

**SITUATING DISCIPLINARY IDENTITY AND MOTIVATION
NEGOTIATION IN UNDERGRADUATE STUDENTS' RACE AND
GENDER EXPERIENCES: THE DESTABILIZING IMPACTS OF
ACADEMIC PROBATION DURING A PANDEMIC**

by

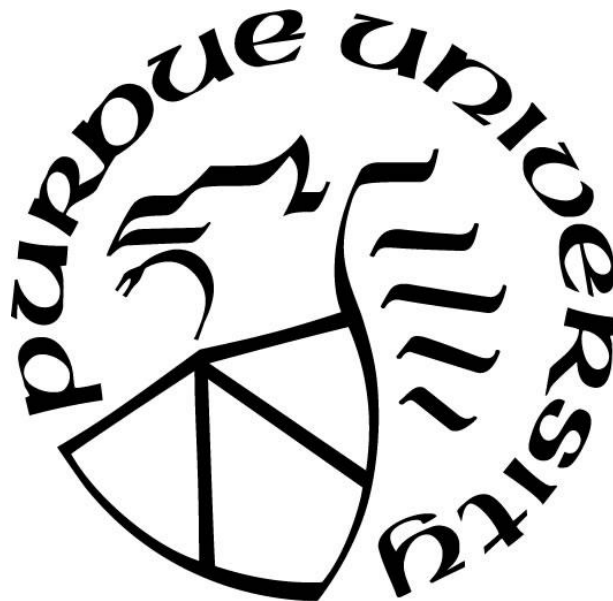
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Dedicated to the learners who were incorrectly told their setbacks or circumstances deemed them a failure.

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ABSTRACT

Situated Expectancy-Value Theory (SEVT) calls for motivation researchers to treat learning and motivation as inseparable from context. Previous research has examined students' expectancies and values in specific disciplines, showing dynamic changes over time. Limited research has examined students' processes of change, considered the influence of students' disciplinary identities, or solicited characteristics of the disciplinary environment that influence change. Additionally, current frontiers of the field aim to race-reimage motivational constructs. By situating motivation research in the race and gender experiences of historically marginalized students (i.e., Black, Latinx, Hispanic, Indigenous, women), the field can expand motivation theories to support a diversifying population, instead of relying on theories primarily based on the experiences of White individuals. Accordingly, the purpose of this study was to examine the processes of motivational and identity change and situate students' identity and motivation negotiations in their disciplines, race, and gender. Using a qualitative, single case study design, eight undergraduate students of color majoring in science or engineering and who were on academic probation were interviewed. Results identified three processes of negotiating their identity and motivation that students employed in response to being on probation. Students reported challenges to their identity and motivation negotiations situated in their race and gender experiences. However, they also shared cultural assets that supported their continued identification with, expectancies for success in, and valuing of their science and engineering disciplines. Findings propose theoretical and methodological implications considering communal values in the SEVT model. Practical implications are discussed for instructors and student success personnel to integrate students' social identities and communal motivations into their disciplinary engagement.

CHAPTER 1: STATEMENT OF THE PROBLEM

As the United States aims to strengthen its science and engineering workforce, students underrepresented in these fields (i.e., women and students of color) are leaving at higher rates than those overrepresented in these fields (Chen, 2013; Landivar, 2013; National Science Board, 2016). Research suggests several reasons for attrition, including underperformance during the first year of college while taking foundational courses outside of their major (e.g., calculus and physics) (Chen, 2013; Lee & Blankenship, 2019). Most higher education institutions place students with performance under a pre-specified level (i.e., grade point average below 2.0) on academic probation - a warning system meant to encourage students to regain satisfactory academic standing in the following semester or face dismissal from the university. At the institution where this research took place (hereafter referred to as “The University”), The University retained 72% of its Fall 2017 science and engineering cohort four years later, meaning 28% left their majors to pursue other disciplines or left The University altogether (Data Digest, 2021a). Further, The University placed approximately 8% of science and engineering students on academic probation in the fall semesters (Data Digest, 2021b). Although The University is retaining a large number of students in science and engineering and seeing only a fraction of students placed on probation, there remains an opportunity to learn from students who persist for how to improve retention and support the academic success of students in science and engineering.

Being placed on academic probation may lead students to question their identification with their discipline and doubt their motivations to pursue their intended career (Meyer & Fang, 2019; Stevens et al., 2008; Turner & Schallert, 2001). Motivation researchers have shown that it is not the outcome (i.e., success, failure) that explains students’ engagement and persistence decisions. Instead, it is how others respond to the outcome and to what students attribute the cause of the outcome (Eccles et al., 1983; Wiener, 1972). For example, students placed on academic probation who have individuals communicate to them that they are capable of returning to good standing and who attribute their setback to an unstable trait, like effort, are more likely to decide to persist. On the other hand, students who have individuals question their future success and who attribute their setback to a stable trait, such as ability, are less likely to persist. These examples partially illustrate why there are individual differences in persistence

decisions. Meaningful individuals, students' causal attributions, and various other factors such as task difficulty and perceived ability all influence students' achievement-related engagement and decisions.

I draw on situated expectancy-value theory (SEVT) to examine students' motivation to persist after being placed on academic probation (Eccles & Wigfield, 2020). Motivation researchers have long used expectancy-value theories to explain the purposes and reasons for students' engagement in academic activities. Such theories have strength in explaining how students' expectancies for success, valuing of academic tasks, and costs of engagement most directly influence academic behaviors and outcomes. The SEVT model advanced by Eccles and Wigfield (2020) includes the social context and students' identities as directly influencing their expectancy, value, and cost evaluations. These identities can include collective identities like disciplinary identity and one's race, ethnicity, and gender identity, as well as more personal identities like creator or innovator (Eccles, 2009; Eccles & Wigfield, 2020). Although students' general motivations and social identities (i.e., disciplinary identity) are considered relatively stable by late adolescence (Wigfield & Eccles, 1992), being placed on academic probation may present a period of destabilization where students [re]negotiate their disciplinary identity and motivations (Eccles, 2009).

Moreover, students underrepresented in their disciplines (i.e., women and students of color in science and engineering) may be particularly susceptible to identity and motivation destabilization following setbacks, given long-standing, negative stereotypes about their disciplinary abilities and limited sense of belonging. Research suggests that when examined in specific disciplinary contexts (e.g., science classrooms), students' fit, or sense of belonging, is informed by their perceived ability (Adeoye, 2019). Thus, negative stereotypes suggesting that they lack the needed disciplinary skills have the potential to further diminish marginalized students' sense of belonging in the discipline. Despite these potentially detrimental outcomes associated with underperformance, some students persist in science and engineering after facing a setback. Although research has examined students' attributions for their placement on academic probation, less is known about students' use of motivational resources to persist off of probation. Much of the early research explaining underperformance among marginalized groups focused on students' deficits, such as poor preparation for college, poverty, and limited access to resources (Oakes, 1990). This research uncovering the inequities marginalized students face is

essential to understanding underperformance. However, focusing solely on inequity and deficits reduces students to what they lack and misses an opportunity to investigate the assets students draw on to persist. Understanding how students negotiate their motivations can have a meaningful impact on how college staff and administrators engage students on probation and can result in improved retention efforts.

Some educational psychologists have called for a reexamination of students' identities and motivations by refocusing on racial and gendered educational experiences (DeCuir-Gunby & Bindra, 2021; DeCuir-Gunby & Schutz, 2014; Matthews & López, 2020; Usher, 2018; Zusho & Kumar, 2018). This reimagining is in response to the reality that, despite an increasingly diverse nation, the majority of scholarship on learning and motivation is authored by White men and women based on theories developed from evidence primarily collected from White people (Usher, 2018). As described by Usher (2018), this history of motivation research can be attributed to the Whiteness of motivation scholarship, defined as:

The tendency of motivation researchers to prioritize perspectives, participants, measures, and ways of knowing that assume White as “normal” or default. I suggest that acknowledging the Whiteness of our research is an important step toward developing a more complete and just understanding of human motivation (p. 132).

We learn about cultural groups' distinct motivations and motivational processes by course-correcting the Whiteness of motivation scholarship.

For example, Gray et al. (2018) discussed the importance of considering the unique opportunity structures for Black students' belonging needs to be fulfilled. Presented as interpersonal, instructional, and institutional structures, the authors outline how understanding the historical and political influences on education for Black students creates opportunities to engage Black students in education and support their belonging needs. Consistent with findings that students underrepresented in their fields value communalism, Gray et al. (2020) found that using communalism as an opportunity structure supported students' high and sustained behavioral engagement. Gray and his colleagues' focus on the opportunity structures that support Black and Latinx students' learning is just one example of how race reimagining our theories to account for the cultural experiences of students affords researchers a more accurate understanding of how to support students who have historically been examined at the margins of motivation research.

Current Study

My dissertation responds to calls from educational psychologists in two primary ways. First, I explore the dynamic processes of motivation during times of destabilization. I interviewed students on academic probation about their motivation negotiations following their probationary notification and examined their retrospective accounts for trends in negotiation from earlier in their college experience. Second, I race-reimage motivation findings. I intentionally sample from races marginalized in science and engineering (i.e., Black, Latinx/Hispanic, Native American) and directly ask about their racialized experiences in their major which may have been interrelated with their motivations.

The purpose of this study was to use a time of potentially destabilized disciplinary identities and motivations to examine whether and how students negotiated their disciplinary identity and motivation. *Disciplinary Identity* was grounded in the learning sciences, engineering education research, and SEVT (Benedict et al., 2017; Carlone, 2017; Carlone et al., 2014; Eccles, 2009; Eccles & Wigfield, 2020; Godwin, 2016). Adapted from such scholars' work, I conceptualized *Disciplinary Identity* as who students see themselves to be within their discipline. *Disciplinary Motivations* were based on SEVT (Eccles, 2009; Eccles & Wigfield, 2020). I conceptualized *Disciplinary Motivations* as students' expectations for success in and valuing of their discipline or major. Students' disciplinary identity and motivations were not restricted to the individual level. Here, I also took into account how students' cultures (i.e., race, ethnicity, gender) and social environments (i.e., adults, media, historical events [COVID-19, police brutality]) influenced their disciplinary identity and motivation development (Carlone, 2017; Carlone et al., 2014; Eccles & Wigfield, 2020; Nolen, 2020).

In this study, I examined how advanced undergraduate science and engineering students evaluated their disciplinary identities, expectancies, values, and costs before and after being placed on academic probation. The following research questions guided my examination:

1. How do students change and renegotiate their disciplinary identity, expectancies, attainment values, interest values, utility values, and costs in response to being placed on academic probation?
2. How do students' racialized and gendered experiences inform their identity and motivation negotiation processes while on academic probation?

To examine these questions, I used a qualitative single-case study design (Lune & Berg, 2017; Merriam & Tisdell, 2015). The case was a phenomenon and was bounded by (a) the experience of undergraduate students of color, (b) in their sophomore or later year, (c) in science or engineering, (d) on academic probation, (e) who had decided to remain in a science or engineering program. My primary interest was in the interrelationships of marginalized students' persistence, identity, and motivation processes. Thus, it was important to bound my case to students from social groups that are historically marginalized in their disciplines (boundary a); committed to their disciplines (boundary e); likely to have existing identities within their discipline (boundaries b, c, and e); and facing a time when they may call their persistence, motivation, and identities into question (boundary d). Further, because the time of data collection occurred during two global pandemics (i.e., COVID-19 and police brutality), my situative examination includes the histories-in-context and, thus, limits the case to students living through those pandemics.

Motivation and Background of Research

I took on this qualitative examination of marginalized students' negotiation processes intending to extend the field's understanding of *how* students negotiate destabilized identities and motivations. Further, I aimed to contextualize *how* and *for whom* certain negotiations are relevant. My first research question addresses the *how* aim by responding to calls from motivation researchers to examine motivational processes during times when motivations are susceptible to decline (Robinson et al., 2018; Robinson, Lee, et al., 2019; Wigfield et al., 2020). Motivation research has long evidenced that motivation is dynamic (Eccles & Wigfield, 2020; Nolen, 2015, 2020; Tonks et al., 2011) and most susceptible to change during crucial phases of development (Wigfield & Eccles, 2002) as well as times of transition (Robinson, Lee, et al., 2019; Robnett & Thurman, 2017). Since much of this research is based on quantitative survey research (Fong et al., 2019; DeCuir-Gunby et al., 2016), less is known about *how* students respond to those times of change and negotiate their motivations.

My second research question addresses the *for whom* aim by responding to calls from motivation researchers to reimage traditional motivation theories to account for the influence of race on student motivation (DeCuir-Gunby & Schutz, 2016; Fong et al., 2019; Kumar et al., 2018; Matthews, & López, 2020; Tonks et al., 2011; Usher, 2018). At the margins of motivation

research are scholars who have been investigating students' intersectional experiences of race and gender in education, primarily at the K-12 level (DeCuir-Gunby & Schutz, 2016). The focus of race-reimagined research on K-12 students creates opportunities to reimage motivation in higher education amongst Black, Latinx/Hispanic, and Indigenous students of color.

Significance

My dissertation contributes to the theoretical and practical investigation of student motivation. First, this research adds to theoretical studies by examining motivation during a potentially destabilizing experience; investigating motivational processes; and situating motivation in science, engineering, race, and gender. While previous research has evidenced that motivational change does occur, my case boundary of academic probation targets a time when destabilization and change are highly probable.

Further, the focus on process contributes to theory by answering questions about *how* changes occur. Situating motivation in disciplines allows one to consider what characterizes values in science and engineering, especially when accounting for the influence that students' conceptualizations of those fields have on their disciplinary motivations. Finally, situating students' motivations in experiences of race and gender contributes to the field's efforts to reimage theory to more accurately capture the experiences of a diversifying student population.

My dissertation can also inform practitioners' approaches to student identity and motivation, especially during academic setbacks. By unpacking the processes that students who decided to stay in science or engineering made, advisors and other student success employees can enhance existing and create additional support mechanisms to guide students through inevitable times of destabilized identities and motivations. Student success personnel can further specialize their services by incorporating findings of how Black, Latinx, and Indigenous students negotiate their identities and motivations situated in their racialized and gendered experiences in science and engineering. Further, I intentionally selected students in their sophomore or later years. I decided to bound my case to students who had experienced some success and likely held existing identities in their disciplines as they entered into major coursework. Although much is known about the identity and motivation work of first-time freshmen transitioning to college, my dissertation contributes pathways to persistence that more advanced took after facing a setback.

Such persistence information can be valuable for practitioners supporting students across the college journey.

Summary of Chapters

In the following chapters, I present the development and execution of this study. Chapter 2 presents the study's theoretical framework and reviews relevant motivation literature. Further, I articulate how I contribute to current frontiers in the field to provide the rationale for this study. I synthesize more recent research that extends the existing theory to situate students' experiences in context. Chapter 3 presents the research design and methodology, outlining the interview protocol used to collect the primary data and the data analysis strategy used to answer the research questions. Chapter 4 presents the study's results by describing students' disciplinary identities and motivations; patterns of negotiation; experiences of vulnerability; and experiences of race, ethnicity, and gender in their disciplines. In Chapter 5, I present the study's key findings and discuss the significance of these findings for extant theory, research, and practice.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

Situated Expectancy-Value Theory (SEVT) is commonly used to explain students' academic choices and performance, suggesting that these outcomes are most proximally influenced by students' expectancies for success, subjective task values, and perceived costs (Eccles & Wigfield, 2020). Specifically, students' expectancies for success are more proximal predictors of academic performance, while students' values are a more salient predictor of academic choices, like persisting in a degree program.

Research investigating the development and change of expectancy and value has a long history in educational psychology (Atkinson, 1964; Crandall, 1963; Crandall et al., 1964). However, there is limited explanation for how students negotiate their expectancies and values during times of change. Moreover, SEVT suggests that students' self-concepts or identities are antecedents to their expectancy and value beliefs, yet few studies examine how students' identities contribute to motivation negotiation. Previous research using the SEVT motivational framework tradition has predominantly investigated students' expectancies and values, reporting declines in expectancy and value over time while *indirectly* explaining changes and/or declines in self-concept and identity. One challenge to studying the role of identity and self-concept *directly* is that it is relatively stable by late adolescence. Although identity is less susceptible to short-term changes and negotiation after late adolescence, it has been theorized that identity may be susceptible to change during times of transition (e.g., transition to college) or after a salient setback related to one's self-concept (e.g., underperformance in college; Robinson, Perez, et al., 2018; Robnett & Thurman, 2017). Students who are underrepresented in their disciplines (i.e., women and students of color in engineering) may be particularly susceptible to identity shifts given long-standing negative stereotypes and prejudice about their disciplinary abilities. Accordingly, one possible means of gaining access to the indirect role of identity in shaping expectancies and values would be to explore short-term identity change. This opportunity to explore potential identity change allows for an examination of whether and how students evaluate their expectancies, values, and costs in making academic choices when negotiating their identity.

In the current study, I examine whether and how students marginalized in science and engineering negotiate their disciplinary identities, expectancies, values, and costs in response to a

potentially destabilizing experience. Toward this end, I examine students' negotiation of their disciplinary identities and motivations in response to a setback, specifically being placed on academic probation. I anticipate academic probation to be a unique time when college students' typically stable disciplinary identities are susceptible to destabilization, given the centrality of competence to students' identities and motivations. I employ qualitative interviews to examine *how* students negotiate their disciplinary identity and motivation to pursue engineering, affording a focus on processes. Studying identity negotiation onset by one's probationary status has key theoretical implications for understanding the role of identity in shaping motivations more broadly.

In the remainder of this chapter, I introduce the theoretical framework guiding this study, review relevant research on identity and motivation, and summarize how the framework and prior research culminated in this research study.

Theoretical Framework

Achievement motivation conceptualizes the purposes and reasons why people engage in activities (Eccles & Wigfield, 2020; Wigfield et al., 2009). Expectancy-value theory is often used in motivation research to explain students' achievement motivation. Eccles' expectancy-value theory (Eccles et al., 1983) suggests that three primary motivations directly explain students' choice of, performance in, and persistence in academic activities: their expectancies for success, subjective task values, and perceived costs (Eccles, 2009; Eccles et al., 1983; Eccles & Wigfield, 2020; Wigfield & Eccles, 2000). These constructs are conceptualized as the most proximal outcome predictors and are subjective because different people may hold different expectations and values of the same task.

Expectancies are students' beliefs about how well they will do on an upcoming task, goal, or activity. Students evaluate *subjective task values* (values) in terms of whether and how much they want to complete an academic task, make an academic-related choice, or perform an academic behavior (Eccles et al., 1983). Eccles' expectancy-value theory describes value as multifaceted, including three primary types of values. *Intrinsic value* is how enjoyable and interesting a student finds a task to be. *Attainment value* is how important a specific task is to who the student sees themselves to be or their identity. Students are more likely to pursue and deeply engage in tasks that are central to their identity. *Utility value* is how useful a student finds

a task for their future plans. Although attainment and utility values are conceptually close, Eccles and her colleagues (Eccles, 2009; Eccles & Wigfield, 2020) distinguish between the two by clarifying that utility values are less identity relevant, whereas attainment values are related to an individual's personal and/or collective identity(ies).

Another component of values is perceived cost (Eccles et al., 1983). *Cost* measures students' perceived drawbacks to engaging in a task. Eccles and Wigfield (1995) conceptualized cost as having three dimensions. *Effort cost* is how hard a student would have to try to achieve a desired academic outcome and whether the effort was worth it. *Opportunity cost* concerns how pursuing one outcome requires sacrificing others. *Emotional cost* involves the emotional or psychological costs of pursuing an academic task or outcome, such as anxiety or humiliation after failure (Eccles et al., 1983; Eccles & Wigfield, 2020). Cost has been included in the values box in Eccles' model (see Figure 1) because Eccles and Wigfield conceptualize values as both the benefits and costs of pursuing academic tasks and outcomes (Eccles et al., 1983; Eccles & Wigfield, 2020).

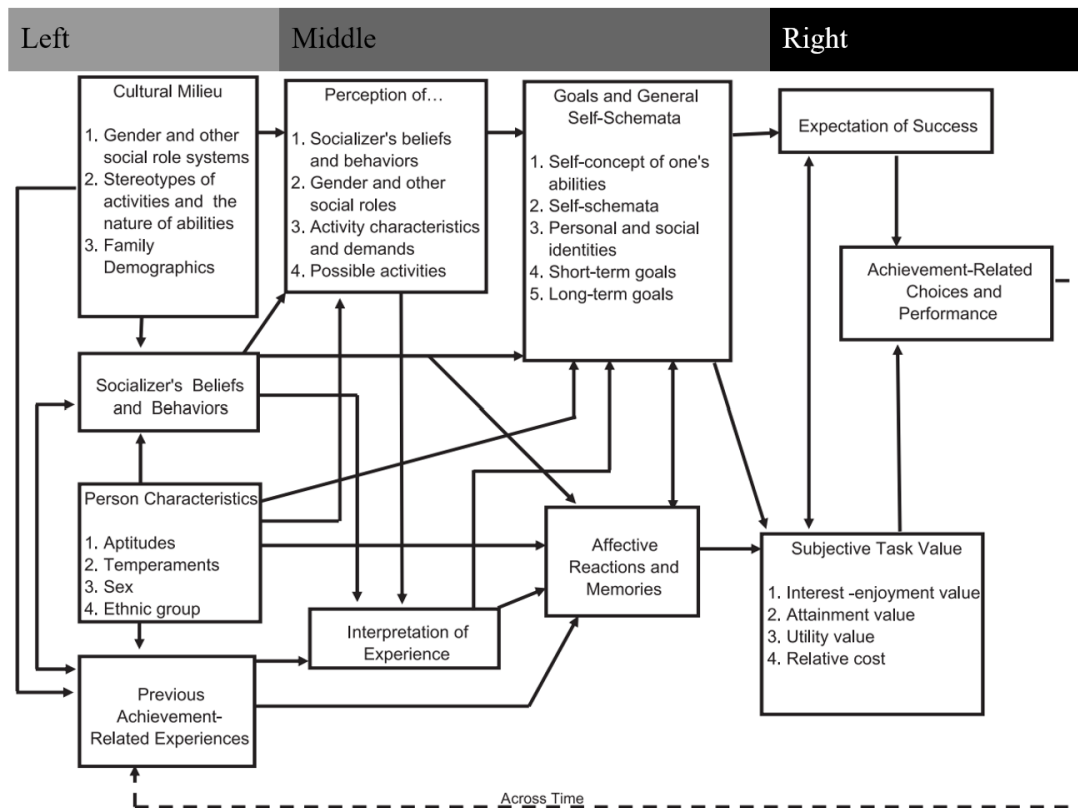


Figure 1. Eccles, Wigfield, and colleagues' expectancy-value model for choice and performance

Situated Expectancy-Value Theory

As depicted in Figure 1, the expectancy-value model proposed by Eccles and colleagues (e.g., Eccles, 2005, 2009; Eccles et al., 1983; Eccles & Wigfield, 2020; Wigfield & Eccles, 1992; Wigfield et al., 2016) outlines the various predictors of and influences on students' academic performance and choices. Much of the work using this model focuses on the most proximal influences: students' expectancies for success and their subjective task values. However, these context and task-specific motivations are grounded in a larger model theorizing the psychological, social, contextual, and cultural influences on students' expectancies and values. Eccles and Wigfield (2020) have encouraged motivation researchers to adopt their updated situated model that accounts for these larger influences. Adopting the situated expectancy-value theory (SEVT) model in my examination allows a shift from examining academic achievement as an individual phenomenon to accounting for the society, context, and culture in which the individual and their achievement is situated. This will allow me to move beyond findings that high motivations lead to achievement by uncovering the personal and social experiences that support high motivations.

