction: Developmental Education
  - cjf47@txstate.edu

This project 7730 was approved by the Texas State IRB on March 22, 2021. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Denise Gobert 512-716-2652 – (dgobert@txstate.edu) or to Monica Gonzales, IRB Regulatory Manager 512-245-2334 - (meg201@txstate.edu).
If you would prefer not to participate, please do not fill out a survey.

TEXAS STATE
Exempt Review
03/22/2021

Appendix H

Exploratory Factor Analysis Options and Indicators

Tables H1, H2, and H3 summarize factor analysis options and interpretation indicators, respectively. Price (2017) suggests that the default order for selecting an extraction method is maximum likelihood (ML), then principal axis factoring (PAF), then principal components analysis (PCA). When factors are expected to correlate as is the case with variables in expectancy-value theory, then Price recommends oblique rotation with a default order for method selection as Promax then Direct Oblimin. Price also indicates testing for basic assumptions by using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) as well as Bartlett's Test of Sphericity.

Table H1

Exploratory Factor Analysis Options

Parameter	Options
Extraction method	Maximum likelihood Principal axis factoring Principal components analysis
Maximum iterations; fixed factors	SPSS default is 25 iterations, but selecting a fixed number of factors forces a structure
Rotation method	Oblique - promax Oblique - direct oblimin
Suppression	Suppressing values <.10 or <.20 may aide in visual interpretation of the pattern matrix.

Table H2

Exploratory Factor Analysis Interpretation Indicators

Indicator	Description
Basic Assumptions	
KMO	Values ≥ .6 are acceptable, .5 are suspect, < .5 are unacceptable.
Bartlett's	This value should be statistically significant.
Correlation Matrix	Indicates correlations among individual items
Eigenvalue	Values greater than one are considered unique factors.
Scree plot	A visual tool to support interpretation of Eigenvalues.
Total Variance Explained	The cumulative % variance explained is ideally 60% or greater.
Pattern Matrix	Examine the visual appearance of factor loadings. Values below .40 are weak. Examine cross-loading values of .20–.40.

Table H3

EFA Extraction-Rotation Combinations

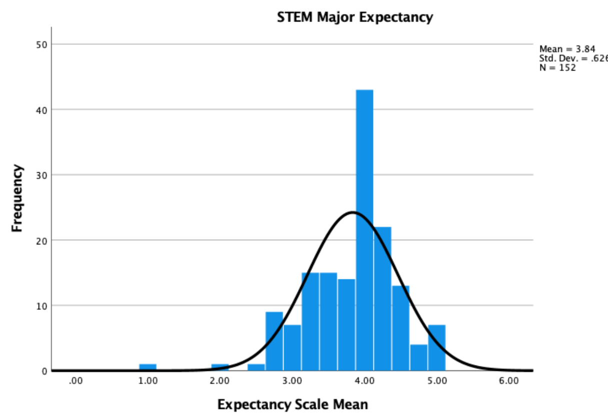
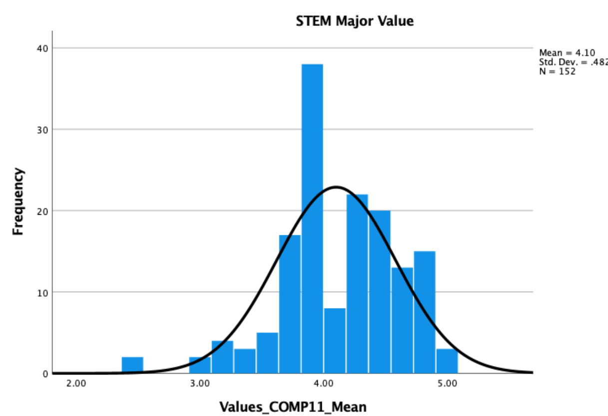
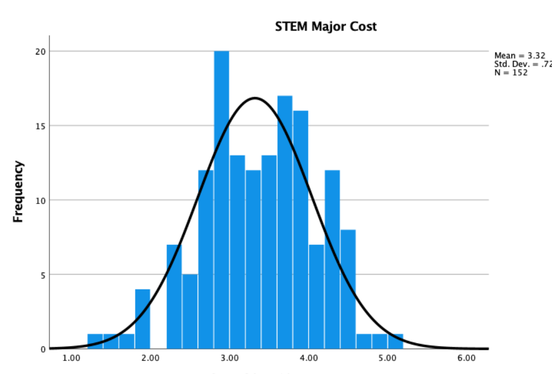
Combination	Extraction Method	Rotation Method
1	Maximum likelihood (ML)	Promax
2	Maximum likelihood (ML)	Direct Oblimin
3	Principal axis factoring (PAF)	Promax
4	Principal axis factoring (PAF)	Direct Oblimin
5	Principal components analysis (PCA)	Promax
6	Principal components analysis (PCA)	Direct Oblimin