As depicted in Figure 1, students' expectations and values are proximally influenced by the student's goals and identities. Additionally, students' values are influenced by the affective memories from previous engagement in similar tasks. Students' goals and academic self-concepts (i.e., identities) are influenced by their perceptions of socializers (other people in the student's world who impose their worldview on the student), society (such as through learned stereotypes and gender roles), and experiences. These perceptions are preceded by — and, arguably, situated in — the individual's cultural world, the beliefs and behaviors of their socializers, and previous achievement.

Recently, Eccles and Wigfield (2020) have called for researchers to adopt the situative perspective implied in their original theory. This shift encourages researchers to give intentional consideration to the contexts in which students' expectancies, values, and motivations occur. These situations include students' cultural milieu (i.e., gender roles, race stereotypes, disciplinary norms, learning environments), the social constructions of those cultures, students' personal characteristics (e.g., sexuality, ethnicity), and students' prior performance experiences. Situating students' perceptions, self-concepts, expectancies, values, and costs in the contexts allows researchers to account for differential outcomes in achievement behaviors and decisions. Further,

situating motivations encourages researchers to consider the various system-level influences that explain students' achievement motivations.

Situative Perspective

Nolen (2020) describes a situated perspective as one that “seeks to understand individuals as part of multiple, partially overlapping and socially constructed systems of meaning in which people do what they do” (p. 1). Individuals' participation in these dynamic systems serve to socially construct their identities and motivations (Nolen et al., 2015). A situative perspective fore fronts individuals' activities within socially constructed systems (Nolen et al., 2015). Thus, to understand students' persistence behaviors in their majors, a situative perspective requires examining the socially constructed systems of race and gender, and the disciplines of science and engineering.

Race itself is a socially constructed concept. Research shows that individuals of the same race can have greater genetic differences than individuals of different races (Lehrman, 2003). Despite this genetic fact, disparities in educational experiences persist between White students and students of color (Losen & Orfield, 2002; Raffaele Mendez, 2003; Schutz & DeCuir-Gunby, 2016). This disparity includes the overrepresentation of students of color identified as special needs (Losen & Orfield, 2002), school suspension (Raffaele Mendez, 2003), and academic probation (Adeoye, 2022). A growing number of educational psychologists have begun questioning whether our theorized understandings are partial depictions since they seldom accounted for marginalized experiences, primarily the experiences of Black, Latinx/Hispanic, and Indigenous learners (Corno, 2016; DeCuir-Gunby & Schutz, 2014; Gray et al. 2018; Usher, 2018). Scholars have evidenced that the experiences of racially marginalized students are vastly different than the experiences of the predominately White men that much of motivation theories were based on and the predominately White American and European men who developed them (DeCuir-Gunby & Schutz, 2014; Gray et al. 2018; Matthews & López, 2020; Usher, 2018). For example, Fong et al. (2019) race-reimagined belongingness items for Indigenous community college students using Native theories, ways of knowing, and ways of being. In addition to traditional variables of belonging (i.e., social connections to peers and teachers), the authors included Native-specific items that measured whether students felt that their community college experience influenced their knowledge, skills, and personal development in their: (a) self-

understanding, (b) code of values and ethics, and (c) contribution to the welfare of their community. Results show that both the traditional and Native conceptualizations of belonging were important to Indigenous students and predicted adaptive outcomes (i.e., goals, GPA). By race-reimagining belonging, the researchers were able to uncover an additional path to belonging for Indigenous students through identity, family, and community.

In addition to the socially constructed norms of race, there are also social norms within disciplines. For engineering, there has been a disconnect between how practicing engineers define engineering and the definitions from youth and their parents. The National Academy of Engineering's (NAE, 2008) research study revealed that while engineers saw themselves as curious and hard-working professionals who “design solutions to difficult problems” and are able to “leave their mark on the world” (p. 53), students saw engineers as people who are “smart, good at math and science, and design and build things” (p. 75). The perception that engineers have to be smart and good at math and science left many students, primarily girls, thinking they were not smart enough to be engineers. This may explain why engineering was seen as a good career choice among boys whereas girls opted for other careers. This finding is supported by additional research showing that girls tend to perceive math as more difficult and requiring more effort than boys did despite performing equally well in mathematics (Eccles et al., 1983). The results of the NAE study exemplify why it is important to consider the socially constructed norms of a discipline. As evidenced here, the disconnect between the norms experienced by professionals compared to the norms perceived by youth impacted who pursued engineering as a future career.

As the world practiced physical distancing during the COVID-19 pandemic and witnessed the relentless acts of police brutality against individuals with marginalized identities, the internet brought humans closer together. STEM professionals took to social media using hashtags to raise awareness of marginalization in STEM and change the narrative of what it means to be a professional in STEM and in science specifically. Hashtags like #BlackInScience and #BlackInSTEM provided a platform for Black science and STEM scholars to share their experiences with discrimination and prejudice in their discipline attributed to their Black identity (Ortega, 2021). Using the same hashtags, along with others like #HowIScience, Black scientists posted narratives and photos of themselves engaging in science. The aim was to show current and future scientists that there is no single way to engage in science and that there is space to

bring your racial identity into your science. Using advancements in technology that allow people from around the world to connect in real-time, some science professionals of color used social media to offer access to live, professional advice to people outside of science as well. This push expands the public's access to the diversity of what it looks like to be a scientist and the skills used to practice science.

Resulting from my use of *situative* expectancy-value theory, my dissertation examines identity and motivation as situated in students' science or engineering disciplines. I conceptualized *Disciplinary Identity* as who students see themselves to be within their discipline (Benedict et al., 2017; Carlone, 2017; Carlone et al., 2014; Godwin, 2016). I conceptualized *Disciplinary Motivations* as students' expectations for success in and valuing of their discipline or major (Eccles, 2009; Eccles & Wigfield, 2020).

Disciplinary Identity

Part of the work to encourage students to pursue science and engineering careers starts with supporting students' identity development as future scientists and engineers. Eccles (2009) defines identity as the highly valued parts of the self that include how individuals define who they are, both for themselves and others. Eccles specifies personal identities as aspects of the self that make an individual feel unique and collective, or social, identities as valued parts of the self that tie individuals to social groups. Two self-perceptions that help individuals define their identities are their perception of their skills and competencies and their perception of their values and goals. Students' identities are also informed by their cultural environment and their perceptions of socializers' beliefs and behaviors. As a part of the broader identity construct, students also hold a *disciplinary identity*, defined as who individuals see themselves to be within a specific discipline. Individuals construct a *disciplinary identity* based on their self-perceptions within the discipline, perceptions of their disciplinary environment, and perception of socializers' beliefs and behaviors related to the student's place in their discipline. When disciplinary skills, ideals, and competencies are central to a student's identity, they experience high attainment value for coursework and tasks (Eccles, 2009; Robinson, Lee, et al., 2019).

Since this study samples students in science and engineering, I define disciplinary identity as students' science or engineering identity, inclusive of students' belief that science or engineering skills, competencies, and ideals are central to who the student sees themselves to be.

I acknowledge that students' disciplinary identity is one part of their identity, with students' social identities, such as race and gender, also being salient aspects of the self. In light of students' intersectionalities, students' disciplinary identities can differ based on their gendered and racialized experiences within the discipline. Including the social construction of disciplinary identity provides an additional component of the social context needed to deepen explanations for students' motivational responses.

Disciplinary Motivations

SEVT was originally developed to examine the determinants of female students' decisions to pursue mathematics careers (Eccles et al., 1983). Eccles and her colleagues' (Parsons et al., 1982a; Parsons et al., 1982b; Eccles & Wigfield, 1995) work that lead to the development of SEVT utilized scales assessing students' expectancies of success in current and future math courses, how useful students saw math for their own goals (i.e., utility or attainment value), students' incentive value of math (i.e., interest value), cost of effort needed to succeed in math (i.e., cost value). Each scale asked students to focus on their individual ability and performance in mathematics. Scholars continue situating motivations in disciplines and have adapted scales examining students' expectancies, values, and costs in math (Conley, 2012; Gaspard et al., 2015), science (Nagengast et al., 2011; Perez et al., 2019), engineering (Jones et al., 2010; Robinson, Lee, et al., 2019), and STEM (Perez et al., 2014). Across domains, scale items typically ask students how well they expect to do in [insert discipline] that year (expectancies), how important it is that they are good at [insert discipline] (attainment value), how interesting they find working on [insert discipline] tasks (interest value), how useful their current learning in [insert discipline] will be for their future goals (utility value) and the effort or sacrifices made when pursuing [insert discipline] (cost). Although limited, qualitative research has also examined students' engineering expectancies, values, and costs (Matusovich et al., 2010). In their study on engineering identity and motivation, Matusovich et al. (2010) classified high attainment as discourse where students expressed that engineering is consistent with their sense of self, high interest as discourse where students expressed enjoying activities believed to be associated with engineering, high utility as discourse where students perceived there was future usefulness of an engineering degree, and high cost as discourse where students expressed making sacrifices to become an engineer.

As conceptualized in the original and preceding SEVT research, situating students' motivations in a discipline traditionally meant asking students about their motivations for the named discipline. Since the current study samples students in science and engineering, I define *Disciplinary Motivations* as students' motivations for science or engineering. Specifically, I examine students' own narrated expectancies for success in science or engineering, attainment values for science or engineering, interest values for science or engineering, utility values for science or engineering, and costs for pursuing science or engineering. Examining disciplinary identity and motivations across cultural groups situates students' experiences in science and engineering and also in their race, ethnicity, and gender.

Literature Review

My dissertation will examine how undergraduate students negotiate their science and engineering identities, expectancies, values, and costs after being placed on academic probation. In the following sections, I review relevant literature outlining the need for my dissertation study. I open with an overview of how motivations (expectancies, values, and costs) are developed and how these motivations relate to academic outcomes. I then review the stability of identity and motivations. I conclude with a discussion of sociocultural influences on students' identity and motivations.

Development of Motivations

Much of the research examining the development and change of students' expectancies, values, and costs (motivations) comes from child development research. Children's expectancy- or competence-related beliefs develop while learning new tasks and while interpreting feedback from adults about their failures and successes across childhood (Bandura, 1997; Dweck, 2002; Wigfield & Eccles, 1992). Competency beliefs deepen as children receive evaluative feedback from informal assessments, standardized tests, and other formal assessments upon starting school. Additionally, schooling provides more opportunities for students to engage in relative comparison to their peers. These comparisons, along with the other histories of students' academic performances, can inform students' concepts of their own competence and abilities (Nolen, 2020; Ruble, 1983; Wigfield, et al., 1998). For example, children develop expectancies

for success on tasks and domains that provide an optimal challenge, where they experience success with a reasonable degree of effort, and where they perform at or better than their same-age peers.

Children's development of values is based on previous experiences of interest and meaningfulness during task engagement and adults' feedback on students' successes and failures (Eccles et al., 1983; Wigfield & Eccles, 1992). As depicted in their SEVT, Eccles and Wigfield (2020) propose that students' value development is grounded in their cultural environment. Within this environment are gender and cultural stereotypes about who typically values the task or discipline and socializers' beliefs and behaviors. The student then forms perceptions of these interacting aspects of the cultural environment which inform their own interpretation of their prior performance and the affect they attach to that performance. Considering their perceptions of their cultural environment and their prior performance, the student develops ideas of who they are in the learning context and goals for engagement in learning. Taken together, these components then inform the student's values.

Eccles and her colleagues (Eccles et al., 1983) refer to adults and other meaningful others as socializers. Socializers primarily refer to parents and teachers but can also include respected peers. Socializers' influence students' motivations through influencing the goals students set for themselves and the values they hold for tasks. Socializers also impact students' self-concept, or identity, which directly influences their expectancies for success. This influence of socializers on students' identity development overlaps with what science and engineering identity theories term recognition (see Development of Disciplinary Identity section).

Throughout development, children pursue and select activities and domains that are aligned with their expectancies and values, thus shaping and stabilizing their identities. While young children's values are primarily based on what they find interesting, older students' values become more differentiated beginning around the middle school years when students start to pursue tasks based on their sense of self and established competencies (Wigfield & Eccles, 1992). By the time students finish high school and are considering college options, they would have a clearer sense of who they are and who they want to be. These emerging identities lead students to select tasks and disciplines that they expect to have continued success in (i.e., disciplinary expectancies), will be useful (disciplinary utility value), are interesting (i.e.,

disciplinary interest value), and that allows them to fill important parts of their social identity (i.e., disciplinary attainment value; Wigfield et al., 2016).

Stability of Motivations During College

College is the first time most students have a significant degree of autonomy and independence, including choosing coursework and declaring a major related to the professional they want to become. Wigfield et al. (2020) propose that as college students choose what activities to engage in, such as selecting a college major, the value for other subject areas likely decreases. Moreover, as students engage and experience success in their selected discipline, their values and expectancies for success in that discipline are reinforced (Wigfield & Gladstone, 2019; Wigfield et al., 2020; Wigfield et al., 2016). Similarly, students' values and expectancies for success in a discipline are susceptible to decline after experiencing salient failure and academic setbacks. Research on adolescents' motivations attributes this susceptibility to students' growing proficiency in integrating evaluative feedback and to the competitive nature of schooling (Wigfield & Cambria, 2010; Wigfield & Gladstone, 2019; Wigfield & Eccles, 2002; Wigfield et al., 2016). This is even more true of college students and college environments.

Wigfield et al. (2020) suggest that the salience and primacy of certain values will fluctuate across the lifespan. Specifically, the authors suggest that attainment value may be more or less important depending on whether an individual's identity is salient in the decision being made (e.g., selecting a career). Research proposing such hierarchical values focuses on hierarchies across domains (e.g., valuing mathematics more than English) as opposed to within a domain (e.g., valuing science's utility more than science's interest value; Eccles, 2005). I assume that students do hold hierarchical rankings or ordering of values within a domain. In the current study, I solicit students' hierarchical value rankings and target a time when these hierarchies are susceptible to destabilization (i.e., academic probation). I examine the nature of and preceding influences for students' motivational changes. Although students in my study likely held high values for engineering upon entering their major, being placed on academic probation may initiate negotiation of those values and call students to question their formerly stable engineering identity.

Relations of Motivations to Academic Outcomes in College

Decades of research have evidenced the relationship between students' motivations and academic outcomes (Eccles & Wigfield, 1995; Jones et al., 2010; Guo et al., 2015; Perez et al., 2019; Wigfield & Eccles, 2000; Wigfield et al., 2009). Previous research has shown that higher-quality motivations relate to desired academic outcomes, focusing on proximal outcomes of students' motivations. For example, previous researchers have found that students with high expectancies, high values, and low perceived costs tend to be higher achievers and persist in academic domains at higher rates (Jones et al., 2010; Matusovich et al., 2010; Nagengast et al., 2011; Robinson, Lee, et al., 2019; Robinson, Perez, et al., 2019; Watt, 2007). Contrastingly, students with lower expectancies, low values, and high perceived costs tend to perform poorly in school and de-identify with schooling altogether (Alexander et al., 2001; Archambault et al., 2009; Perez et al., 2019). For example, Perez and his colleagues' (2019) examination of STEM motivational profiles and academic outcomes revealed that students with moderate motivations (moderate competence beliefs, moderate values, and moderate costs) had lower STEM GPAs and took fewer STEM courses during their college career. Additionally, underrepresented minority (URM) students were more likely to belong to this moderate profile, suggesting that URM students face early systemic barriers that negatively influence their STEM motivations. Similar detrimental outcomes are associated with students who are not certain of their ability to do well on tasks they find valuable. Since students' motivations are subjective constructions, my dissertation will examine how students who decide to persist negotiate their motivations after facing an academic setback.

Researchers have also found that the relationship between students' motivations and academic outcomes is dependent not only on high motivations but also on the development of students' motivations over time. For example, Robinson, Lee, and their colleagues (2019) showed that students with higher rates of increase in expectancies and values, and slower rates of decline in costs over time, had higher grade point averages (GPAs) and were more likely to remain in engineering after their first two years of college. As students face academic setbacks, such as being placed on academic probation, one could anticipate declines from before the probationary period in expectancies and values paired with increases in perceived costs. Academic probation presents a unique time to examine how students at risk of attrition renegotiate their motivations to persist despite their probation status.

Researchers have also shown that students' values are more important when making academic choices, such as persisting in a major, than are their expectancies for success or costs (Eccles & Wigfield, 2002; Jones et al., 2010; Perez et al., 2014). Additionally, researchers have shown that students' expectancies are more important to their academic performance than their values or costs (Eccles & Wigfield, 1995; Jones, et al., 2010; Guo et al., 2015; Perez et al., 2019; Wigfield & Eccles, 2000; Wigfield et al., 2009). Previous research seeking to explain relations between and changes in students' expectancies and values has defined change as increases and decreases in mean value scores or profiles (Benden & Lauermann, 2020; Lazarides et al., 2018; Robinson, Lee, et al., 2019).

Researchers have also examined whether *certain* values have different influences on academic outcomes (Guo et al., 2016; Jones et al., 2010; Robinson, Lee, et al., 2019; Robinson, Perez, et al., 2019). For example, Robinson, Lee, and their colleagues (2019) examined whether seven expectancy-value constructs (expectancy, interest value, attainment value, utility value, opportunity cost, effort cost, and psychological cost) had unique predictive values of academic outcomes for undergraduate engineering students. The attainment value model explained significantly more variance in retention than all the other models ($r^2 = .472$ compared to $r^2 = .375$ [interest], $.360$ [utility], $.202$ [expectancies], and $.157$ [effort cost]). This suggests that students' choice to stay in a major is closest tied to one's self-concept, such as attainment value and identity. Further, attainment value's unique explanation of variance in retention suggests that although all values predict academic choices, certain values may be more salient than others in predicting certain academic outcomes. In my dissertation, I will examine whether certain values were more susceptible to change and whether students perceive certain values as more salient influencers on their persistence in engineering.

Development of Disciplinary Identity

SEVT suggests that students consider their disciplinary identity before evaluating their more immediate task motivations and, ultimately, making decisions like selecting a college major. Similar to their motivation stability, students' disciplinary identity is supported by their continued success in and support from socializers for their pursuit of their major (Wigfield & Gladstone, 2019; Wigfield et al., 2020; Wigfield et al., 2016). Moreover, SEVT suggests that students' identities are stabilized as their motivations are integrated into their sense of self over

time (Eccles, 2009). Students are then likely to sustain high motivations and pursue tasks and courses that reinforce their disciplinary identity.

Previous research has explained science and engineering identity development using constructs that overlap with SEVT. Carlone and Johnson (2007) theorize science identity development as a triangulation of students' *performance* of relevant science practices, science *competence*, and *recognition* by self and others as being a science person. Since their research was with practicing scientists, a fourth concept, *interest*, was implied and has been included in similar work by other researchers (Hazari et al., 2010; Patrick et al., 2018). The performance and competence components are similar to the academic self-concept portions of SEVT. Students can position themselves within the discipline through their academic performance, performing disciplinary skills, and making bids for recognition in disciplinary spaces (Carlone & Johnson, 2007; Carlone et al., 2014; Davis et al., 2020; Eccles, 2009). Students can be positioned as an engineer when others recognize their disciplinary competencies and skills, celebrate the student's forms of disciplinary engagement, and emphasize congruencies between the student's skills and those valued by the discipline (Carlone & Johnson, 2007; Carlone et al., 2014; Eccles, 2009; Hand & Gresalfi, 2015). Recognition is related to students' perceptions of socializers' messages and interest is a subjective task value. Thus, science and engineering identity researchers' explanations of identity development overlap with Eccles' (2009) synergistic conceptualization of identity development described above.

Research shows that college students can experience a destabilization of their identity during their college years. For example, Robinson, Perez, and their colleagues (2018) examined trajectories of change in undergraduate students' science identities and whether these trajectories were related to final exam grades and continued STEM major enrollment. Their findings suggest that having an initially high level of disciplinary identity alone is not sufficient for promoting academic success. Instead, the stability of identity over time, preferably at a high level, is equally important. Being placed on academic probation is such a time when students' disciplinary identity may be susceptible to decline.

Further research is needed to understand how students make academic choices despite declining disciplinary identity and motivations. Additionally, this destabilized identity likely results in a re-evaluation of disciplinary motivations. More research is needed to examine how

students negotiate their disciplinary identity during these rare periods of identity destabilization and the impacts of unstable identity on subsequent motivation.

Stability of Disciplinary Identity

More than other personal and social identities, disciplinary identity involves becoming a member of a disciplinary community (Carlone & Johnson, 2007; Eccles, 2009; Hazari et al., 2010; Patrick et al., 2018). For this reason, I examine identification with science and engineering as a social process of students being integrated into an academic community of practice (Lave & Wenger, 1991). Students' disciplinary identity and subsequent motivations are theorized to be stabilized through their participation in disciplinary practices (Eccles, 2009; Hand & Gresalfi, 2015). Thus, as students negotiate their disciplinary identity after facing an academic setback, engaging in authentic practices of their discipline likely supports their sustained or increased identification with their discipline.

Aligned with SEVT and previous research on science and engineering identity development, students' perception of socializers' messages plays a salient part in disciplinary identity development and stability. Socializers recognize students' ability to perform science and engineering competencies and skills deemed relevant by the disciplinary community (Carlone & Johnson, 2007; Eccles, 2009; Hand & Gresalfi, 2015; Hazari et al., 2010; Patrick et al., 2018).

Cultural Influences on Students' Identity and Motivation Stability

In addition to the internal evaluations students make, Eccles and colleagues' (2020) SEVT also proposes that the cultural environment indirectly influences students' expectancies and values. The cultural environment includes race and gender stereotypes, primarily about marginalized groups' abilities. These cultural environments are primarily filled with negative stereotypes that, consequently, influence marginalized students' expectancies for success and belonging in science, technology, engineering, and math (STEM) fields, which in the United States are dominated by White men.

Eccles' expectancy-value model (Figure 1) can be used to theorize how students' disciplinary identities and motivations de- and restabilize. Students' prior performance, students' interpretation of socializers' messages, and the cultural environment all contribute to students'

goals and identity. As theorized by the model, when a student experiences underperformance in their discipline (e.g., engineering), they use their history of performance in engineering, socializers' perceptions of their underperformance, and the messages received from their cultural environment to interpret the meaning of the underperformance. Students' interpretation then informs their goals and identity which then inform their expectancies, values, and costs (motivations). It is unclear exactly how these middle processes work, but it has been hypothesized that adaptive interpretations lead to adaptive goals and identity, resulting in adaptive motivations that then guide their academic behaviors and choices. For example, a student who interprets their underperformance as attributable to controllable causes (e.g., effort, time management) is likely to set goals for behavior change, likely to sustain identification with engineering even if initially destabilized by the underperformance, and likely to maintain sufficient expectancy for success, sufficient values of engineering, worthwhile costs associated with remaining in the discipline. In the current study, I investigate whether this process occurs as theorized or if there are challenges to sustained identification and motivation that students must first negotiate.

I hypothesize that this occurs as students continue to interpret feedback and performance after the initial, salient underperformance experience. An important addition in more recent SEVT models is the inclusion of the dotted line showing a loop back through the model (see Figure 1). Thus, if after an underperformance experience, a student experiences success, receives messages that support their pursuit of engineering, and are in supportive engineering environments, they are likely to sustain their identification with and experience motivation for engineering. This will result in behaviors and choices that support academic success in engineering and reinforce students' identification with and motivation for engineering. Over time, the continued success students experience in their discipline stabilizes their disciplinary identity and motivations. Focusing on processes allows me to uncover how students negotiate their disciplinary identity and motivations during the destabilizing experience of being placed on academic probation.

Returning to the NAE's (2008, 2013) new messages to promote engineering, findings suggest that since the release of the NAE's report, universities have begun including these messages in their promotional materials (NAE, 2013) and have revised their curricula to better promote these messages and scaffold students' ability to pursue these values. Between 2008,

when the Challenges was first released, and 2016, engineering saw a slight increase in female (approximately 5%) and underrepresented minority (URM) student enrollment (approximately 3%) (NSF, NCES, 2019). However, women and URM students continue to enroll in engineering at disproportionate rates (24% and 19%, respectively) (NSF, NCES, 2019).

The continually disproportionate representation of women in engineering, and STEM broadly, could be explained by women's experiences and sense of fit in STEM. Wegemer and Eccles (2018) examined students' gender self-schema (how feminine or masculine students perceive themselves to be) and how it related to students' STEM motivations and pursuits. Their findings clarify another important aspect of attainment value: students pursue careers that allow them to express their femininity or masculinity only to the extent that they value alignment between their gender identity and beliefs about STEM careers (e.g., it's important to me, as a woman in engineering, that my career allows me to be both a woman and an engineer). Thus, students with salient feminine gender identity may face unique challenges when pursuing careers dominated by masculine messages or fields that reinforce masculinity, such as engineering. Conversely, women who do not value their feminine gender identity likely do not attend to whether they can express their femininity.

Negative experiences can, ultimately, have detrimental consequences on women's identification with STEM (Good et al., 2012; Perez-Felkner et al., 2017; Robnett & Thoman, 2017; Steele & Aronson, 1995). For example, Rainey and colleagues' (2018) examined the intersections of race and gender with students' sense of belonging and perceived competence in STEM. Findings show that a lack of competence mainly was evaluated as compared to others, especially among women and racial minorities in STEM. Moreover, students' perception of low grades was set with a high bar, primarily among females who left STEM, describing low grades as any grade lower than an A. These long-standing self-doubts may result in deidentification with STEM and leaving STEM altogether.

For students who identify with their discipline, the mere existence of these stereotypes is sufficient to threaten marginalized students' expectancies of success and, in turn, result in a deidentification with the discipline (Steele, 1997). Further, if high-achieving, marginalized students hold doubtful expectancies for success, this doubt would be heightened for marginalized students following failure. Extending prior expectancy-value research that primarily focused on

proximal processes, my dissertation will include an examination of the sociocultural factors that further explain students' identity and motivations.

Current Study

SEVT has explained the development and change in students' identities, expectancies, and values over time. However, these examinations have prioritized evidencing change instead of exploring how that change occurs. Additionally, much of SEVT research has seldom considered whether this theory based on findings from predominantly White populations is upheld among students of color. Some motivation researchers have called for a reimaging of SEVT, and all motivation theories, on the experiences of racially marginalized students. I respond to these opportunities for continued research in my dissertation. Specifically, I examined the processes of how changes in identity and motivation occur by selecting a time of potential destabilization (i.e., academic probation) and using qualitative interviews to solicit students' negotiations of their identity and motivations before and after being placed on academic probation. Additionally, I took up researchers' call for race reimaging SEVT by bounding my case to students of color and examining whether their racialized experiences revealed additional conceptualizations of expectancies and values for science and engineering.

My dissertation research examined undergraduate students' disciplinary identity and corresponding expectancies and values (i.e., disciplinary motivations). Given the centrality of competence to students' identities, I anticipate academic probation to be an opportune time when college students' typically stable identities are susceptible to change. Unlike previous research that primarily focused on the strength of the relationship between motivation and choice, my study magnifies student voices using a qualitative single-case study design to examine *how* students' identity and motivations change after being placed on probation. My dissertation aimed to answer the following questions:

1. How do students change and renegotiate their disciplinary identity, expectancies, attainment values, interest values, utility values, and costs in response to being placed on academic probation?
2. How do students' racialized and gendered experiences inform their identity and motivation negotiation processes while on academic probation?

CHAPTER 3: METHODOLOGY

This chapter describes the procedures I employed for data collection and analysis. I used a qualitative analytic approach drawing on a journeying data collection method adapted from Cruz and Kellam (2018) and a semi-structured interviewing data collection method. I begin this chapter by describing and justifying my study design. I then describe the research context, participants, and data sources. I conclude with a detailed description of my data collection, organization, and analysis procedures.

Study Design and Justification

The purpose of this study is to examine students' STEM identity and motivation negotiation after being placed on academic probation. This study used a qualitative case study design to explore how Black, Latino, Indigenous, and students of multiple races experience academic probation. Specifically, I examined primary patterns in students' identification with and motivation for science or engineering despite their probationary status. The qualitative data collection method I used was semi-structured interviewing. My research aligns with principles for qualitative inquiry as outlined by Patton (2015). I ask questions of naturalistic inquiry by examining real-world situations (i.e., shifts in identity and motivation while on academic probation in college) without manipulating participants' experiences. I examine dynamic systems by contextualizing negotiations in science, engineering, gender, and race experiences. Moreover, I accounted for the dynamic historical system by explicitly asking students how national events impacted their journeys. Finally, my research questions require inductive analysis. My inductive analysis began with immersion in students' journeys to and through their majors to discover essential patterns, themes, and interrelationships.

My dissertation employs a qualitative case study design. "A case study is an in-depth description and analysis of a bounded system" (p. 38; Merriam & Tisdell, 2015). The unit of analysis of a case study is the bounded system (Merriam & Tisdell, 2015; Stake, 1995; Yin, 2003). My selection of a qualitative case study design aligns with guides outlined by Yin (2003) that (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behavior of those involved in the study; (c) you want to cover contextual

conditions because you believe they are relevant to the phenomenon under study, or (d) the boundaries are not clear between the phenomenon and context. My dissertation examines “how” students engage in identity and motivation negotiations. My semi-structured interview protocol sought only to elicit students’ experiences and did not manipulate participants’ behaviors. I believe the contexts of science, engineering, race, ethnicity, gender, and history are relevant to students’ identity and motivation negotiations, so I explicitly asked about each of these during interviews. Lastly, the larger phenomenon of identity and motivation negotiations did not have a clear boundary, so I developed the boundaries as outlined above.

In my dissertation, the case was a phenomenon. It was bounded to (a) the experience of undergraduate students of color, (b) in science or engineering, (c) on academic probation, and (d) who had decided to remain in a science or engineering program. My primary interest was marginalized students’ persistence, identity, and motivation processes. Thus, it was important to bind my case to students from social groups that are historically marginalized in their disciplines (boundary a); committed to their disciplines (boundary d); likely to have existing identities within their discipline (boundaries b and d); and facing a time when they may call their persistence, motivation, and identities into question (boundary c).

University Context

The University’s primary source of enrollment is undergraduate students (79%). The Colleges of Engineering (COE) and Science (COS) have the highest representation of undergraduate enrollment (29% and 14%, respectively). Within the COE, 26% of students are female, 57% are White, 15% are international, 15% are Asian, and 7% are underrepresented racial and ethnic minority students (i.e., American Indian or Alaska Native, Black or African American, Hispanic or Latino, or Native Hawaiian/Other Pacific Islander). Within the COS, 39% of students are female, 50% are White, 16% are international, 16% are Asian, and 7% are underrepresented racial and ethnic minority students. Across both the COE and the COS, Black, Hispanic/Latinx, and Indigenous students are overrepresented of those on probation. For example, White students make up more than 54% of students enrolled in the COE and COS yet less than 8% of enrolled White students are on academic probation. In contrast, Black students make up less than 2% of students enrolled yet 22% of enrolled Black students are on academic probation. Hispanic/Latinx students make up less than 6% of students enrolled yet 11% of

enrolled Hispanic/Latinx students are on academic probation. Native American/Alaskan Native students make up less than 1% of students enrolled yet 9% of enrolled Native American/Alaskan Native students are on academic probation.

College of Engineering retention. From the Fall 2017 cohort, 75.7% of students were retained in COE over four years by either graduating with an engineering degree (51.5%) or remaining enrolled in the COE in Fall 2021 (24.2%). Of the Fall 2017 cohort, 24.3% had left engineering by Fall 2021 by either graduating with a degree from another college (7.3%), remaining enrolled in another college (6.2%), or leaving the university without a degree (10.8%). Approximately 8% of engineering majors in any given semester are placed on academic probation (see Table 1).

Engineering undergraduates are first accepted into the COE's First-Year Engineering Program. After completing prerequisite courses, students "Transition to Major" (T2M) in their third semester. T2M is a process of identifying which major they wish to pursue and acceptance into that major based on their university GPA, engineering GPA, pre-college achievement, and other department considerations.

College of Science retention. From the Fall 2017 cohort, 63.8% of students were retained in COS over four years by either graduating with a science degree (56.7%) or remaining enrolled in the COS in Fall 2021 (7.1%). Of the Fall 2017 cohort, 36.2% had left science by Fall 2021 by either graduating with a degree from another college (16.8%), remaining enrolled in another college (5.4%), or leaving the university without a degree (14%). Approximately 8% of science majors in any given semester are placed on academic probation (see Table 1).

Table 1. College Demographics, Enrollment, and Probation Frequencies

Context	COE		COS		TOTAL		Probation	
	Count	%	Count	%	Count	%	Count	%
URRM	787	7.46%	348	6.84%	1135	7.26%	150	13.21%
Hispanic/Latino	595	5.65%	269	5.27%	864	5.53%	93	10.77%
Black or African American	177	1.68%	75	1.47%	253	1.61%	56	22.18%
American Indian or Alaska Native	9	0.08%	2	0.04%	11	0.07%	1	9.32%
Native Hawaiian or Other Pacific Islander	5	0.05%	3	0.06%	8	0.05%	--	--
Non-URRM								
White	5,967	56.60%	2,529	49.66%	8,497	54.34%	647	7.61%
International	1,545	14.66%	896	17.59%	2,441	15.61%	225	9.22%
Asian	1,530	14.51%	1,045	20.51%	2,574	16.47%	210	8.16%
2 or more races	527	5.00%	195	3.82%	721	4.61%	64	8.87 %
Unknown	186	1.76%	80	1.58%	266	1.70%	24	9.01%
Gender								
Male	7,822	74.20%	3,091	60.69%	10,913	69.80%	977	8.95%
Female	2,720	25.80%	2,002	39.31%	4,722	30.20%	343	7.26%
FA17 Cohort Retention	1457	75.7%	653	63.8%	2110	71.57%	--	--
Continued Enrollment	465	24.2%	73	7.1%	538	18.25%	--	--
Graduated	992	51.5%	580	56.7%	1572	53.32%	--	--
FA17 Cohort Attrition	468	24.3%	370	36.2%	838	60.5%		
Enrolled another college	119	6.2%	55	5.4%	174	5.90%	--	--
Graduated another college	141	7.3%	172	16.8%	313	10.62%	--	--
Left university	208	10.8%	143	14.0%	351	11.91%	--	--
Probation (Fall 2021)	888	29.17%	432	14.19%	1320	43.4%	3044	8.24%

Note. COE = College of Engineering, COS = College of Science, URRM = Underrepresented racial minority. Percentages are of 10,541 enrolled in COE and 5,093 enrolled in COS. Probation percentages are within row (i.e., 10.77% of enrolled Hispanic/Latinx students are on academic probation).

Historical Context

At the time of data collection, a pandemic plagued the nation. COVID-19 was a global health pandemic. Discovered in 2019, “the coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus” (World Health Organization, n.d.). Many countries, including the United States of America (US), issued a shelter-in-place order in response to the disease outbreak. Residents were instructed to remain indoors and only leave their homes for emergencies or to report to work as an essential worker. Following guidance from the Centers for Disease Control and Prevention (CDC), the Indiana State Department of Health (ISDH), and their own public health safety experts, The University went fully remote from March 23, 2020 through the end of the spring term. This included the abrupt shift of all classes to fully online, the closure of university residence (except for students with no alternative housing), the offering university services as remote only, and hosting commencement virtually. Additionally, exceptions were made to evaluation and grading requirements, including allowing 24 hours for all assignments, quizzes, exams, and assessments; option for instructors to not require a final exam; option for students to switch their course from a letter grade to a pass/no pass option; extended deadlines for students to withdraw from or drop a course; and no students being placed on academic dismissal or academic probation.

As the COVID-19 pandemic continued in the fall of 2020 and spring of 2021, grading and evaluation requirements returned to normal. The University allowed undergraduate and graduate students to “opt-in to the fully online fall academic experience.” Fully online students did not live on campus and took all their courses online. In-person students were either fully in-person or hybrid, meaning they had all in-person classes or a mixture of online and in-person classes. Many instructors of in-person classes occasionally held class online. In-person students also fulfilled a variety of new safety requirements, including obtaining a negative COVID-19 test result before returning to campus, engaging in random surveillance COVID-19 testing, wearing a face mask in all indoor, public, and private spaces; maintaining a distance of six feet between other individuals, and taking all meals to-go and eating at new outdoor dining spaces or at a distance in their rooms. In the fall of 2020, the campus returned to the fully remote guidelines listed above after the campus closed for Thanksgiving break.

A COVID-19 vaccine became available for college-aged students in April of 2021. In response, The University reopened campus to be fully in-person for the Fall 2021 term. All students and employees were required to be vaccinated against COVID-19 or engage in routine COVID-19 surveillance testing. Campus spaces returned to full density, online options were removed, sporting events returned, and university residences were full.

Another global event shaped the historical context during data collection. Awareness of and calls to address police brutality in the US were renewed after the fatal police killings of Breonna Taylor on March 13, 2020 and George Floyd on May 25, 2020 (Edwards et al., 2020; Waldrop, 2022). Despite making up less than 13% of the US population, Black Americans account for more than 26% of individuals killed by police since 2015 (Tate et al., 2022). Excessive police force and police killings disproportionately plagued Black communities worldwide. For example, in Nigeria, the Special Anti-Robbery Squad (SARS) unit of the Nigeria Police Force fatally shot peaceful #EndSARS protesters on October 20, 2020 (Abiodun et al., 2020). In response to these injustices, people of all nationalities took to the physical and virtual streets to raise awareness and seek support, effectively reigniting the Black Lives Matter movement that began in 2013. Peaceful and violent protests occurred across the globe throughout 2020 and 2021, with some continuing in 2022. Hashtags such as #BlackLivesMatter, #BLM, #SayTheirNames, and #JusticeFor were used on social media to bring awareness to the issue and memorialize the names of Black lives lost to racism and police brutality (Herstory, n.d.; About say every name, n.d.). In response, The University's College of Engineering engaged in their own peaceful protest online by launching their We Support Black Engineers campaign (Gatson, n.d.). Students, staff, alumni, and faculty of various nationalities gave personal testimonies of the value that Black innovation brings to engineering.

Impact. Above I described sudden and frequent shifts in the modes of instruction during the four semesters that were the focus of this study. Study participants reported difficulties faced in Fall 2020 – Fall 2021. Primarily, students reflected on difficulty accessing campus resources, the decrease in instruction quality due to faculty being overwhelmed with the transition to online instruction, and mental health concerns triggered by extended periods of isolation.

Further, the reignition of the Black Lives Matter movement created an opportunity for people across the globe to engage in activism. Students in the current study spoke of the exhaustion felt as Black individuals when learning about another killing of an unarmed Black

person while trying to continue being productive students. Others were not as directly impacted. Nevertheless, the Black Lives Matter movement and the COVID-19 pandemic shaped the history that the students in this study lived through at the time of this interview.

Probation Context

The University has a standard probation policy that stipulates students be placed on probation if their cumulative GPA and/or a semester GPA is below a 2.0. The purpose of the academic probation notification system is to alert students whose GPAs are below a 2.0 that The University is concerned about their trajectory for success. Students' academic advisor emails students to notify them of their probationary status (see Appendix A for The University's email template). The communication alerts students to consider using different strategies and seek resources to reset their path to academic success.

To return to good academic standing students must raise both their cumulative and semester GPAs to be at or above a 2.0 in a fall or spring semester. Students have the option to retake classes they underperformed in to replace GPA points from previous classes. Additionally, when students perform well enough in new classes their GPA increases. Students have two semesters (fall and spring only) to raise their GPA above a 2.0. If their GPA remains below a 2.0 for three consecutive semesters, they are dismissed from The University. Students can apply for readmission after spending one fall or spring semester out of The University for their first dismissal or one year for their second dismissal. If granted readmission, the student returns to The University on academic probation.

Some academic units have additional requirements. For example, students in the First-Year Engineering program cannot Transition to Major while on academic probation. Moreover, students are only allowed to remain in the First-Year Engineering Program for four semesters. If a student remains on academic probation upon completing their fourth semester, they will need to select a different major or leave The University.

Mechanical Engineering (ME) is one of the more competitive programs at The University and has a more punitive academic probation system. ME students also have an ME GPA based on their performance in their ME core courses. Thus, ME students have three GPAs they need to maintain above a 2.0: (a) cumulative GPA, (b) semester GPA, and (c) ME GPA. If any GPA falls below a 2.0 the student is placed on academic probation. Once placed on academic probation, the

student must meet with their academic advisor and share the following items with them: a revised plan of study, their ME Core GPA Calculator Sheet, their decision on whether to repeat courses, their success plan, and a signed probation contract. Unlike other academic units, students in ME can be placed on academic probation and return to good standing during the summer terms. ME students on probation are not allowed to enroll in more than 15 credit hours. Additionally, ME has a “Three Strike” policy where a student is not allowed to be on academic probation more than three times while enrolled in ME. If a student is placed on academic probation for a fourth time, they will need to change majors as they are no longer allowed to complete the ME degree. Similarly, if a student is dismissed from The University as a result of academic probation, they are not allowed to pursue ME upon readmission.

Electrical and Computer Engineering (ECE) has a voluntary initiative to support students who are At-Risk of being placed on academic probation, on academic probation, and recovering from academic probation. The initiative aims to support students in designing a support team consisting of their academic advisors, faculty, and campus resources. Together, they support students on discovering strategies that no longer work and replace them with new ones that will support the student’s academic success. Students who are in the At-Risk group have a cumulative GPA of 2.00-2.30, experienced a significant drop in their GPA, or have a cumulative GPA that is above a 2.30 but their ECE GPA is below 2.30. Students who participate in the At-Risk level of the initiative take an assessment, co-develop an individualized academic success plan with their academic advisor, and are encouraged to take less than 15 credit hours each semester. Students at the Probation level have a cumulative or semester GPA below 2.00. Students complete the same requirements as the At-Risk level except they are not allowed to enroll in more than 15 credit hours. If a student is on academic probation more than three times throughout their ECE journey they may be dismissed from the ECE program. Students are moved to the Recovery level when they return to Good Academic Standing, meaning their semester and cumulative GPAs are above 2.00. During their one semester in the Recovery level, students complete the same requirements as the At-Risk level except they can determine, with their advisor, what a manageable number of credits will be. Additionally, students continue working with their advisor to make habits of the academic success strategies they previously identified.

Academic probation is a university policy primarily meant to alert students to seek resources that will support their academic success. While most units follow these guidelines, each unit has the autonomy to make their unit's academic probation policy as punitive or restorative as they deem necessary.