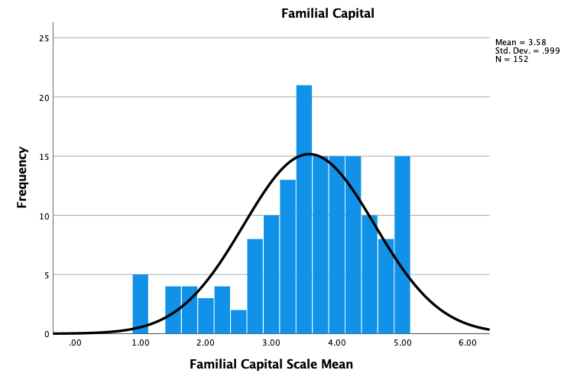
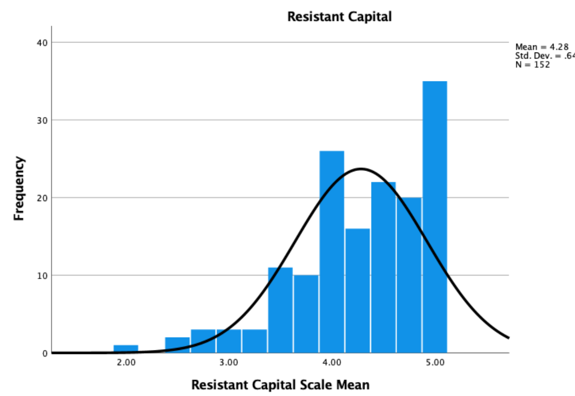
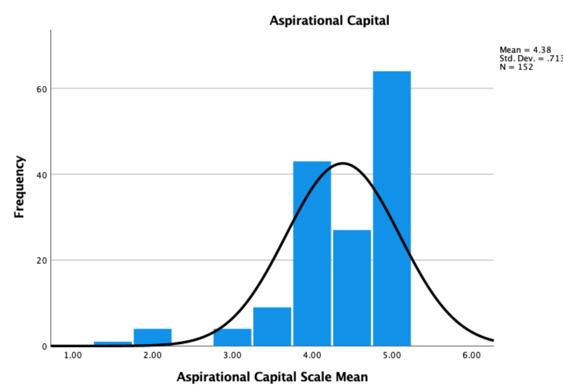
Appendix I

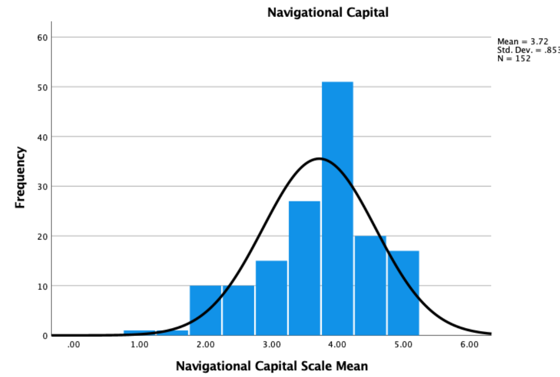
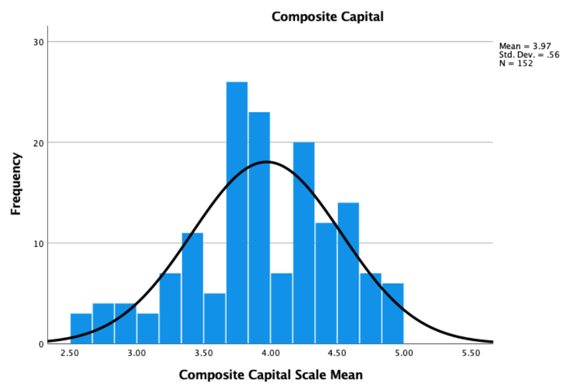
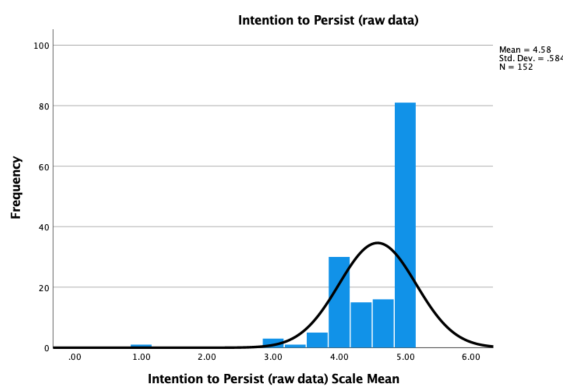
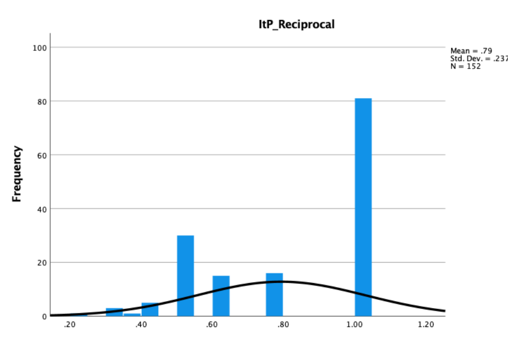
Instrument Subscale Histograms

Table I1

Histograms for Survey Subscales

Subscale	Histogram
Expectancy	
Value	
Cost	

Subscale	Histogram
Familial capital	
Resistant capital	
Aspirational capital	

<table>
<tr><th>Subscale</th><th>Histogram</th></tr>
<tr><td>Navigational capital</td><td>
</td></tr>
<tr><td>Composite capital</td><td>
</td></tr>
<tr><td>Intention to persist r</td><td>
</td></tr>
<tr><td>Intention to persist t</td><td>
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