Participants

Participants included eight racial minority undergraduate science and engineering students at The University. To be eligible for enrollment in this study, students must have self-identified as being (a) At least 18 years old, (b) An undergraduate student at The University, (c) Enrolled in the Polytechnic Institute, College of Engineering, or College of Science, (d) In their sophomore or later year, and (e) Currently or previously on academic probation. Seven students were enrolled in the College of Engineering and one student was enrolled in the College of Science, resulting in a total sample of eight participants. Students were on academic probation at the time of the interview, and some had been on academic probation during previous academic semesters (see Table 2). Students were placed on probation in Spring 2021 or Fall 2021 for their Fall 2020 or Spring 2021 GPAs, respectively.

Table 2. Participant Demographics

Pseudonym	Race/Ethnicity, Gender	Class, Major	Semesters on Probation
Alex Palmer, III	Latino (son of immigrants)	Senior, Industrial Engineering	2
Jorge	South American Man	Junior, Computer Engineering	2
Jonathan	Black Man	Junior, Electrical Engineering	1
Juniper	Native American Woman	Sophomore, Chemical Engineering	1
Kim	Black African Woman	Sophomore, Mechanical Engineering	1

Table 2 continued

Luke	Black and Asian Man	Sophomore, First-Year Engineering	1
Pico	Latino/ Hispanic Man	Senior, Computer Engineering	2
Shark	Black Man	Senior, Computer Science	5+

In this section, I introduce the study participants and describe students' reasons for being placed on academic probation, supported by interview excerpts. Each student selected or was given a pseudonym of their preference during the interview, as presented below. I present both students' racial identity (i.e., Black) and their ethnicity (i.e., African, Latino/Hispanic, South American, Native American/Indigenous) where applicable. I include both race and ethnicity where relevant to honor students' identification. Although all students with ties to a country outside of the US specified that country, I present students' home continent instead to protect their identity.

Alex Palmer, III

At the time of the interview, Alex Palmer, III was a senior in industrial engineering with one year of courses remaining at The University. He identifies as and is proud of being a “son of immigrants” from South America. He identifies as Latino more than Hispanic because “any Spaniard can be Hispanic, but ultimately they're European.” Alex is proud of his identity as a Latino son of immigrants and discusses how, as the third Alex Palmer, he is responsible for making sure “not only can I not let myself be like the decline, I can't let my kids be the decline either. After that they can mess it up if they want to.”

Alex was placed on probation in Spring 2021 for his Fall 2020 GPA. He attributes being on probation to difficulty transitioning to fully online instruction in Fall 2020:

There is a bit of an adjustment period for a couple of weeks [with online learning], and that adjustment period led to a couple of missed quizzes or a missed homework assignment or something. And I think just generally with school and maybe just how I am as well if something is going poorly, especially when it's like when it's school, where like if you start bad, you have to be equally

as good just to balance it out later. It really just kills the motivation, I guess. Versus like a job. Like I could start poorly, but if I start killing it, then I just kill. And that's it right, you're only as good as your current day versus school. It's like, yeah, you're as good as the average of the last who knows how many months. And if my average is already down then I'm like, "oh geez. You know, what can I do?"

Beyond the difficult transition, Alex provided insight into his approach to improvement. Valuing opportunities to recover later, such as in professional settings, the weight of missed deliverables early in the semester negatively impacted Alex's desire to put in enough effort to recover.

Jonathan

Jonathan identified as an African American male in his junior year of the electrical engineering program. Although Jonathan lives in the US now, his father was in the military, so Jonathan lived the majority of his life in different European countries. Jonathan was placed on probation in Fall 2021 for his Spring 2021 GPA. Jonathan was a remote learner from March 2020 through May 2021. He had a challenging Fall 2020 and was identified by his school as being at risk for academic probation. Jonathan described inadequate study skills and difficulty managing the "free time" gained from living at home. He was "under the impression it would be easier when it was probably <inaudible> Because I couldn't ask as many questions as I'm used to. So, I guess the transition period was a bit difficult for me." Being placed on probation was the jump start that Jonathan needed "They tell you like 'Oh, you're gonna be on academic probation soon.' And I was like, 'Okay, I'll fix myself.' And I started fixing myself." Jonathan reflects on having a strong start to the semester but "then I had some family struggles. And my mood and my motivation took a hit. I was a little depressed. So, during finals, it did not... Me during finals [shakes head and waves hands to suggest no one wanted that version of himself]. And yeah, so now I'm actually on probation." Jonathan described a variety of reasons for being on probation, ranging from difficulties transitioning to online learning to dealing with mental health and family challenges.

Jorge

Jorge identified as a Latino who immigrated from South America and was in his junior year of the Computer Engineering program at The University. Jorge was placed on probation in

Spring 2021 for his Fall 2020 GPA. Jorge shared that there was a substantial increase in difficulty from FYE into his major:

When I started in sophomore year, the gap between FYE and the actual major, the computer major was so big and difficulty and everything that I struggled to land on my feet there and get a hold of a piece of everything... It was like, I came here (to the US), it was challenging, but then I felt like the real difference. My FYE, it was challenging, but I think that I was able to adapt quicker than I was to when I was actually in computer engineering... I also maybe didn't put in enough time to those classes, you got for what they were asking for.

This transitional period in Fall 2019 was the first time Jorge was placed on probation. He was able to improve his GPA and return to good standing in Spring 2020 but was placed on probation again in Spring 2021. Jorge describes the many challenges he faced transitioning to online learning

We had to try to transition from being in class to online classes, and that transition didn't really help me a lot.[...] It was harder for me to, because I'm a person that always goes to the office hours when I need help, and to meet up with people to do work, and that prevented me from that big side of how I think my thinking processes [...] They [instructors] had to improvise that absence [of students being in class], so that was very... because you get like, cozies, how do you say? You get used to [in person] teaching and bamante to another, you just don't have it, and that's hard.

Jorge describes here the missed learning opportunities he experienced when his classes were moved online. He learned that he enjoys the camaraderie that is built through solving problems together in class, study groups, and office hours. He does well with hand-on applications in labs and being able to get immediate feedback. With online instruction, Jorge felt he lost access to these learning opportunities, and his grades suffered because of it.

Juniper

Juniper identifies as a Native American woman and was in her sophomore year of the chemical engineering program. Juniper is from a “very diverse community” in the Southwestern region of the US. She reflected on growing up in a large Native American community that was also home to Black and Hispanic individuals. This diversity:

affected my sense of community... everyone cares about each other and like you're family, no matter who you are, like if you're there, we're going to treat you like family or we're going to try our best to make you feel like you belong.

Juniper was placed on probation in Spring 2021 for her Fall 2020 GPA. She attributes being on probation to challenges transitioning to online learning, taking too many classes, being overinvolved in co- and extracurricular activities, and mental health challenges:

I do have a issue with being overambitious. I guess I set my own standards for myself really high. And I want to be involved in every opportunity I find [...] be well-rounded. So that's another issue I had I was taking like 17 credit hours. You know, I work really like almost 24/7-hour job like on campus. And then which obviously this job helps me pay for school, so I can't really not do it. I'm also involved with research and then like I'm involved in all these different organizations. So, it's like I was taking those doing too much and I thought it was like it was going to be easy [...] or I'd be able to do it on top of, like, obviously all the online classes. But I was wrong. And I try to learn from that this semester. But even this semester, I definitely still added a little bit too much [...] Also because I do have some mental health issues as well that like kind of... I don't know. Like have obviously been like increased or affected by, like the isolation that the pandemic has brought.

Kim

Kim identified as a Black, African woman in her sophomore year of the Mechanical Engineering program. Kim was placed on probation in Spring 2021 for her Fall 2020 GPA. She attributes being on probation to difficulty transitioning to online learning, increased rigor of classes upon transitioning into Mechanical Engineering, and decreased motivation to complete classwork.

At the beginning of covid they said that if you had a little more than a C you could get into ME [... So] even if I didn't have, like, a high GPA, it does still helps me just get into ME. And then I think like because the classes were online, I might have slacked off a bit. I just like it's online, it's open book, I'll just sack it. So, I think like I didn't put in my maximum effort [...] I was just like, "oh, I just want to pass." Like I wasn't, my motivation for being in the class wasn't there [... unlike] my second semester [...] I was still working towards something, getting into ME. So, I still had the motivation that if I didn't get into ME I'll have to choose another course. And I didn't want to choose another course, because nothing else spoke to me. So, I was just, I still had the motivation to actually work towards something [in Spring 2020]. Unlike when I had initially entered [ME in Fall 2020].

Kim's minimal effort approach was deepened in response to courses where she felt that,

The professors gave more of the burden to us. It's so theoretical that I have to project what's in my head onto paper to understand the situation first. I feel like they should have been more helpful, but also a lot of work on my part. I was

watching and knowing. I wasn't understanding. I was just like to then just pass. I just want to pass. I don't want to be in this anymore.

Kim's decreased desire to put in effort and underestimation of the workload led to her being placed on probation.

Luke

Luke identifies as a Black and Asian man in his sophomore year of the First-Year Engineering program. Luke moved around a lot but feels most at home in a Middle Atlantic city. Luke was placed on probation in Fall 2021 for his Spring 2021 GPA. Luke attributes being placed on probation to difficulties managing his mental health during isolation. Luke's challenges managing his mental health date back to his childhood and were amplified during COVID-19:

[My father] had this way of speaking to me that made me feel like nothing. And so in about the fourth or fifth grade, I picked up the habit of cutting [...] COVID kinda took the parts of me and amplified them [...] In the spring semester [of 2021] I was cutting just about every day [...] I was doing it so frequently that I was spending more time cutting and cleaning the cuts. Making sure I don't get affections or anything. I was spending more time doing that than I was doing my work. And so eventually I just got to the point where I couldn't play catch up anymore and my grades started to take the hit.

Luke's childhood mental health challenges with self-harming were amplified after the "mystique of college kinda wore off" and he was social distancing during COVID. All these challenges came together and resulted in Luke "flat out not doing [classes]," and being placed on probation.

Pico

Pico identified as a Latino from the Southeastern region of the US in his senior year of Computer Engineering. Pico was on probation twice during his time before our interview. He attributes his first time on probation to challenges transitioning to college:

My crippling weakness had been in exams [...] From how drastic the difference is from high school [...] where there's multiple exams throughout the period to now college, where there may be two, three, four max exams that you have to perform well on because there are huge chunks of your grade. It's a completely different ballgame for it.

For our interview, Pico primarily reflected on his most recent probation experience in the spring of 2021 due to his fall 2020 grades. Pico took advantage of the option to enroll as a fully remote learner from March of 2020 through May of 2021. Pico returned to his home in the southern US living with his mother, little brother, and grandmother. Pico reflects on how he struggled to balance completing his classwork with making time for his family and being "the only man" in the house.

I'd have to spend time with my family, and I'd have to make sure I'm able to get all my assignment done and then make sure I can do them all correctly while also studying for everything and being able to help around the house because I'm the only man really there to be able to move everything around

Pico attributes his probationary status to the difficulty he had performing all his roles as son, grandson, brother, man of the house, and student.

Shark

Shark identified as an African American from the US. Shark stated that he is a "super, super senior" in Computer Science with a minor in Management. He sees himself as a "quirky" and "goofy" guy, evidenced by how he selected his pseudonym. He looked at the first thing in sight, his vacuum cleaner, and went with Shark. He immediately regretted it but decided to keep the name saying it fit his quirky personality.

Shark was placed on probation in Fall 2021 for his Spring 2021 GPA. In response to rarely knowing what was going on in his Computer Science classes and feeling "uncomfy" in Computer Engineering, Shark turned to deeply engage in his minor and various extracurricular activities. He joined a campus choir, fraternity, recruitment program, and retention initiative. All of these engagements kept him busy enough to stay away from his Computer Science classes. Shark identified this as the reason he was placed on probation multiple times: "I was putting aside facing something that made me uncomfortable instead of facing it directly."

Procedures

After obtaining IRB approval, I recruited eligible participants through emails, social media posts, and a network of science and engineering advisors. Students self-enrolled in the study by completing a Qualtrics form with their informed consent and demographics. Of the 255

students who enrolled, eight students were selected. Given my case bounding to racial minorities in STEM who were currently on probation, I selected all individuals for interviews who were enrolled in science, technology, engineering, or mathematics majors; identified as being currently on probation; and identified as belonging to the racial/ethnic groups of Black/African American, Hispanic/Latinx, and/or Native/Indigenous American or Pacific Islander. Virtual interviews lasted approximately 75 minutes and participants received a \$25 gift card for completing the interview. Interviews were transcribed using Casting Words and temi transcription services and were uploaded to Nvivo for coding.

Measures

Demographic information was collected during self-enrollment using measures developed for this dissertation study (see Appendix B). Information collected from the enrollment survey was used to determine students' eligibility for the study. To be eligible for enrollment in this study, students must have self-identified as being (a) At least 18 years old, (b) An undergraduate student at The University, (c) Enrolled in the Polytechnic Institute, College of Engineering, or College of Science, (d) In your sophomore or later year, and (e) Currently or previously on academic probation.

Academic Background and Demographic Information

Students provided their semester of enrollment, major grade point average (GPA) the semester before being placed on probation, and major GPA from the most recent semester. Students self-reported their age, classification, major/school, gender, race, ethnicity, college generational status, number of semesters on probation, and estimated family income.

Interviews

Students participated in one semi-structured, virtual interview. The interview focused on their disciplinary journey and how they negotiated their disciplinary identity and motivations after being placed on academic probation. Interviews were organized into three sections: disciplinary journey, disciplinary identity, and disciplinary motivations. To assess the intersection of students' race and gender with their disciplinary identity and motivation, I asked

students how their gender and race influenced their experience in each of the three interview sections (see Appendix C).

Disciplinary Journey

Using Cruz and Kellam's (2018) engineering journey interview protocol, I asked students to share their disciplinary journey from their initial exposure to their discipline through their current learning experiences. For example, interview questions included, "Think about your experiences in engineering as far back as you can. Could you tell me your story of how you got to where you are today?" To situate students' experiences in historical context, I also prompted students to reflect on how their journey was impacted by COVID-19 and increased attention to racial injustices. Students' journeys were used to further evidence their disciplinary identity and motivation development and negotiations.

Disciplinary Identity

Students' disciplinary identity is defined as who individuals see themselves to be within their discipline. The identity portion of the interview was used to directly solicit students' disciplinary identity upon beginning in their major, after being placed on probation, and how they negotiated potential differences between their Start and Probation Identities. I asked students to describe what it means to be a professional in their discipline from their perspective (i.e., "What does [computer science/engineering] mean to you?) and who they saw themselves to be within their discipline before being placed on probation (i.e., How does that [definition] fit into your sense of who you are?" "What types of knowledge do you need to be considered a [computer scientist/engineer]?").

Students then reflected on whether their probationary status destabilized their disciplinary identity and how they worked to reidentify with their discipline. For example, interview questions asked, "What helped you maintain your engineering identity?" "How would you better describe your engineering identity after being placed on probation?" "How did you come to this new/revised/adjusted sense of yourself as an engineer?" The identity portion of the interview ended with a discussion of the student's belonging in their discipline, adapted from Vaccaro and Newman's (2016) belonging interview protocol. Sample questions included, "Can you give me

some examples of what it is like to be a [insert gender + racial/ethnic identity] [computer scientist/engineer] on this campus? How do those identities influence your sense of belonging in [computer science/engineering]?”

Disciplinary Motivations

Disciplinary Motivations are students' expectancies, attainment value, intrinsic value, utility value, and cost as it relates to their discipline and coursework in their major. The motivation portion of the interview was used to directly solicit students' disciplinary motivations upon beginning in their major, after being placed on probation, and how they negotiated potential differences between their Start and Probation motivations. For example, expectancy was solicited with interview questions such as “What [expectations/values/ costs] did you have for yourself when you began in your major?” “How did your expectations influence your decision to continue in engineering?” and “Let’s focus now on a course that you took while you were on probation. In that course, how did your expectancies for success in [computer science/engineering] influence your engagement in the course?” The latter questions aimed to solicit changes in students’ motivations after being placed on probation.

General values were prompted with interview questions such as “Why did you choose engineering when you began in your major?” Each value when starting in their major was elicited using the following interview questions: “There are a range of reasons people might have for choosing engineering. Let me ask you about a few. Would you say you chose [insert major] because you found it interesting or enjoyable [interest value]? Would you say you chose [insert major] because of the pay or the skills you could gain [utility value]? Would you say engineering coursework allows you to solve important problems or make a meaningful contribution [utility value]? Would you say majoring in [insert engineering major] helped you to fulfill an important part of who you were? [attainment value]” Changes in students’ values were prompted for with interview questions like “How were these [expectations/values/costs] impacted as you thought about your [computer science/engineering] identity?” and “Did you think staying in engineering would cost you anything? Why/Why not?”

Researcher Positionality and Validity

I acknowledge that I approach this project with dispositions that influence the development of my research questions, interactions with participants, as well as analysis and interpretation of data. However, with this awareness, I aim to make intentional efforts to account for my subjectivities. My racial identity has allowed me membership to a larger community that emphasizes, despite adversity, that my Black race is to be cherished and celebrated. There are both physical and virtual places where my Black culture is celebrated, thus where I am celebrated. My pride for my race and ethnicity along with my disdain for the America that has historically refused me may increase my ability to relate to students of color. Conversely, this same pride and disdain may have distanced me from students of color who did not share my experience or who did not view their race and ethnicity as central to their identity. As a graduate student, I am afforded a retrospective understanding of the undergraduate experience. Although this may stimulate alternative viewpoints during conversations, I was intentional not to impose my understanding or experiences. Further, my lack of personal experience of being on academic probation may have influenced the depth of which I could relate to the challenges my participants face.

To account for my subjectivities, I developed researcher memos after each interview to allow myself time to reflect on how my subjectivities impacted my interpretation of participants' interviews. I also solicited more detail from participants to ensure I captured *their* lived experiences from *their* perspective.

I used a subset of student responses to share my coding framework with an expert in identity development and an expert in Eccles' expectancy-value theory. The aim of this process was to ensure I applied my coding framework in a consistent way that accurately captured students' perspectives (Richards, 2015). This process, along with the subjectivity and member checks supports the validity of my analyses and subsequent findings.

Data analysis

Analyses occurred in three phases: coding framework development, case analyses, and cross-case analyses. I used existing literature to deductively develop an initial codebook. I then read all transcripts to familiarize myself with the data. With in-vivo coding, familiarizing oneself

with the data is important to capture participants' voices and begin noting salient, common, and/or divergent voiced experiences (Saldana, 2013). I further developed and elaborated the predeveloped codebook inductively using students' responses. This inductive process warrants coding framework development as an analytic procedure. Next, I conducted thematic analyses of each participant's interview transcript. Lastly, I examined similarities and differences across all participants.

Coding Framework Development

I developed a deductive coding framework informed by previous engineering identity, expectancy-value, and race and gender equity literature (Benedict et al., 2017; Godwin, 2016; Matusovich et al., 2010; McGee & Bentley, 2017). I deductively analyzed transcripts based on identity, motivation, and race codes developed from previous literature. I then inductively created codes in vivo, or directly from students' responses, of students' identities, motivations, and race and gender experiences. I also developed a procedure using the annotation function in Nvivo to annotate students' descriptions of negotiations. After creating a full coding framework of students' conceptualizations of identity, motivations, race, and gender (Tables 3-5), I applied the framework to the full data corpus.

Disciplinary Identity Coding Framework

The identity coding framework had two parts: (a) STEM Identity Development and (b) STEM Characteristics and Practices (see Table 3). The STEM Identity Development framework adapted from Godwin (2016) was used to detail the case descriptions. Specifically, students' *Performance/Competence* included their perceived STEM knowledge level and whether they viewed themselves as skilled, knowledgeable, and capable in their discipline and was rated on students' perception of whether their Performance/Competence was *High*, *Moderate*, or *Low*. *Recognition* included students' perception that socializers viewed and acknowledged them as capable and well fitted with their discipline. *STEM Characteristics* included latent characteristics from Benedict et al. (2017) like application of skills, interpersonal skills, work ethic, and knowledge/competence as well as characteristics students identified such as creativity, problem-solving, and making a positive impact. These specific characteristics were not coded but rather

fell into two subthemes of *General STEM Characteristics* or *Integrated STEM Characteristics*. General STEM Characteristics were traits that students stated were needed or common to be considered a professional in their discipline. Integrated STEM Characteristics were similar except students stated that they either personally exhibited or valued the trait. *Recognition* and *Performance/Competence* were used to construct the case narratives whereas the characteristics, primarily *Integrated STEM Characteristics*, were used to determine students' Start and Probation Identities (see Case Analyses).

Table 3. Disciplinary Identity Coding Framework

Name	Description	Example
Recognition	Self, others, or resources who position student as competent or having skills needed to be a STEM professional.	I found a lot of podcasts that kind of pointed to that, like, "Hey, when you're doing science and you're working in technology, you're helping mold humanities possible futures. " <i>Shark, Black Man, Senior, Computer Science</i>
Performance/Competence	Student's perceived STEM knowledge level; Whether student views self as skilled, knowledgeable, and capable in discipline. Includes unspecified/general competence	<i>See examples below</i>
High Performance/Competence	Student's perceived high STEM knowledge level; Student views self as skilled, knowledgeable, and capable in discipline	When I was young... math and science just came to me and I never really had to study or try or push myself <i>Alex Palmer, III, Latino, Senior, CompE</i>
Low Performance/Competence	Student's perceived low STEM knowledge level; Student views self as unskilled, unknowledgeable, and incapable in discipline	These University math courses, they would throw a lot of concepts that in the speed that they would go out, I was like, "man, I think I suck at math " <i>Pico, Latino, Senior, CompE</i>
Moderate Performance/Competence	Student's perception that their STEM knowledge level is average; Student views self as having sufficient skills/knowledge, but not high/low. Just enough, need extra time, etc.	I've always been able to scale by . <i>Kim, African and Black Woman, Sophomore, ME</i>
Early STEM Exposure	Opportunities to engage with STEM before college. Ex. meeting engineers, research, classes, internships, etc	I [had] taken a Cisco class that was free or sponsored by my school... I was able to learn a little bit of coding from them <i>Pico, Latino, Senior, CompE</i>

Table 3 continued

Pre-College STEM ID	Student's STEM ID from before entering college	I always wanted to do engineering. It was something that I knew before I got into middle school and high school <i>Kim, African and Black Woman, Sophomore, ME</i>
General STEM Characteristics	Character traits common among/needed by STEM professionals	One of the main things [to be an engineer] is communication , learning how to build relationships <i>Pico, Latino, Senior, CompE</i>
Integrated STEM Characteristics	Character traits student endorses that align with those valued in their field	I could do that by solving the problems that they despise the most... that's what an engineer should be : the best and smallest possible investment for the largest possible return <i>Alex Palmer, III, Latino, Senior, CompE</i>
STEM Belonging	Sensing community/membership. Having similar motivations, values, perspectives, purposes, experiences, etc. as other STEM students and professionals	I want to fit into the engineering picture . Being an engineer, I want to fit into that. I want to have the right requirements . I want to be able to succeed in it. I don't care about the student body. <i>Kim, African and Black Woman, Sophomore, ME</i>
STEM Practices	Practices specific to the discipline. Ex. engineering design cycle, coding, scientific method, proofs. Also includes practical experiences in internships	what career goes into knowing math and science and building and designing and all these words that kind of lead to engineering. <i>Alex Palmer, III, Latino, Senior, CompE</i>

Disciplinary Motivation Coding Framework

I developed a deductive codebook (see Table 4) for students' expectancies, values, and costs from Matusovich et al.'s (2010) qualitative coding framework in addition to theoretical expectancy-value literature (e.g., Eccles, 2009; Eccles & Wigfield, 2020). *Expectancies* included how confident students were that they would be successful in their disciplines. Success was determined by each student and included contexts of grades, projects, persistence in their major, internships, and future careers. Expectancies were further coded as (a) *High Expectancy* if a student described feeling confident that they would do well in their discipline, (b) *Low Expectancy* if a student states that they were not confident they would do well in their discipline, and (c) *Moderate Expectancy* if a student was uncertain about how well they would do in their discipline or expected to perform at an average level. *Attainment value* included how important doing well in their discipline was to who the student saw themselves to be or how important their discipline was to their identity. *Interest value* was how enjoyable and interesting a student found their discipline to be. *Utility value* was how useful a student found their discipline for their future plans and goals. *Cost* included what students felt they must sacrifice and the effort needed to persist in their discipline. Although there is overlap between *Utility* and *Attainment value*, I distinguished the two by including values external from the self as utility value and values integral to one's personal identity as attainment value. For example, if a student valued engineering because their future salary allows them to provide for their family, I coded that as utility value. However, if a student listed being a provider as integral to their personal identity and engineering allows them to fulfill that identity of provider, I coded that as attainment value.

Table 4. Disciplinary Motivation Coding Framework

Name	Description	Example
Expectancies	Parent node for student's beliefs about how well they will do in STEM	See examples below
High Expectancies	Student expresses they were confident they would do well in STEM	It just feels like arrogance at this point. I was so confident. <i>Shark, Black Man, Senior, Computer Science</i>
Low Expectancies	Student expresses they were not confident they would do well in STEM	[Probation] got my confidence a little down or very low <i>Jorge, Latino, Junior, CompE</i>
Moderate Expectancies	Not high nor low expectancies. Also captures when uncertain of or mixed expectations	I'm still pretty confident that I can do it. But now I know there is a possibility I could fail and that's kind of scary. <i>Jonathan, Black Man, Junior, Electrical Engineering</i>
Probation Expectancy	Student's confidence after being placed on probation	I fully anticipate being back on track <i>Luke, Black & Asian Man, Sophomore, FYE</i>
Start Expectancy	Student's confidence before being placed on probation	I was very confident at the beginning. <i>Juniper, Native American Woman, Sophomore, ChemE</i>
Other	Motivations not related to EVT	"Ooh, that sounds hard, do it Let's go!" Because I just was always looking for like the next challenge. I was like "Oh! How can I level up from here? What's the next step? I want to be better tomorrow than I am today " (mastery-approach goals) <i>Shark, Black Man, Senior, Computer Science</i>
Probation Values	Student's values after being placed on probation	See examples below
Probation Attainment	After being placed on probation - how student sees STEM as helping them fill an important part of who they are	It remained the same. I never really question those [whether being on probation made value engineering as less important to who I am] <i>Jorge, Latino, Junior, CompE</i>

Table 4 continued

Probation Cost	After being placed on probation - cost/sacrifice/drawbacks of pursuing STEM	There's more free time in other majors. <i>Jonathan, Black Man, Junior, Electrical Engineering</i>
Probation Interest	After being placed on probation - how interesting/enjoyable student sees STEM	This is something that I actually do have a passion for and would be devastated if I would be unable to continue with it. <i>Pico, Latino, Senior, CompE</i>
Probation Utility	After being placed on probation - how useful student sees STEM (transferability, future use, etc.)	Why I stayed in it was for the problem solving. I wanted to solve important problem and see technology move in a beneficial way for people, for society <i>Shark, Black Man, Senior, Computer Science</i>
Start Values	Student's discussion of attainment, utility, interest, and cost value before probation	See examples below
Low Start Values	Student's discussion of attainment, intrinsic, and utility values when low	<i>Temi: Would you say that engineering coursework allows you to solve important problems or make a meaningful contribution?</i> Luke: Not for the most part. Not really. <i>Luke, Black & Asian Man, Sophomore, FYE</i>
Start Attainment	Before being placed on probation - how student saw STEM as helping them fill an important part of who they were	I would say [I chose engineering] because it's a part of who I am. <i>Jorge, Latino, Junior, CompE</i>
Start Cost	Before being placed on probation - cost/sacrifice/drawbacks of pursuing STEM	I felt like I was always slamming my head against a brick wall when it came to computer science. It was just so foreign to me <i>Shark, Black Man, Senior, Computer Science</i>
Start Interest	Before being placed on probation - how interesting STEM was for student	my first year when we were learning how to code. I loved coding. <i>Alex Palmer, III, Latino, Senior, CompE</i>
Start Utility	Before being placed on probation - how useful student saw STEM (transferability, future use, etc.)	my biggest goal when I was deciding my major, I was like, I wanted to find a way to help people by doing <i>Jonathan, Black Man, Junior, Electrical Engineering</i>

Each value was also rated as *High*, *Moderate*, or *Low*. I rated each value as (a) *High* if a student stated that they valued the interest, utility, or attainment of their discipline or saw high costs associated with pursuing their discipline; (b) *Low* if a student stated that did not value the interest, utility, or attainment of their discipline or saw few to no costs associated with pursuing their discipline; and (c) *Moderate/Mixed* if a student was uncertain about how they valued the interest, utility, attainment, or cost of their discipline or spoke of a value in both high and low ways.

Race/Ethnicity and Gender Coding Framework

I adapted McGee and Bentley's (2017) Collectivism code and Barriers descriptions (see the following Negotiation Coding Framework section) from their STEM equity ethic coding framework to develop my race and gender coding framework (see Table 5). *Collectivism* included students' desire to help their own communities. In my dissertation sample, helping their own communities included helping one's family, giving back to their marginalized ethnic and racial communities, giving back by being a role model, and being a good representative. I also developed a code grounded in students' experiences of *Advantages* or perceived benefits through membership in their racial, ethnic, and gender communities. Advantages ranged from access to special programming to belonging experienced by connecting with others who had shared experiences.

Table 5. Race/Ethnicity and Gender Coding Framework

Name	Description	Example
Dissociate with Race or Ethnicity	Student expresses they do not identify with one or more of their races or ethnicities	I don't identify it as, with it as much as I do like being Native American because, like, I'm a lot more culturally involved with, like my Indigenous side in comparison to like my Hispanic side. <i>Juniper, Native American Woman, Sophomore, ChemE</i>
Collectivism	Students desire to help their own communities	the path has to be paved or cleared out by someone first... I'm happy to take that discomfort if that means a drove of people can also come and join and help me problem solve in this space as well. <i>Shark, Black Man, Senior, Computer Science</i>
Advantages	Academic advantages raised by race/ethnicity	As a result [of feeling isolated as a Native American], I have been like a lot more adamant about being involved with other communities that are minority <i>Juniper, Native American Woman, Sophomore, ChemE</i>
Race Belonging	Feeling [or not feeling] community/ membership with people from same or similar racial/ethnic background	I sometimes feel like I'm not Black enough. I'm not Asian enough... I found some sense of community in the Black community. <i>Luke, Black & Asian Man, Sophomore, FYE</i>
Race Minority	Sense or fact of race/ethnicity being marginalized/underrepresented [in STEM]	Can we just start by saying there's a lot more white people at The University than there is Black people! <i>Jonathan, Black Man, Junior, Electrical Engineering</i>
Gender Minority	Sense or fact of gender being marginalized/underrepresented [in STEM]	the percentage of women engineers are really tiny, the percentage of black engineers like African girls in STEM still was really tiny. <i>Kim, African and Black Woman, Sophomore, ME</i>
Gender Discriminate	Sense of being discriminated against, others holding prejudice against, or being marginalized due to gender	even in classes, once they see you as a woman they don't take you as serious or they talk over you. Sometime, you have to, like, [knocking sound] "Hello. I'm talking." That kind of thing. Remind them that just because I'm a woman in STEM doesn't mean I don't know what I'm talking about. <i>Kim, African and Black Woman, Sophomore, ME</i>

Table 5 continued

NA Gender	Student did not consider their gender	I wouldn't say my gender did [impact my engineering journey] at all
<i>Alex Palmer, III, Latino, Senior, CompE</i>		

Negotiation Annotations

Negotiations included decisions students made to resolve challenges regarding their disciplinary identity, disciplinary motivations, race, ethnicity, and gender. Negotiations primarily captured how students reconciled their Start and Probation Identities and Motivations but could also include students' reconciliation of any challenge experienced in their science or engineering journey. McGee and Bentley (2017) developed their STEM equity ethic coding framework to examine how students reconciled barriers to advancing equity in STEM. Students in my study, however, spoke primarily of *Challenges* defined as instances where students faced internal and/or external threats to their disciplinary identity, disciplinary motivations, racialized experience, or gendered experiences. Challenges varied for students, so I took a grounded approach and coded all relevant text that mentioned a Challenge and how students responded to that Challenge as a *Negotiation* (see Table 6).

Table 6. Negotiation Annotation Framework

Name	Description	Example
Negotiations	Decisions made to resolve challenges	"Do I- Am I just am I going to hate it in the same way that I hate mathematics kind of now?" [...] And slowly, slowly speaking with the professor, working with him so I can be able to understand everything at the pace that, you know, I can understand it. And then, as I'm able to understand everything, work my way through it and you know, being able to actually perform. I realize "No I do still love it." But it's just I can't keep up with the pace that they want me to do it for. So what I'll just have to do is increase my effort for it so I can, maybe not be on the same plane, but be close enough to be able to reach it. <i>Pico, Latino, Senior, CompE</i>
Challenges	Instances where students faced internal and/or external threats to their disciplinary identity, disciplinary motivations, racialized experience, or gendered experiences	I actually didn't get any support professionally from The University. Besides, like, being able to put that name on my resume. <i>Alex Palmer, III, Latino, Senior, CompE</i>

Case Analysis

My first analytic step was to develop artifacts for each participant, called participant memos, in which I summarized codes from their transcript. For the Identity and Motivation analyses, specifically, to examine changes in students' identity and motivation, I first characterized what students' motivations were upon starting in their major and after being on probation. I then analyzed the differences (or consistencies) between their start and probation identity or motivations to determine whether there was a change and, if so, how that change occurred. Students' process of changing (or maintaining) their identity or motivations, including how that change did or did not occur, is classified as a *Negotiation*. As described above, this Negotiation process is often triggered by a *Challenge*. Thus, I drew primarily on the Negotiation annotations to analyze how students changed or maintained their disciplinary identity and motivations. Below I describe how I analyzed relevant *Negotiation* text to characterize what negotiation looked like for each student's identity, motivation, and race and gender experiences. The **bolded text** represents organizers used when elaborating on each student's participant memo.

Identity Change and Negotiation

To examine students' negotiation of their disciplinary identity, I created disciplinary identity participant memos for each participant. Each memo summarized (a) who the student was upon starting in their major (*Start Identity*), (b) who the student was at the time of probation (*Probation Identity*), (c) how (or whether) probation impacted their view of themselves (*Identity Change*), and (d) how they negotiated their identities (*Identity Negotiation*). Multiple methods, including the journey and interviewing methods, provided evidence of students' pre- and post-probation identities. For example, the journeying method collected students' experiences through their discipline. I constructed students' *Start Identity* from the *STEM Characteristics* and explicit statements about who they saw themselves to be as professionals before being on probation. This information was gathered from their journey responses and the first few questions in the identity interview.

I constructed students' *Probation Identity* from the *STEM Characteristics* and explicit statements about who they saw themselves to be as professionals after being on probation. This information was gathered from their journey responses and their response to the following question in the identity interview "Has being on probation influenced how you see yourself as an [engineer/computer scientist]?"

Drawing on text coded as Negotiations, I classified *Identity Negotiation* as (a) *Changed* if a student negotiated their Start Identity into a different *Probation Identity*, (b) *Reconceptualized* if a student kept the same identity characteristics but described them in a different way, (c) *Reprioritized* if a student kept the same identity but adjusts importance of characteristics, or (d) *Unchanged* if a student did not negotiate their Start Identity into a different Probation Identity.

I then described students' *Identity Negotiations* by summarizing any text that referenced a Challenge or a process a student engaged in to reconcile their Start and Probation Identities. Although most students whose *Identity Change* was *Unchanged* did not have any negotiations, one student did engage in a negotiation to maintain their disciplinary identity. Thus, *Unchanged Identities* did not exclude students from engaging in negotiations (see Vulnerability section in results for further elaboration on students whose *Unchanged Identities* and Motivations needed to be negotiated).

Motivation Change and Negotiation

To examine students' negotiation of their disciplinary motivations, I created disciplinary motivation participant memos for each participant. Each memo summarized (a) what motivated the student before probation (*Start Motivations*), (b) what motivated the student after being placed on probation (*Probation Motivations*), (c) how [whether] probation impacted their motivations (*Motivation Change*), and (d) how they negotiated their motivations (*Motivation Negotiation*). Memos were detailed at the individual motivation level, summarizing each of the *Start* and *Probation Motivations* for students' expectancies, attainment values, interest values, utility values, and costs separately. I constructed students' Start Motivations from codes in students' journeys and the first half of the motivation protocol when students spoke about their expectancies, attainment values, interest values, utility values, and cost values before being on probation. I included the level of expectancies from the codebook (high, moderate, low) and constructed students' ranking of their values. I constructed students' rankings from responses to

motivation interview prompts 3 and 4 asking about the “range of reasons people might have for choosing [engineering/science]” and “You talked about [list values]. Which of these were most important to you?” For example, if a student said a value was not important to them when beginning in their major, I ranked that as their lowest value. If a student said a value was important, I ranked that as high. Then I ranked the value they said was most important as the highest. If a student was unsure how important a value was I ranked it as moderate. This created a hierarchy of Start Values for each student. The participant memo included a summary of each motivation, if discussed, before being placed on probation.

I repeated the same process to construct students’ *Probation Motivations* after being on probation. The information in the Probation Motivations portion of the memo was summarized from their journey responses and their responses to the following questions in the identity interview “Earlier you shared that your identity [changed, stayed the same] after being placed on probation. Thinking about your engineering identity, how was your confidence impacted?” and “Did your [insert value that was most important] shift with your engineering identity?” Changes in motivation were asked in relation to changes in identity to investigate the first research question of how identity and motivation negotiations interact (see the following section on Identity-Motivation Connections). However, students’ responses also included elaborations focused solely on what their Probation Motivations were.

Drawing on text coded as Negotiations, I classified *Motivation Change* as (a) *Reconceptualized* if a student kept the same expectancies and/or values but described them in a different way, (b) *Reprioritized* if a student kept the same values but repositioned values in their ranking, (c) *Increased* if a student described having higher expectancies or values, (d) *Decreased* if a student described having higher expectancies or values, or (e) *Unchanged* if a student did not negotiate their *Start Motivation* into a different *Probation Motivation*. Note that there was no Reprioritization of expectancies, only values. Change codes were applied for expectancies and values separately.

I described students’ *Motivation Negotiations* by summarizing any text that referenced a *Challenge* or a process a student engaged in to reconcile their Start and Probation Motivations. Similar to Identity Negotiations, *Unchanged Motivations* did not exclude students from engaging in negotiations (see Vulnerability section in results for further elaboration on students whose Unchanged Identities and Motivations needed to be negotiated).

Analysis of Interactions Between Concepts

The following two analyses were conducted at the individual participant level but shifted my analytic focus from looking at a single codebook to examining how concepts interacted. The previous analyses needed to be completed prior to engaging in the following analyses that directly answer my research questions. I first describe how I analyzed each students' participant memo for connections between motivation and identity negotiations (RQ1). I then describe how I contextualized students' negotiations in their race, ethnicity, and gender (RQ2).

Identity-Motivation Connections

To analyze my first research question, I analyzed how identity negotiations interacted with each student's expectancies, interests, utilities, attainments, or costs in the semester after receiving their probationary status. I allowed for the possibility of multiple pathways by focusing on the processes of interaction rather than looking solely for the identity → motivation process suggested in the SEVT model (see Figure 1). Specifically, I used the developed summaries to examine each student's explicit mentioning of connections between identity and motivation negotiations. Information for the Motivation-Identity Connection memo primarily drew upon Negotiation coded text. For example, in speaking about how he negotiated his engineering identity, Jonathan reflected on needing to first negotiate his expectations of how successful he could be based on the effort he put in. Once he reconciled his expectancies, he could negotiate whether he was cut out for engineering. I summarized each student's Identity-Motivation Connections in their respective participant memo.

Gendered and Racialized Experiences

To analyze my second research question, I analyzed how students considered their race, ethnicity, and gender when negotiating their disciplinary identity and motivations. I examined the belonging portion of the interview and other responses where students spoke of their racial, ethnic, and/or gendered experience in their discipline. I elaborated each student's participant memo with summaries of their race, ethnicity, and gender codes for Collectivism, Advantages, Challenges, and Negotiations. Most often, these experiences were prompted during the interview with questions like "What role did your race or gender play in your journey?" and "Tell me

about what it is like to be a [insert gender + racial/ethnic identity] engineering major at The University?” Other times, students volunteered the information within their responses to questions about their journeys, identities, or motivations. For example, when sharing her story of how she became who she is today, Juniper described her motivation to use her engineering degree to research sustainable ways to implement renewable energy sources into her own and other Native American tribal communities (**Collectivism**). Since being an engineer who gives back was central to Juniper’s identity, her valuing of engineering allowing her to fulfill that identity was considered an Attainment value. Thus, this is an example of how Juniper’s ethnicity (coded as Collectivism) was related to her engineering motivation (coded as Attainment Value).

Between Participant Analyses

For each student, I classified changes in their disciplinary identity, expectancies, and values to calculate frequencies of changes across the sample. I also classified the direction of negotiation between identity and motivations. I then compared patterns across all participants to examine the role students’ representation in engineering played in their negotiation processes. To investigate whether there were patterns of negotiation pathways across cases (RQ1), I examined participant memos for each student and classified patterns of whether students negotiated their disciplinary identity or motivations first. To showcase how disciplinary identity and motivation negotiations were contextualized in students’ race, ethnicity, and gender experiences (RQ2) I created an interaction matrix in Google Sheets (see Table 7).

Table 7. Influence of Race, Ethnicity, and Gender on Disciplinary Identity and Motivation

	Similarities	Differences
Identity Negotiation	Race Minority Jonathan is still working out how he feels when he realizes "I'm the only Black person here." He does feel "it's also a little empowering, like I made it here. And so other people [minorities] can too"	ID Negotiation Kim - negotiates low expectations of Black ppl in STEM by reminding self must work harder to be equal as Black woman
	Juniper struggles being 1 of few NatAm. Negotiated by joining minority spaces (NSBE, AAACRC)	Gender Minority Kim - Eng experience challenged bc underrep in eng and often only girl on teams --> discrimination (men get credit for her ideas, expected to do more with less, [Black] women are angry/emotional) and imposter syndrome. Negotiates discrimination by not addressing it so not seen as angry Black woman
	Luke struggles being a racial minority (Black) both in the nation and in his engineering classes. This is detrimental for his race belonging. Negotiate by finding community in the Black community and MEP	
	Kim - Barrier=URM as Black. Negotiate = work with other Black students BUT Barrier = only Black person in groups	
	Shark finds it hard to see his place in CompSci since there aren't many reflections of himself taking this path. Feels isolated	
	Lack of Belonging Luke often feels he isn't Black or Asian enough. Negotiate - His habit of overcompensating for his race is also reflected in his tendency to overcompensate in STEM classes, wanting to "do everything"	Good Representative Juniper wants to set a good example of NatAm in engineering, disprove negative stereotypes about NatAm. Probation left her feeling she may not be setting the best example <i>Note others had this code but not necessarily related to STEM</i>
	Shark's lack of belonging as a Black man in CompSci amplifies the drawbacks to pursuing the degree "because I'm also doing it in a vacuum by myself"	
	No Impact - Dissociate with Race Alex - Doesn't ID with broad Hispanic Alex, Jonathan - Doesn't notice/impact journey unless pointed out	Altruism Juniper wants to help minorities fight climate change using alternative energy

Table 7 continued

Dissonance btwn ethnic culture and eng culture

Jorge intentionally integrates his home country's culture of building relationships into his approach to group projects

Kim feels her theoretical training in home country did not prepare her for the applied education in US

Belonging helps ID

Alex - belongs with Spanish-speaking groupmates and operators

Juniper feels she belongs in engineering bc of MEP and We Support Black Engineers Ss goal of being role model

Motivation Attainment Value

Negotiation *Good Representative*

Alex - of his immigrant and Spanish-speaking "gang".

Representing parents, family back home, Spanish-speaking students. serving as connector for operators and good role model for operators' sons

Fill ID

Alex - Extend connector role of engineering to include bridge communication gap between Spanish-speaking operators and English-speaking bosses. Also, negotiated being URM by finding place of belonging w/ Spanish-speaking operators and being connector

Kim - be role model for Black/African woman, sister. Give back to home country and others

Table 7 continued

Expectancies for Success

Alex felt his confidence drop with the pressure to perform well after being placed in a Spanish-speaking group. Negotiated by getting confirmation from internships that "killing it"

Juniper's resistance to letting ppl judge her left her with high fake-it-till-you-make-it energy, eager to figure out what she doesn't know. probation hurt her confidence tho.

Juniper also sets high expectations for herself bc wants to be a role model for others, uplift entire community, and create intergenerational wealth. Probation left her feeling she may not be setting the best example and that she has to work harder than peers with fewer responsibilities

Juniper negotiated her expectations by remembering trailblazers of color who also had setbacks but took a diff journey

Kim feels her theoretical education in home country did not prepare her for the applied education in US

Luke knows many companies have "diversity quotas" they have to meet. So despite being on probation he is confident that once he improves his GPA he can leverage his racial ID to get a job

Shark as Black man feels pressure to "fake it till you make it"

Utility value

Shark sees his pain now as helping marginalized community members get into CompSci the future. also negotiate

Juniper sees ChemE as a way to give back to her and other minoritized communities via alternative energy

MISC

No discussion w/o prompting: Alex, Jonathan, Jorge, Pico, Shark, Kim

Luke decided to come to The University and major in engineering despite racial unrest bc of the MEP

Table 7 continued

Lack of Belonging

Luke struggles to find belonging within the Asian community

Luke often feels he isn't Black or Asian enough

Shark has always attended PWI so hard to ID with a race he's not exposed much to

NA Gender

Alex, Jonathan, Luke, Pico don't feel their gender has impact

NA Race

Alex, Jonathan, Jorge, Pico do not regularly reflect on race/ethnicity Alex, Jonathan reflect when pointed out

Good Representative

Jonathan feels that racial unrest left him feeling that if he can be a good representative of Black people and Black men it could ease the journey of those coming after him

Gender Norm

Jorge talks about the norms of men being engineers in his home country

Race Belonging

Luke has found a sense of belonging in the Black community

Shark - some people weren't a fan of his long hair as a man

Negotiation Patterns

To answer my first research question, I reviewed each student's participant memo for instances of overlap in students' descriptions of their disciplinary identity and motivations. I prioritized students' explicit mentioning of connections between their disciplinary identity and motivations prompted in the interview. I then reviewed memos seeking answers to whether students' identities influenced their motivation negotiations and vice versa. I organized these answers into a written document. I then read each full transcript to examine additional connections and areas of overlap between disciplinary identity and motivation. This process revealed three patterns of overlap (see Results). Once those patterns were identified I reorganized the document to classify each student into a negotiation pattern and confirmed each student's pattern classification by reviewing their individual transcripts for consistency or misrepresentation.

Patterns Between Genders, Races, and Ethnicities

To answer my second research question, I organized each student's race, ethnicity, and gender experiences from their participant memo into a table outlining commonalities and diversions (see Table 7). Rows organized how these experiences influenced disciplinary identity, disciplinary motivations, and general disciplinary journey. Columns organized commonalities across two or more students and dissimilarities where only one student had that experience. For example, many students reflected on how their race and ethnicity influenced expectancies for success. A unique gender influence on disciplinary identity development was the challenges Kim experienced as a Black, African woman in predominately White teaming experiences. The patterns identified in the matrix were used to further contextualize negotiation results in how students simultaneously negotiated their often-intersecting social identities for race, ethnicity, and gender.

CHAPTER 4: RESULTS

The purpose of this study is to examine students' STEM identity and motivation negotiation for persisting in their discipline after being placed on academic probation. Specifically, I investigated two research questions:

1. How do students change and renegotiate their disciplinary identity, expectancies, attainment values, interest values, utility values, and costs in response to being placed on academic probation?
2. How do students' racialized and gendered experiences inform their identity and motivation negotiation processes while on academic probation?

Descriptives

In this section, I describe the sources of students' disciplinary identities and motivations. I also detail the nature of the changes students reported between their *Start* and *Probation Identities* and *Motivations*.

Sources of Disciplinary Identity and Motivations

As students shared their journeys to science or engineering, many described how they came to identify with and be motivated for their discipline. In the sections below I share each students' sources for their disciplinary identity and motivations.

Alex Palmer, III

Alex had *High Competence* and *High Prior Performance* in school, stating, "I've always been one of those kids who is good at math and science, like in grade school, just in the regular grade school, high school all throughout when I was a kid." Alex also had a *High Interest* in coding, construction, and business, likely attributable to his early engineering exposure taking engineering-related classes in high school and from observing his parents who are both engineers. Alex's journey to and through engineering was supported by the behaviors of his

socializers and by his social capital or networks. Alex's parents are both industrial engineers and played significant roles in his engineering journey. Alex had an early interest in engineering, so during high school, his parents sent him to a summer camp at a university to explore different engineering majors. His parents also knew the value of practical experiences when going on the job market, so they encouraged Alex to get internships starting the summer after his freshman year. Alex gained his first college internship when "I went to a career fair at my community college, not even The University because I knew I had to stand out and I knew a freshman at The University is not standing out against other people from The University." Once he got a recommendation from his first internship director, Alex shared that this set him up to gain additional internships that led to additional practical skillsets. Alex was birthed into a network through his parents' hard work as immigrants to America and integrating into the American engineering culture. Alex also built a network for himself through internships. Both networks played a significant role in his engineering identity and motivation negotiations.

Jonathan

Jonathan had a middle school fascination with Ironman and "all of the cool things that he could do with technology" (*High Interest*). He also performed well in engineering-related subjects (*High Prior Performance*), stating that he "always had a knack for just like math and science." Jonathan felt *High Competence* in engineering, attributable to him being good at math, science, general engineering skills, and putting forth minimal effort. "I already had a knack for making and building things as well." Jonathan had challenges reconciling his socializers' expectations of himself (*Other Recognition*) with the minimal effort he knew he was putting forth (*Self Recognition*), "From the outside people you've gotten external validation saying, 'Oh, you're hard-working. I've seen you do this.' Then you look back on and you're like 'I could be working so much harder and not been realizing it.' It's kind of a hit. It doesn't feel too good." Here, Jonathan reflects on how disappointing it is to not be putting in the effort others expect of and have recognized him for. Nevertheless, Jonathan's early interest in engineering concepts, efficacy for performing engineering skills, and even his ability to meet others' expectations with minimal effort explain his high motivations and identification with engineering.

Jorge

Jorge had early engineering exposure because his father is an engineer and he took engineering-related courses before college. Jorge was good with numbers and programming (*High Prior Performance*) and had multiple socializers communicating to him that he should be an engineer (*Other Recognition*):

My father is an electrical engineer, which he always said, like, "Oh, I want my son to be an engineer," so that forged my path a little, as well... [I knew so early that engineering was for me] mostly because of the messages that my parents said like, "Oh, I want him to be an engineer." Also, my bigger brother was already an engineer. That was a legacy kind of thing.

Reflected in Jorge's response about his father and brother being engineers is an acknowledgment that in his South American home country engineering is dominated by men. He also stated that "It's very hard to find a woman that's an engineer back in my country." Jorge's home culture invited him into engineering and encouraged him to maintain the gender roles of who pursues engineering.

Juniper

Juniper had early engineering identification attributable to taking engineering-related classes in high school, "I was taking engineering classes as a sophomore in high school. And I was like, 'I really like the engineering cycle and how it works [*High Interest*]. And so, I decided that I want to be an engineer.'" Juniper was also connected to a Minority Engineering Program in her home state. She formed a mentoring relationship with one of the assistant directors who encouraged her to apply for scholarships and ensured she achieved her goals. Further, the director of the Minority Engineering Program at The University also invited Juniper into engineering, socializing her into her place in engineering, "[The director] was one of the first people and she was like, 'you know, we only have so many students of this demographic. I want you to be here. And I know you can. We're here for you'" (*Other Recognition*). Juniper had a low ACT score that required her to start in Pre-calculus instead of the suggested start in Calculus I (*Low Prior Performance*). Despite her low performance on the ACT, Juniper found her freshman year courses to be easy (*High Competence*).

Kim

Before entering college, Kim took advantage of opportunities to take engineering-related classes and construct robots via robotics club. She received good grades in school (*Moderate Prior Performance*), was creative, and had family and family friends who were engineers. These early engineering experiences supported Kim's identification with engineering upon starting college. Specifically, Kim was confident in her engineering abilities because she knew she was good at engineering skills, such as the hands-on, building experience she got in engineering classes and robotics club (*High Competence*). However, Kim also knew her performance more generally was average since she used to "scale through" her classes, doing just enough to earn good enough grades (*Moderate Prior Performance*). The engineers in Kim's life recognized her engineering-related skills such as creativity, curiosity, design, and building (*Other Recognition*). Kim's early experience with these skills will have a strong impact on her engineering identity and motivation negotiations.

Luke

Luke had an early *High Interest* in STEM from when he "discovered it in middle school doing things like Lego robotics. I was immediately hooked." Luke had experiences where he and others recognized his abilities (*Self* and *Other Recognition*). For example,

It was kind of a thing that I did passively through high school. And it's one of those things where, you kinda step back eventually and you're like, "Hmm. I seem to be doing this a lot. And I seem to be good at it." It was never something that I've ever said about myself until recent. It was more like people telling me I was good at it and I was like, "Oh, whatever, whatever." But eventually you kind of realize, "Maybe I am good at this thing."... Program mentors in my clubs in high school. And then also my peers, my friends. They were all kinda like, "You have a knack for technology." And I was like, "Okay."

This recognition, along with Luke's good mathematics grades (*High Prior Performance*), led to Luke having *High Competence*.

Pico

Pico had early exposure to coding through a free class he took in high school. His early "passion" for computer engineering was sparked in that class and was furthered as he started

practicing coding on his own, “Most of it was just on my own using programs... Code Academy was one... when I was younger, just to be able to slowly understand what I was doing and see a final product” (*High Interest*). Pico had good performance in science and mathematics in high, suggesting that he felt competent in those subjects. However, when he started at The University, he took some challenging mathematics classes that left him questioning his mathematics ability:

And a lot of times with these University math courses, they would throw a lot of concepts that in the speed that they would go out, that I was like, “Man, I think I suck at math.” I remember math being one of my favorite subjects and I, slowly, started to just get frustrated with it because I can't keep up with this kind of pace that they want me to go at.

Unfortunately, the fast-paced mathematics courses were not the only hurdles Pico had to jump to get into Computer Engineering. Pico also had an unreasonable instructor who refused to accommodate Pico's temporary challenges accessing the required course materials due to COVID-19. Pico also had an instructor and advisor tell him that he should "quit and go to another department" (*Other Recognition*). Pico's decreased mathematics efficacy (*Mixed Competence*), as well as negative comments from socializers in his major, will have important impacts on his computer engineering identity and motivation negotiations.

Shark

When selecting his college major, Shark had various socializers encouraging him to pursue Computer Science (*Other Recognition*): “Feedback that I got from advisors and family, that close circle of people that you turn to for advice. They're like ‘Hey, The University sounds like it will give you a good challenge if that's what you're looking for.’”

Shark had limited early exposure to coding before college working on robot mazes. Although upon starting at The University Shark “knocked electives out of the park,” he had more of a learning curve when it came to Computer Science (*Mixed Performance/Competence*). Shark acknowledges that besides working on robot mazes in high school, “I knew very little coming in... didn't know too too much about how much computers can do. And how much they can aid people in processing and calculating and collecting information and data and creating deliverable results from that.”

Changes in Disciplinary Identity

Upon starting in their majors, students had various *Start Identities* but all expressed having an identity in their discipline. After being placed on probation, three students had *Reconceptualized Probation Identities* stating a need to rethink the meaning of their identity (see Table 8). For example, upon starting in computer science, Shark identified as a connector who approaches challenge. After being placed on probation, Shark maintained that identity but *Reconceptualized* approaching challenge to include making mistakes (see Table 9). One student, Alex Palmer, III had *Reprioritized Identities* by changing which aspect of his disciplinary self he focused on developing, prioritizing his professional engineering identity above his academic engineering identity. Another student, Kim, had a *Changed Identity* and went from viewing herself as an average engineer who enjoys creating when she began in mechanical engineering to a knowledgeable creator who values application and communication after being placed on probation. Lastly, three students had *Unchanged Identities* meaning that who they saw themselves to be in their discipline remained the same on probation as when they started in their major.

Table 8. Frequencies of Disciplinary Identity, Expectancies, and Value Changes

Change	Identity	Expectancy	Values*	Total
Changed	1 (12.5%)	0 (0.0%)	0 (0.0%)	1 (4%)
Increased	0 (0.0%)	2 (25.0%)	0 (0.0%)	2 (8%)
Decreased	0 (0.0%)	4 (50.0%)	1 (12.5%)	5 (21%)
Reprioritized	1 (12.5%)	0 (0.0%)	4 (50.0%)	5 (21%)
Reconceptualized	3 (37.5%)	1 (12.5%)	1 (12.5%)	5 (21%)
Unchanged	3 (37.5%)	1 (12.5%)	2 (25.0%)	6 (25%)

* All students were not prompted for *Start* and *Probation Cost* so cost is not considered when evaluating students' value change.

Note. Column percentages are calculated by dividing the cell count by the total number of students ($n = 8$). Total column percentages are calculated by dividing the cell count by 24 which is the product of multiplying the total number of students ($n = 8$) by the three categories each student could report a change (Identity, Expectancy, Value).

Table 9. Change in Disciplinary Identity, Expectancies, and Values by Student

Pseudonym	Identity Stability	Expectancy Stability	Values Stability*
Alex Palmer, III Latino, Snr, IE	Reprioritized	Increased	Reprioritized
Jorge Latino, Jr, CompE	Unchanged	Decreased	Unchanged
Jonathan Black, Male, Jr, EE	Reconceptualized	Decreased	Reconceptualized
Juniper NatAm, Female, Soph, ChemE	Reconceptualized	Decreased	Unchanged
Kim Black, Female, Soph, ME	Changed	Increased	Reprioritized
Luke Multiple races, Man, Soph, FYE	Unchanged	Decreased	Decreased
Pico Latino, Snr, CompE	Unchanged	Unchanged	Reprioritized
Shark Black, Male, Snr, CompSci	Reconceptualized	Reconceptualized	Reprioritized

* All students were not prompted for *Start* and *Probation Cost* so cost is not considered when evaluating students' value stability.

Changes in Disciplinary Motivations

The majority ($n = 5$) of students had *High Start Expectancies* while others had *Moderate/Mixed Start Expectancies*. After being placed on academic probation, four students' expectancies *Decreased* from *High* to *Moderate/Mixed* or *Low Expectancies*. The other four students' *Probation Expectancies* and associated change varied: one student's *Moderate Start Expectancies* increased to *High Probation Expectancies*, another had *Reconceptualized Probation Expectancies*, another had *Unchanged Moderate Expectancies*, and the last had *Moderate Start Expectancies* that increased but were still *Mixed* with *High* and *Low Expectations*.

All students ($n = 8$) had *High Start Interest* when beginning in their majors. Most students ($n = 6$) had *High Start Utility* and *Attainment Values*, however, one student had *Low*

Start Attainment Value and another student had *Low Start Utility Value*. After being placed on probation, half of the students ($n = 4$) Reprioritized their values by changing which values they deemed to be the most important reason for their valuing their major. For example, upon starting in computer engineering, Pico had *High Interest* and *Attainment Values*. He valued computer engineering most for the *Utility* of using his degree to support his future family and apply his skills to multiple careers. Pico's *High Utility Value* outweighed all of his other values for computer engineering. After probation, however, Pico *Reprioritized* his values to place an equally high emphasis on his passion for computer engineering (*High Interest Value*). Meaning that while Pico's *High Utility Value* was sufficient for Pico to enter computer engineering, facing a setback helped him realize that he also needs *High Interest Value* to support his persistence decisions.

One student (Jonathan) *Reconceptualized* his *High Attainment Value* after being placed on probation (see Table 9). Another student (Luke) expressed *Decreased Interest Value* and was still working to rediscover his joy in engineering at the time of our interview. Lastly, two students had *Unchanged Values* between when they started in their major and when they were placed on probation.

To summarize, students attributed the sources of their disciplinary identity and motivation to early *Recognition* by family members, professionals in their field, and themselves; to *High Competence/Performance* in mathematics, science, and engineering-related courses; and to early *Interest* in science and engineering. Upon beginning in their majors, students' disciplinary identities and motivations varied between students and often resulted in a change after being placed on probation. Academic probation was a destabilizing enough event for all students that they needed to reassess their beginning identities in and/or motivations for their major in order to make persistence decisions. As shown in Table 9 there was no student whose disciplinary identity, expectancies, and values all remained *Unchanged*. In the next section, I draw on students' voiced experiences to elaborate on these disciplinary identity and motivation changes and evidence patterns of negotiation.

Motivation and Identity Negotiations

To answer the first research question, I investigated students' descriptions of how they negotiated their disciplinary motivations and their disciplinary identities from when they started in their

major (*Start Identity* or *Motivation*) to after they were placed on academic probation (*Probation Identity* or *Motivation*). My thematic analysis of these negotiations revealed three patterns: (a) students first negotiated their disciplinary motivations which supported their disciplinary identity negotiation (Motivation → Identity), (b) students first negotiated their disciplinary identity which supported their disciplinary motivation negotiation (Identity → Motivation), and (c) students concurrently negotiated their disciplinary motivations and identities (Motivation × Identity). In the following sections, I describe these patterns exemplified with excerpts from students' interviews. I also describe the stability or change between students' *Start* and *Probation Identities* and *Motivations*. Further, I integrate students' race, ethnicity, and gender experiences in their disciplines into the description of students' identity and motivation negotiations.

Pattern 1 - Identity → Motivation

In this first pattern, four students (Alex, Jorge, Luke, and Pico) described focusing first on their disciplinary identity prior to considering their disciplinary motivations. Some students described how being placed on academic probation triggered a time of uncertainty in their engineering identities (Alex, Pico). Prior to considering their motivations for engineering, these students described a need to reconcile their uncertain identity and recommit to their formerly strong identification with engineering. Others' engineering identities did not change and they shared how they needed to draw on their *Unchanged Identity* to negotiate their engineering motivations (Jorge, Luke). I evidence this pattern with one student from each trend, Alex and Luke.

Alex Palmer, III's Negotiations

Alex's Start Identity

Alex started in his major identifying as a high-performing engineering student (*Start Identity*). This self-concept is based on socialization from his parents and engineering camp experience before entering his major. Additionally, Alex had his engineering skills affirmed after entering his industrial engineering major. Specifically, Alex's internship managers applauded his work and his coworkers recognized his industrial engineering skills:

For every hour I put in my manager liked me more, my coworkers saw I could do better things. The other interns were like, I could go to him for help. I'd get more requests, more project asks, more people wanting to work with me.

Some of Alex's coworkers supported him based on their shared Latinx heritage: "But to the few [Spanish-speaking operators] that saw me as one of their own and really took me under their wing... I feel like it just means more when you're Latino, or a child of immigrants."

Alex also sees making connections as an integral trait of being an engineer. Alex had the opportunity to cultivate this skill during his early internship experiences. Extending what he saw as a traditional connection, Alex was able to be a "bridge" between Spanish-speaking operators and English-speaking bosses: "just being able to be that bridge just kind of reminded me, 'hey, I'm going to be different from these engineers because they can't do this [use Spanish to bridge the communication gap between Spanish-speaking operators and English-speaking bosses].'"

Alex's Probation Identity Negotiation

Alex was placed on probation in his senior year during a time when he was excelling in his internships. To negotiate his identity as an engineer receiving conflicting messages, Alex decided to sacrifice his focus on being a high-performing engineering student to being a high-performing engineering professional, "Probation, I think it might have pushed me more towards the professional side." Below, Alex described a dissonance between what he has been told it takes to be successful and what he did to experience success:

Doing really well professionally... [getting an internship is] just not hard because of the effort I put in away from school. Which is kind of counter what I've been told. You're supposed to study hard and put everything into school. That's how you get the jobs. But now, I've done the opposite, shifted my focus away from that. And that's how I am now comfortable professionally, even though academically, it's a bit on the ropes for sure, but it's not that bad either... Part of me wants to do well academically... definitely a lower GPA closes some doors, but not all. And the ones that I'm knocking on don't really care... Where it was like, "yeah, I failed a class that other people passed. But I also got the job no one else has."

Alex also started to share that sacrificing his academic identity as an engineer was worth it because he has found success with companies that are more interested in his skill sets than his GPA. Alex further reflects on why he made this shift to placing his effort into internships

[The University] gave me a good skill set to have and a good skill set to market myself with plus the word The University. And then from there I really took it myself. And I think that kind of plays into why I've been shifting so much more attention towards just me myself professionally versus academics, because [The University] never really supported me that way [professionally]

Alex describes here that he felt a need to focus on his professional engineering identity development because although The University has supported his academic skill development, he has not felt he was supported in gaining field experience.

Alex had been making time to pursue his identity as an engineering professional since his freshman year. However, being placed on probation in the same senior semester as he secured a prestigious internship was the confirmation he needed to officially shift from focusing on being a high-performing engineering student to being a high-performing engineering professional (*Probation Identity*). Thus, Alex negotiated his conflicting identities by *Reprioritizing* his professional engineering identity (internships) above his academic identity (GPA). With this decision, Alex also enacted his agency by deciding to deviate from the norm of being an engineering student. Alex negotiated the challenge of his conflicting values (The University valuing academics over professional experiences) by shifting from agreeing with the norm to focusing on his own value of developing skills and experiences.

Alex's Start Motivations

When beginning in his major, Alex had *Mixed Start Expectancies*. He states that "I was confident I would pass, like succeed... I can't do great because I'm always going to be on this minimal effort, some type of trade-off. I'm cool with that." While he expected to succeed, success for Alex was passing with minimal effort. Alex also momentarily had lowered expectancies based on some groupings in his first years:

knowing I'm that guy [that was grouped based on speaking Spanish] definitely... put more pressure on. And I think the pressure led to a drop of confidence initially. But as soon as the results started coming in [from my internships], it was like, "OK, we banged it, we did it again. We did really well again."

Despite allowing the pressure of performing well as a Spanish speaker to decrease his expectancies, Alex's confirmation that he was good at engineering from his internships helped him to regain confidence.

Alex had high values, specifically an early *High Start Interest* in coding, construction, and business; *High Utility Value* for engineering enabling him to set a good example of Latinos and for his future children; and *High Attainment Value* for engineering allowing him to attain the role model part of himself that is important to who he sees himself to be.

Alex's Probation Motivation Negotiation

After being placed on probation, Alex had *Increased Probation Expectancies* and became more confident in his ability to succeed. He did not attribute this increase to probation but instead to his success in internships which was co-occurring with his probation. Alex also maintained *High Probation Values* with *Increased Attainment*. Alex's increased motivations were only able to occur once he accepted that he needed to reprioritize his professional engineering identity above his academic identity. His *Reprioritized Probation Identity* allowed him to see how competent he was professionally. Sacrificing his academic focus led him to realize increased expectancies.

Funny enough now... during probation I feel like I could do anything... My resume is like, nice! It's pretty good, I'm pretty proud of it. And it'll definitely do me well for the full time stuff. And even then a resume doesn't just build itself, it's the experiences that I have on there that'll make me good in the workforce. And then at the moment I step off campus, I feel like I'll do really well.

By releasing himself from measuring his identity as an engineering student, Alex reports pride in his professional accomplishments and expects to do better upon graduation than he expected before (*Increased Probation Expectancies*). Alex also spoke of staying in engineering despite probation so that he can set a good example:

I'd like my kids to see me as a very successful engineer... I'm Alex Palmer, the third. So I'd like the fourth to be like, "Wow, this guy's sick!" That motivated me when I saw my dad was the junior and I'm the third... There's no way I was going to be the decline... I want to keep the upwards on the graph of senior junior, three, four. There's no way it's going to go like that (gestures dip/decrease on three). So they can't be dissin my family name either so... [The reason I stayed in engineering was] Probably be the example side of things, for sure. Because in terms of finding the solutions, I don't necessarily have to be an industrial or an engineer to provide solutions for a company, right? I could just go into business and be a business guy and do business things. But in terms of the example, I guess I want to set the image I want to portray and the type of work I want to do as well. That's the part that's unique to engineering and that's why I've kept doing it.

Alex spoke here about wanting to continue the family habit of being engineers. Thus, remaining in engineering and being a successful engineer allows him to attain his value of being a good example to his future kids for pursuing engineering like his parents were to him (*High Probation Attainment Value*). Further, being a competent engineer allows Alex to fulfill his identity of being “that guy” who represents his community well (*Increased Probation Attainment Value*). Alex views his community as inclusive of his immigrant and Spanish-speaking “gang [family],” his parents, and his family in his home country.

Alex exemplifies the Identity → Motivation trend. Alex first needed to reprioritize his professional engineering identity above his academic engineering identity to realize his increased expectancies and attainment values.

Luke’s Negotiations

Luke’s Start Identity

Luke’s identification with engineering was rooted in his early engineering experiences in Lego robotics and socializers praising his “knack for technology.” After starting in engineering, Luke found that “I was really good at solving these kinds of technology-related problems... I’m not so great at the technical things. Like designing and building. I have some skills in those areas.” Although he did not have high enough grades from high school to get into Calculus II, Luke did very well in his first semester at The University. Further, Luke reflected on how his multiple racial and ethnic identities left him feeling he is not Black or Asian enough. Similar to his tendency to overcompensate to be “enough” for his race and ethnic identities, Luke also feels a need to overcompensate in STEM classes, “I try and do everything. In projects, I try to do design, but also be the one who tried to do the marketing, the outreach, and the fundraiser, but also wanna be the one building the stuff.”

Overall, Luke had mixed identity sources. However, the recognition received from himself and others supported his *Start Identity* as an engineer who is good at problem-solving and connecting people with technology, “I was really good at solving these kinds of technology-related problems... the strongest of my skills kinda revolve around how technology kinda interacts with people, how people interact with technology, and how we can make that process better.”

Luke's Probation Identity

After being placed on probation in the spring semester of his freshman year, Luke had an *Unchanged Probation Identity* as an engineer who is good at problem-solving and connecting people with technology. He was able to maintain this identity based on:

Just pure hardheadedness to be honest. It was just one of those things where it's like, "No, I refuse to switch. I know this is what I'm good at. I know this is what I wanna do. I'm not switching into anything else. So how am I gonna figure out how to stay in this and make this a success?"

Since probation did not trigger a time of questioning for Luke's identity he did not engage in any identity negotiation processes. Luke does, however, struggle with finding a place of belonging as a racial minority (Black) both in the nation and in his engineering classes. Although he tries finding community in the Black community and the Minority Engineering Program, Luke wishes it was in his "very White" classes and "White domineering field." Luke sought similar community among Asian students, but since he physically presents as Black more than Asian he often felt treated as not being Asian enough.

Luke's Start Motivations

Luke started at The University feeling "super confident" that he would succeed in engineering (*High Start Expectancies*). He had *High Start Attainment Value*, valuing engineering because "it's just part of who I am. I enjoy doing things that express me." Luke also expressed *High Start Interest Value* because "In middle school doing things like Lego robotics. I was immediately hooked." Luke, however, had *Low Start Utility Value*. He felt that the pay or skills he could gain in engineering were more consequential than a motivational value. Additionally, Luke did not feel that engineering coursework allows him to solve important problems or make a meaningful contribution. Luke also saw the general social *Start Costs* that come with any major "Sacrifices in terms of social life that have to take place. But I feel like that's common in every major. School's first... I've yet to come across anything in engineering specifically that isn't present in just about every other major."

Luke's Probation Motivation Negotiation

Being placed on probation resulted in *Decreased Probation Expectancies* for Luke.

Although he “fully anticipate being back on track,” Luke admits that

[Probation] lowered it [my confidence] a bit. I think it's one of those things where you give everybody else advice but you won't take your own advice... I certainly have the skills and ability to solve my own problems and to figure out what was wrong and course correct. I just didn't for whatever the reason may have been.

Luke's response about not solving his own problems and avoiding probation suggests that he felt unsure if he would be able to do the things he knows he needs to do in the future to solve his problems. Unlike other students whose expectations were impacted by being on probation, Luke's decreased expectancies were not attributable to a knowledge gap or challenging course content,

In the spring semester, I was cutting just about every day. And it could be any time of the day. I mean, I was doing it so frequently that I was spending more time cutting and cleaning the cuts. Making sure I don't get infections or anything. I was spending more time doing that than I was doing my work. And so eventually I just got to the point where I couldn't play catch up anymore and my grades started to take the hit... I didn't do well in spring, not because I was doing poorly in the classes, but cause I wasn't doing the class. I wasn't doing my homework. I wasn't doing quizzes that I should have been doing. And so all of those zeros, 10%, 15%, 20%. You can't pass with that.

Luke further shares that,

It was kinda the first time where it was like the consequences of my mental state had kinda been so clear in front of me... And so I cried about it and then I was like, "Alright. What am I gonna do to make sure this never happens again?" So I went and sought out professional help. And I got it. So I think now I kinda learned more effective coping strategies other than just playing video games. But it's still kinda a work-in-progress thing.

When Luke reflects on whether he can follow his own advice, he is not necessarily concerned about academic advice since his underperformance was not based on a lack of understanding. Further, Luke knows many companies have "diversity quotas" they have to meet. So despite being on probation he is confident that once he improves his GPA he can leverage his racial identity to get a job. Instead, his concerns are related to whether he can maintain the changes he has made to improve his mental health.

In addition to his *Decreased Expectancies*, Luke also lost his joy in engineering (*Decreased Probation Interest Value*).

It was kinda not fun figuring out how to keep going in engineering once I realized the obstacles that I put in place for myself. But like I said, it wasn't really a difficulty thing with the class or anything. So once I figured out and kinda mapped out a way that I could stay in engineering and succeed, I wasn't really worried about it... that kinda allowed me refocus and rediscover my ability to find joy

Luke's "mapping out a way I could stay in engineering and succeed" involved him reconsidering his engineering discipline,

Being on probation is what kind of led my investigation into switching from aerospace to industrial. And it started from a place of "I don't know if I'm gonna have a high enough GPA to get into aerospace." And then that transformed into the sort of insecurity of "Am I a good enough student to be in aerospace?" And then I spent more time thinking about it. And the more time I spent, the more rational it became. Because something I was doing out of anxiety and insecurity, it turned out to be something that I feel like is gonna end up changing my course for the better. Because as I was doing the research, I realized I was reading typical "Things in the lives" and what they do. And industrial engineering just happened to be something that I happened to look at and also coincides with my skillset. So it was something that kind of worked out in that way.

Although Luke had an *Unchanged Probation Identity*, he did decide to change engineering disciplines. Part of "figuring out how to stay in this and make this a success" meant changing the discipline Luke intended to pursue. His *Unchanged Probation Identity* proved to be advantageous for Luke maintaining sufficient expectations for success and allowed him to "refocus and rediscover my ability to find joy." Note Luke was still working to "rediscover" his joy and reconcile his *Decreased Probation Interest Value* at the time of the interview.

Although he specified that he does not see them as full losses, he reflects on *Probation Costs* that he did not identify pre-probation, "I never really had any intentions of switching out or anything. So I've lost some opportunities, but I don't really see them as sacrifices... I'm just glad that it only happened in my second semester, my freshman year." Luke further specifies the opportunities he lost,

One of the base requirements for eligibility [for internships and co-op opportunities] that they list is a GPA requirement. And so my overall right now is a 2.5. And from what I've seen so far, you gotta have at least a 3 to be generally considered for most roles.

Luke classifies his *Probation Costs* as “A necessary step in my personal development” and as “Issues that would've come up at some point eventually.” His reflections collectively suggest that he views these costs as worth his reconciled identity, increased interest, and mental health. The costs associated with his underperformance and being placed on academic probation were “necessary” for him to develop into the engineer he wished to become.

Pattern 2 - Motivation → Identity

In this second pattern, two students (Kim and Jonathan) described focusing first on their disciplinary motivations prior to considering their disciplinary identity. For Kim and Jonathan, their engineering identities took such a hit that they first needed to decide whether they still expected to be successful in and found value for engineering before they could repair their identities as engineers.

Kim's Negotiations

Kim's Start Motivations

Kim entered engineering with *Moderate Start Expectancies* because she had “scaled through” her classes before and expected to continue putting in sufficient effort to pass her engineering classes. Kim's top values for engineering when she began in her major were her *High Start Utility* and *High Start Attainment Values*. She valued the utility of using engineering to solve important problems.

With mechanical engineering, you can move into other places. So I decided to choose that in case Aero is not the one I choose later in future, I can still work as a mechanical engineer... Every time I thought of using my degree, it was always like to solve an issue when I was thinking of doing EE or social stuff like the power issue.

Kim's *High Start Utility Value* also described her *High Start Attainment Value* as she viewed engineering as a career that will allow her to fulfill an important part of who she saw herself to be, a problem solver who gives back to her home community. For example, Kim shared:

Potentially having our own Space Station or creating more jobs for people, because I didn't think there's essentially like an Aeronautics Department in [my home country] like there is here. So creating a broader road for people because not everybody wants to do ME. But they do ME because it's closest to what they

can do [in my home country]. So, I feel like me getting a degree is not just for me. It's for other people, too. I don't want to just stay in the U.S. with my degree. I want to be able to go home and work with some things there. And not necessarily just planes but maybe cars or just create more job opportunities too. But I also feel being an engineer is a huge part of the identity I see for myself.

As a Black, African woman, Kim also valued engineering for enabling her to be a role model for other Black women interested in becoming an engineer (*High Start Attainment Value*).

Since [the representation of Black women in engineering is] so small I'll more likely stand out... and then it'd be good if I have a lot of achievement in this. Because not a lot of people like me in this field. And then my younger sister too wants to do STEM. So I would like to be a role model to show her that it's possible, more likely than it's hard

Although not primary, she was also more interested in mechanical engineering (ME) than any other engineering discipline, "I didn't want to choose another course [besides ME], because nothing else spoke to me" (i.e., intrinsic value).

Kim's Probation Motivations Negotiation

After being placed on probation, Kim was uncertain whether she should stay in ME or engineering altogether. Coming into The University, Kim was open to the possibility of switching majors if she did not like ME. Since she had previously given herself permission to change majors, Kim started the detailed process of changing her major. She explored other programs and eventually settled on Mechanical Engineering Technology (MET). Kim met with her current ME advisor, an advisor in MET, and her mother to discuss what is needed to transfer into MET. When the time came to complete the documentation to change majors, however, Kim was unable to go through with it. Although Kim was interested in engineering before, her exploration of other majors and finding nothing she is more passionate about left Kim with an elevated value of the interest she has in mechanical engineering. This says a lot since Kim's alternative, Mechanical Engineering Technology, was very closely related to mechanical engineering.

I was imaging myself leaving ME... I was like, "Oh, I'm going to change. I'm going to change" Then at the last minute, I couldn't change. I feel this is actually what I want to do. Now, I feel like I'm more determined to finish this now than before.

Going through her potential major change left Kim with more certain motivations. Specifically, Kim expressed continued *High Probation Expectancies* after being on probation, though she needs to put in more effort. Kim is confident that she can do better than she hoped in engineering. Although there was a time when Kim questioned her interests, ultimately, she maintained *High Probation Interest Value* in mechanical engineering. Kim also became more certain that engineering was useful and that she would be able to use engineering in her future career (*Increased Probation Utility Value*). Kim felt more certain that ME was the career she needed to pursue in order to attain what she values most (solving problems, giving back to her home country, becoming an engineer; *Increased Probation Attainment Value*). After exploring other majors and failing to find something she was equally passionate about, the value Kim placed on being interested in ME increased. Her actual interest remained stably high but the value she placed on how passionate she was about ME increased. Moreover, Kim's interest in hands-on engineering motivates her in a project-based course she was taking. Further, Kim's interest in advocating for mental health awareness in her home country motivated her for her psychology course. Kim also has a more realistic view of the time and effort required to be an engineer. Related to *Probation Cost*, Kim felt she had to sacrifice her enjoyment of and aim for understanding in classes. Instead, her focus is on avoiding failure.

Kim's Start Identity

Kim had early engineering experiences that supported her identification with engineering through courses, robotics club, and other opportunities to tinker and create things, such as through sewing and 3D printing. Kim also mentioned how she usually just “scaled” through her academics, doing enough to get good, but not amazing, grades. Upon starting her major, Kim identified as an average mechanical engineer who enjoys creating (*Start Identity*).

Kim's Probation Identity Negotiation

After Kim was placed on probation, she explored alternative majors. Kim's major exploration helped her to, first, negotiate her motivations for ME. Kim maintained her *High Probation Expectancies*, maintained her *High Probation Interest*, *Increased her Probation Utility Value*, and *Increased her Probation Attainment Value*. Once she negotiated these motivations,

Kim realized there was not an alternative major to pursue that would fulfill her identity. Thus, Kim felt more certain that engineering, specifically ME, was the career she needed to pursue. Ultimately, Kim decided to continue in ME despite being on probation. Kim Changed her identity from an average engineer who enjoys creating to a mechanical engineer who is knowledgeable, disciplined, and a creator who values good communication and application. Thus, Kim is a case example of the Motivation → ID negotiation pattern. Kim first had to negotiate her mechanical engineering motivations to reinforce her commitment to and identification with mechanical engineering.

Jonathan's Negotiations

Jonathan's Start Motivations

Jonathan entered electrical engineering with *High Start Expectancies*, rating his confidence as an “8 outta 10.” He also had *High Start Interest*, “I’m just a tad more interested in cool, electronic things than I am in helping people with their issues” and *High Start Utility Value*, “my biggest goal when I was deciding my major, I was like, I wanted to find a way to help people.” Jonathan’s highest value was his *High Start Attainment Value*, valuing engineering for helping him fulfill an important part of who he saw himself to be.

Jonathan's Probation Motivations Negotiation

After being placed on probation in the fall semester of his junior year, Jonathan’s motivations took a hit. Specifically, Jonathan’s expectations were vulnerable as he reflects on here, “At the time I was definitely questioning whether or not I was cut out for it [engineering].” Jonathan negotiated his wavering expectations by increasing his effort:

I just had to adjust expectations a little bit. Because I guess it hadn't really sunk in that this is one of the best engineering schools in the nation. And I subconsciously expected it to just be a walk in the park for me. Like everything else has been up until this point academically... I haven't had anything challenging up until this point. For the most part... this is the first time I felt like, "Oh, I have to put in actual effort." Not the effort that makes it look like I am doing well. But the effort that makes it so that I actually stand past a fundamental level. Or first level of understanding, but truly understanding what I'm working with.

Jonathan reflected on his starting expectations that majoring in electrical engineering would “just be a walk in the park.” However, after being at The University for two years, Jonathan realized that he was putting forth the same, minimal effort from high school at “one of the best engineering schools in the nation.” Jonathan had to first *Reconceptualize* his *Probation Expectancies* by accepting that he cannot continue to put forth minimal effort and expect high results. Although this negotiation left Jonathan “pretty confident that I can do it. But now I know there is a possibility I could fail and that's kind of scary.”

Jonathan had *Reconceptualized Probation Attainment Value*: “When I was placed on probation it [attainment value] did shift a little bit. Because I wasn't getting the dopamine and the chemical that makes me feel satisfied with myself solely through my academic work. Because I wasn't performing as well as I was accustomed to.” Here, Jonathan reflects on how his underperformance hindered him from seeing electrical engineering as helping fulfill an important part of himself, the part of himself that is a confident and competent engineer. However, by acknowledging his prior minimal effort approach to coursework, Jonathan shares that “[Being on probation] made me explore new things to make me feel competent. But my main desire to be competent in my career of choice is still very much there. Just widened my horizons a bit.” Jonathan reconceptualized his attainment values from putting forth minimal effort to attain his identity as someone who looks like a confident and competent engineer to focusing on deep understanding to evidence his attainment of being a confident and competent engineer. Shifting his attainment “horizon” from minimal to deep understanding as evidence of being a competent engineer allowed Jonathan to maintain his *High Probation Attainment Value* of electrical engineering. Moreover, Jonathan’s *Unchanged Interest Value* also helped him maintain his desire to pursue electrical engineering.

Jonathan’s Start Identity

Jonathan’s identification with engineering was supported by his early engineering exposure and prior engineering engagement. Upon starting in electrical engineering, Jonathan’s *Start Identity* was an engineer who wants to help people. He reflects on this early identity, “When I was a small child, I always wanted to help people. Like all the heroes you saw on TV or like the Power Rangers or whatever was cool at the time... electrical engineering is... the way

with which I can best use my abilities to help people.” Further, Jonathan identified as an engineer who put forth minimal effort, as described above (see Jonathan’s motivation sections above).

Jonathan’s Probation Identity Negotiation

After being placed on probation, Jonathan started to question whether he was cut out for engineering, “At the time [of being placed on probation] That kind of hurt my sense of belonging. I was like, ‘Is this really what I wanted to do?’” Jonathan was able to reconcile his doubts to continue identifying as an engineer who wants to help people but acknowledges that he could be putting forth more effort. Thus, Jonathan Reconceptualized who he was as an engineer by shifting from viewing himself as an engineer who puts forth minimal effort to an engineer who aims for deep understanding (*Reconceptualized Probation Identity*). After recognizing that putting in more effort than he previously had would increase his expectations of success (negotiated his expectancies), improving his academic performance and maintaining his high engineering identity did not seem like an impossible task, “[Probation] made me realize I have to put in more work. Not really work. It's just, I haven't been putting my best self forward.” Jonathan’s negotiation of his expectations for success in engineering supporting his reconceptualized engineering identity is another example of the Motivation → Identity negotiation process.

Pattern 3: Identity x Motivation

In this final pattern, two students (Shark and Juniper) described concurrently negotiating their disciplinary identity and disciplinary motivations. Unlike the prior patterns, it was difficult to separate which negotiation process came first. Instead, Shark and Juniper describe times when they used similar processes to negotiate both their disciplinary identity and motivations at the same time.

Juniper’s Negotiations

When beginning in chemical engineering, Juniper’s *Start Identity* was an engineer who was passionate about using engineering to help others. Her good performance in her “easy” freshman courses influenced her *High Start Expectancies*, “my opinion was that it'd be easy for

me since freshman year was a lot easier for me.” Moreover, Juniper’s confidence came from her high self-efficacy to figure things out,

Freshman year, I had [an] air of, I don't know, like confidence to me. And I was like, "yeah, I know what I'm doing or I don't know what I'm doing, but I'm going to try and learn how to do it!" Or I was very forward and be like, “you know, I'm really trying here.” I'm a part of the team and so I'm going to contribute as much as I can. I know my skill level.

Juniper’s response speaks to her confidence in her ability to figure out things she did not know. However, her statements also suggest a pressure to prove that she’s “really trying” and “part of the team.” Juniper ties this pressure to the challenge of “not having someone who looks like me and someone who can understand the stress I have for wanting to do well in classes.”

Nevertheless, Juniper remains confident that she can prove that she knows what she’s doing and will learn what she does not know.

Juniper had *High Start Values* upon beginning in her major. Her ultimate value was her *High Start Utility Value* “to develop the skills to solve the problems that I want to solve.” Juniper also noted wanting to afford her desired lifestyle but that was an aside to her “main thing” of solving problems that are personally meaningful to her. Related to her utility values, Juniper had a *High Start Attainment Value* rooted in her integrated valuing of engineering for helping her become who she sees herself to be: a skillful problem solver. Specifically, Juniper desires to use her chemical engineering skills to solve problems facing marginalized communities,

I chose chemical because I am also very interested in alternative energy because I also understand that climate change affects a lot of minorities, a lot more in terms of temperature changing and the sea levels rising. So I figure that's also a really important topic right now and I think it needs to be addressed.

Juniper acknowledged that she could attain these goals in another major but “being an engineer is a big part of me because I've obviously centered a lot of my life around it.”

Juniper’s Identity and Motivation Negotiations

Probation sparked some time of Juniper questioning her place in engineering. “[Being on probation] made me question myself. It's like, "well, how badly do you want to be an engineer?"” Although Juniper’s identity of being a problem solver did not change, she did *Reconceptualize* what it means to solve problems: “I still think it's about solving problems. Just that sometimes the problems are pretty hard to solve! It takes more than a semester to understand what's going

on.” Juniper accepted that it takes her much longer to understand than her peers, this more accurate view of her competence allows her to continue identifying with engineering. Juniper’s *Reconceptualized Probation Identity* is also related to her *Decreased Probation Expectancies*. Juniper still expects to do well in engineering but knows it may take longer than she originally thought,

Oh, yeah! [Being on probation] definitely makes me question whether or not I am cut out for engineering... I think it also stresses me out a lot because I don't want to continue this path. But it's like if it's happened two semesters already, it kind of makes you stressed out that it'll continue to happen... This semester I have less confidence because I'm not doing well. I don't really know what's going on sometimes in classes. But I still think I'm almost the same person. I'm just a little well knocked down because I didn't do too well. But I'm still trying to bring in that mentality back because confidence is key.

At the time of the interview, Juniper was still in the process of negotiating her expectancies. However, drawing on her early interest in the engineering design cycle, she approached being on probation as a problem to solve and a challenge that needs revision:

I approach this problem of passing my classes and managing online classes. I've had time to think about it [as] always problem-solving. I was like, "OK, well, I know what I did wrong, so I know what I can try to avoid. And also I know what is available to me... Last semester I made a whole list of what went wrong and what I think was bad. And I actually went through to find solutions for each one of those things.

Although Juniper remained nervous about whether she would continue to be on probation, she was able to use the engineering design cycle to develop a more accurate engineering identity based on effort and improvement, as opposed to basing her identity on how easy the class was for her and her *High Start Expectancies*.

It's just another problem I have to solve. It might take a little bit longer for me to understand what exactly I'm doing wrong. But I know that I'm always going to try to do better. I'm always going to try to see what I can improve or what I'm missing.

Thus, Juniper *Reconceptualized* her chemical engineering identity to still be an engineer who uses engineering to help others while extending it to include being an engineer who puts in effort and focuses on improvement.

Juniper’s motivation negotiation was intertwined with the negotiations she engaged in to reconceptualize her chemical engineering identity (Identity x Motivation pattern). For example,

by reflecting on engineers of color who succeeded after failure, approaching probation as a problem to solve, remembering that she has had different preparations than her peers, remembering her persisting *High Interest*, and accepting that understanding takes her longer, Juniper continued to identify with engineering and she regained her confidence.

Shark's Negotiations

Upon starting in computer science, Shark identified as a connector who approaches challenge (*Start Identity*). He selected computer science thinking “‘Ooh, that sounds hard, do it! Let's go!’ Because I just was always looking for like the next challenge.” His approach to challenge was supported when he “knocked electives out of the park.” However, Shark acknowledged that computer science did not come naturally to him,

It's never been something that was super innate to me. I always feel like I'm trying to learn something or that my peers have some insights that I don't have or something. But yeah, it's been a lot of trial and error.”

The feeling that his peers had additional “insights” also related to Shark’s low perceived competence as he often did not know what was going on in his computer science classes “Not knowing what was going on in a course... statistically speaking is probably untrue, but the feeling in the moment was like, ‘I am the only one that doesn't know what's going on! Like everyone else gets it!’” Shark’s low perceived competence and comparisons to his peers may also be related to a sense of imposter syndrome due to being one of few Black, male computer scientists and also his challenges in understanding coursework.

Then I would ask a TA, I was just like, "Hey, can you like, can you help me try to figure this out? "And maybe it was like, what you're saying with the imposter syndrome? Maybe it was a mix between that. Like they could help me, but because I had something in my head, it just felt like what they were saying was combative. And I have no way to verify that, but it just felt to me. I was just like, oh, you know, like, "Never mind, you know, I get it. It's fine. It's fine. I get it. I, I, I know what's going." And, do it enough times and people are not gonna help anymore... So I've always felt like I've had to at least project it [confidence]. Even if I didn't have it.

Shark’s description here speaks to the pressures he felt to project confidence in an attempt to not be the Black male who is “the only one that doesn’t know what’s going on!”

Shark internalized his need to project confidence which was reflected in his *High Start Expectancy*,

I was so confident that every answer that I put on the paper- I'd walking into- <deep sigh> I was way too confident before... Before I would look at the question, not really know what it's asking and be like, "But this answer's still right"... before I was just kinda putting down answers, like, "Yeah, this is gold!"

Shark's high confidence was related to his *High Start Interest*. Shark valued challenging things and was interested in approaching challenge, "[I chose computer science because I found it] Interesting. But maybe not enjoyable... Uh, [my reason] for choosing it? I would say interesting. It looked like the best challenge." He also was drawn to science based on his family's fascination with the subject and liked how computer science involved a lot of simple connections.

Characters in TV shows that have really dope [cool] powers. They're often really simple. It's just like, "Oh yeah, my power is like magnets, like Magneto. My power is magnetism." But he can use that to fly. He can use that to move buildings. He can use that to do this, that, and the other. Magnetism is a fundamental aspect of reality, but because it's so fundamental, it's everywhere and it can be applied in a bunch of different ways. So, I wanted to find something that I enjoyed doing that I could see appear in a bunch of different places and connecting things happens all the time... And I just like how simple it is.

Although Shark's valuing of engineering for his interest in making connections sounds integral to his computer science identity of being a connector, Shark clarifies that he did not immediately see the attainment value in making connections. "it wasn't always like that.... There was a transition to make that the case, but that wasn't always the case" (*Low Start Attainment Value*).

Shark's other values were more explicit perceptions. Shark attributed his *High Start Utility Value* to a wanting to "be better tomorrow than I am today" sort of thing. This University's computer science was the most difficult competitive program that I was accepted into." He also shared that "Oh yeah. [The pay and skills] are both attractive" and that he "100% I definitely want to help solve some of the problems of the world."

Shark also discussed the *High Start Cost* he experienced by majoring in computer science. In addition to the cost of "My mental health," Shark reflected on how uncomfortable majoring in computer science was for him,

I was trying everything that I could to not do computer science because just sitting at the computer just made me feel dumber than how I perceived myself. I like to think that I'm a smart guy. Or at least relatively intelligent. And so whenever I sat at the computer and it was something that was not in my wheelhouse... There's that dissonance. Like the way you perceive yourself and the way reality is. It made me uncomfy.

Shark's feeling of being "uncomfy" extended to the cost of comparing his understanding to others'

I ran into that feeling of looking around and feeling like everyone else got it, I was just like, "Okay, I guess I'm just gonna have to figure it out." And it just got super frustrating after a while. So I was just like, "You know what, I'm better at other things." So I diverted to other things.

Shark's Identity and Motivation Negotiations

Shark was placed on probation multiple times but chose to focus on his two most recent experiences since that was the time he made the most changes. Shark concurrently negotiated his computer science identity and motivations. He had a *Start Identity* of being a connector and entered computer science not fully knowing all the field had to offer. Shark put off feeling "uncomfy" in computer science classes to pursue minors and extracurriculars that allowed him to feel and demonstrate his competencies. When COVID hit in 2020 and Shark was placed on probation in Fall 2020 he had to make some decisions

I have to do this computer science thing if I wanna graduate - that's [2020] when it, when it started. Like I finished all my other, I think I finished my last management minor course the summer of 2020. So like right after the pandemic started. So after that was just all CS (computer science)... So I could do nothing or I can put in the effort to try to get over this hurdle. And that is what 2020 kind of left me with. There was no going anywhere. There was no extracurriculars to turn to to sort of deal. Because all the events that I was planning with those other organizations, they all stopped completely... So all of the escapes were gone. Computer science was all that was left. And so I had to find some way to get through it.

Shark found multiple ways to "get through it." One was to adjust his approach to academics by focusing on increasing his effort,

Shifted [my mindset] to one that says, "I am just going to get all of the points. Any point that exists is one that I want." Instead of trying to find like, "Oh, what is the minimum threshold that I need to get to pass?" I'm just trying to get all of them. And that mindset has made it a lot easier. Instead of turning in things the night of, or like a hour before, or the minute it is due I'm turning them in like a day early or something... it's been trusting the process and trying to do it every day. Going into bright space. Checking my classes. Checking lecture notes. Talking to classmates. And just trying to put in the due diligence and going for those uncomfortable situations.

Increasing his effort and “going for those uncomfortable situations” allowed Shark to *Reconceptualize* his identity and expectancies. For example, Shark started spending extensive time on his computer science coursework, “For three, four or five hours. I'm building a website, I'm debugging a program, I'm learning how to use a new software. And that is just sitting down in one spot and just trying to understand and problem solve.” This allowed him to learn about the opportunities in the field to be a connector. Shark's *Reconceptualized Probation Identity* now is described as a computer scientist who is a connector in “anything.” Relatedly, Shark's *Reconceptualized Probation Expectancies* are based on knowledge,

My confidence in my abilities sits on some sort of foundation of knowledge... now I can look at it and actually understand what the question's asking. And have at least a little bit more certainty that what I'm putting on the paper is correct... I can at least ask questions for why or... make a point to what I was thinking or trying to convey on the paper that might have been missed... So I can actually hold a conversation when I think I got the right answer, but the grade I'm getting says that I'm like way off base or something

In combination with his increased effort, Shark started listening to science podcasts during the COVID lockdown. By taking time to engage with computer science, Shark sees how he can use technology to help solve problems facing society.

I listened to a lot of podcasts about scientists just talking about science stuff... Listening to those conversations were so motivating. And that was something that I found during 2020... found a lot of podcasts that kind of pointed to that, “Hey, when you're doing science and you're working in technology, you're helping mold humanities possible futures”

Listening to podcasts supported Shark's computer science motivations, specifically resulting in *Increased Probation Utility Values*. “why I stayed in [computer science] was for the problem-solving. I wanted to solve important problem and see technology move in a beneficial way for people, for society.”

Shark's *Increased Probation Utility Value* also helped result in his *Increased Probation Attainment Values* and his *Reconceptualized Probation Identity*. Shark shared that “[In 2020] I had to kinda fuse [computer science filling an important part of who I am] in there.” However, it was unclear whether Shark reconciled this Attainment Value or his Identity first:

I kind of wanna say, “Chicken or egg?” Because I'm not particularly sure. Actually I wanna say I saw myself as the connector - you know what, I'm gonna go with chicken or egg because there are just so many thoughts going around during 2020 when I was just trying to figure stuff out that I'm not really sure

which one came in first. But they both came in and they're just like, "Yo!" "Yo!" And they dabbed each other up. And they're just like, "This seems like a partnership that can work: connecting." And I just rolled with it. Feels good. Feels great.

Here, Shark reflected on being unsure whether he negotiated his values or identity first, suggesting this negotiation happened concurrently. Shark concurrently recognizing that he can be a connector in computer science (computer science identity) and that he valued computer science for allowing him to fill his personal identity of being a connector (attainment value) is an exemplar of the Identity x Motivation theme for negotiation.

While Shark was going through some very adaptive identity and motivation negotiations, he did mention some *Increased Probation Costs*. For example, Shark shared about some missed opportunities by deciding to remain in computer science each time he was placed on probation:

I had some friends, like my freshman, sophomore year come up to me and be like, "Man, you would knock it out of the ballpark in HTM [Hospitality and Tourism Management], man. Like you should do this. You'd be making salaries comparable to what you'd be making in CS. And you'd be able to socialize and do this, that, and the other. Travel da da da." Made it sound very attractive. And I feel like I might have missed some connections. One of the drawbacks would be missing the opportunities that I could have had from deciding to stay with this path.

Shark also shared that "I've been in Spain, without the s." As one of few Black men in computer science, Shark felt that these costs are amplified

I don't really have many people to turn to if I'm having a lot of issues. Other people, they come in with people from their culture, like they see people that they can look at and relate with... They have something that they can connect with and come closer on. They know that they can have a connection just by looking at each other. And I don't share that same benefit with a lot of people in class, which makes it often more isolated. So any of the drawbacks kind of get amplified because I'm also doing it in a vacuum by myself.

Despite this cost and the "Spain without the s" of being a Black man in computer science, Shark does not view this cost as outweighing the benefit of helping others in the future:

Oh, I definitely think they're worth the mission. I want to... Hmm. You know, I said that with maybe a little too much confidence. I do think it will benefit the mission, but I don't have a clear enough vision of what it is yet. Something I believe in is that life just goes like this. It's gonna fluctuate. It's gonna fluctuate. So if you hit a low, you know, that might just be that pulling the rubber band back so you can reach a new high. So I'll take it for now because... it just feels like an indicator of that Slingshot effect that's gonna go high again. So it's totally fine. It's

whatever. I'll take what I need to if that means other people get to come down this path with far less complications. If people don't have to experience what I've experienced doing this, that means that's good.

Despite feeling uncomfortable in computer science during his first years, Shark is now in a place where he identifies with and values computer science. Specifically, Shark's *Reconceptualized Probation Identity* is as a computer scientist who uses his skills and technology to make connections and improve society. He values computer science for the contributions he can make to humanity (*Probation Utility Value*), his interest in the application of computer science (*Probation Interest Value*), and how computer science allows him to fulfill important parts of himself like being a connector (*Probation Attainment Value*). Shark's pain (*Probation Cost*), thus, is "worth the mission" so long as he is able to ease the road for Black scientists coming after him.

Motivation and Identity Results Summary

Academic probation triggered changes in students' disciplinary identities and/or motivations. Students' identity changes were reflected as having the same identity *Reconceptualized*, the same identities but *Reprioritized*, or a completely *Changed* identity. Students' expectancies were either *Increased*, *Decreased*, or *Reconceptualized*. Finally, students' values were either *Decreased*, *Reprioritized*, or *Reconceptualized*. There were a number of students whose identity, expectancies, or values were unchanged but all students experienced some form of change in at least one of these variables. Regardless of the pattern, students reported needing to go through some internal processes in order to reconcile their vulnerable disciplinary identities and/or motivations.

Vulnerability

Students reflected on how impactful it was to receive an official letter from the university that their academic performance did not meet university expectations. A common trend emerged when analyzing students' science and engineering identity and motivation negotiations. Many students reported their probationary status evoked an intermediate stage of questioning their motivations or identities, triggered by a state of vulnerability. First, I exemplify *Vulnerable*

motivations and identities, then I contrast these with students who had *Invulnerable* identities and motivations.

Vulnerable Negotiations

Vulnerability is conceptualized as an intermediate stage where students questioned or doubted their disciplinary identities or motivations. For some students, having *Vulnerable* identities and motivations did not result in a change. For example, after being placed on probation, Pico temporarily questioned whether he “sucks at” and is going to hate computer engineering like he learned to hate mathematics (*Vulnerable Probation Identity*).

First time [I took this C programming course] it kicked my ass! Dramatically kicked my ass and I thought, "Do I- Am I just going to hate it in the same way that I hate mathematics kind of now?" Because I can't keep up with this kind of pace that they're doing and I have almost no idea what the professor's talking about sometimes.

C programming is an integral skill set to computer engineering that Pico previously enjoyed. The sudden possibility of hating coding left Pico in a space of doubting what he formerly knew to be true of himself: he is an engineer who is good at and enjoys coding. However, Pico sought opportunities to increase his competence and maintain his interest in coding and computer engineering. Thus, although Pico had a period of doubting whether he was cut out for computer engineering (*Vulnerable Probation Identity*), he was able to negotiate his *competence* and interest to continue identifying with computer engineering.

Similarly, Shark experienced a period of *Vulnerable Probation Interest* and *Vulnerable Probation Identity*. After being placed on probation for his performance in the University's challenging computer science courses, Shark questioned his interest in approaching challenge and his decision to major in computer science. “Uh, for choosing it? I would say interesting. It looked like the best challenge. But I've definitely doubted that decision a lot.” For Shark, he chose computer science because he enjoys challenge (*High Start Interest Value*). However, as shared previously, Shark underestimated just how challenging computer science would be. His constant feeling of being “uncomfortable” because he did not understand the content left Shark with *Vulnerable Probation Interests* and even a *Vulnerable Probation Identity*. Shark doubted whether he was right to select computer engineering as his major solely based on how challenging it was. Moreover, receiving communication from The University that his

performance was not satisfactory for his major extended Shark's feelings of doubt and discomfort in his major. This time of doubt classifies Shark's probation interests and identity as *Vulnerable*. However, by adjusting his study strategies to allow time for understanding and taking advantage of his newfound free time, Shark was able to prioritize his utility value as his top motivator (*Reprioritized Probation Values*).

So I could do nothing or I can put in the effort to try to get over this hurdle. And that is what 2020 kind of left me with. There was no going anywhere... All of the escapes were gone. Computer science was all that was left. And so I had to find some way to get through it... So it's been trusting the process and trying to do it every day. Going into bright space. Checking my classes. Checking lecture notes. Talking to classmates. And just trying to put in the due diligence and going for those uncomfortable situations... And so why I stayed in it [computer science] was for the problem-solving. I wanted to solve important problems and see technology move in a beneficial way for people, for society.

Pico and Shark's experiences with vulnerable identities and/or motivations reflected the majority of experiences. Juniper feared continued failure and questioned how often she was going to allow herself to underperform (*Vulnerable Probation Expectancies*). Kim questioned whether she could do engineering and even explored other majors (*Vulnerable Probation Identity*). Jonathan had a period of *Vulnerable Probation Expectancies* after realizing how competitive the coursework is at one of the top engineering programs in the nation. Jonathan's expectancies remained vulnerable as he expressed being scared of the possibility that he would fail again (*Vulnerable Probation Expectancy*). Probation left Luke with *Vulnerable Probation Interests*. He lost his joy in engineering and is working to rediscover it. Taken together, being placed on probation initiated a time of questioning and doubt for Pico, Shark, Juniper, Kim, Jonathan, and Luke. These vulnerabilities remind us that although students' identities and motivations remain stable or change over time, there may still be a period of vulnerability that triggers important negotiation work.

Invulnerable Negotiations

Students with *Invulnerable* negotiations did not question their identity or motivations. Some students' *Invulnerability* is not paired with a (re)negotiation at all. For example, Jorge and Luke had *Unchanged* engineering identities and did not question their identification for engineering after being placed on probation. Jorge explicitly states, "I never really question [my

identity], because it's very hard to say, 'Oh, because of probation, now, I feel less of a computer engineer.' No... being on probation will not take away from me what I already think of myself." Similarly, when asked how he decided to stay in engineering, Luke states:

Just pure hardheadedness to be honest. It was just one of those things where it's like, "No, I refuse to switch. I know this is what I'm good at. I know this is what I wanna do. I'm not switching into anything else. So how am I gonna figure out how to stay in this and make this a success?"

For Jorge and Luke's identities, there was not an intermediate period of questioning whether they should leave engineering. Instead, their identities were *Invulnerable*.

Influence of Students' Race, Ethnicity, and Gender on Negotiations

My second research question examined how students' racialized/ethnic and gendered experiences informed their identity and motivation negotiation processes. I began introducing answers to this question in the above sections about negotiations. Here I elaborate on students' race, ethnicity, and gender experiences by organizing students' responses into primary themes. Although most students only spoke of their race, ethnicity, or gender when prompted, many spoke in detail about how their identities impacted their disciplinary identity and motivation negotiation processes after probation as well as their journey through their major. I first present themes related to students' negotiations in response to probation then elaborate with how students' race, ethnicity, and gender influenced their science and engineering journeys more broadly. My thematic analyses revealed four major themes: Good Representative, Marginalization and Belonging, Support Marginalized Groups, and Dissociation with Race, Ethnicity, and/or Gender.

Theme 1 - Good Representative

The majority of participants ($n = 6$, 75%) spoke of being a *Good Representative* or a pressure to be a good example of their racial or ethnic group. Being a *Good Representative* was defined in two ways. First, most students approached exhibiting good representations, reflecting on the importance of ensuring their actions and accomplishments reflect positively on their cultures. For example, when starting in his major, Alex valued engineering as helping him attain his personal identity of being a *Good Representative* of his immigrant and Spanish-speaking

“gang [family]” and being a proud representation for his parents, family back home, Spanish-speaking students, and Spanish-speaking coworkers and their sons. Despite being placed on probation, Alex reflected on how his internship successes still allow him to do that,

And I can let out almost what they were saying in English and then back and forth. And just being able to be that bridge just kind of reminded me it's like, "hey, I'm going to be different from these engineers, right, because they can't do this." [...] That's happening because feedback is so important in engineering. Right. And I'm able to be that feedback connector. They [the operators] told me, "you know, I hope my son does this engineering stuff you're doing because you're doing great." I'm like aw (heart touched gesture)... me and other Latinos have a similar experience where like I mean, not, this is a little different for me because my parents came here as college educated engineers. But... I don't know. I just saw, like how similar we all are. And then it just means even more when, like, you know, I can take that experience and think about all those people, go to the next internship, the automotive place, and do well. And, you know, kind of keep showing good stuff.

Alex describes his approach to being a *Good Representative* of the Spanish-speaking community as intrinsic to his identity as an engineer who serves as a feedback connector.

Similarly, part of Kim's identification with engineering upon starting in her major was being a *Good Representative* to Black girls that Black and African women can succeed in engineering. However, Kim has faced numerous encounters with racial and gender discrimination during engineering group work that left her feeling she must work harder than her White male peers to be seen as equally capable as Black woman.

When I look at myself as an engineer, I don't see myself as that African woman. Instead, I just see myself as an engineer. If in a situation I have to remind them that I'm a Black African woman in STEM, then I will. I feel, even in classes, once they see you as a woman they don't take you as serious or they talk over you. Sometime, you have to, like, [knocking sound] "Hello. I'm talking." That kind of thing. Remind them that just because I'm a woman in STEM doesn't mean I don't know what I'm talking about. Most of the time, I just see myself as an engineer but there are some situations where you have to remind yourself that you're not just an engineer. You have to do some extra work to be on the same level as most of your peers.

Because of the times Kim has been treated as less than because of her race, ethnicity, and gender she shares feeling the pressure to be a *Good Representative* and “remind them that I'm a Black African woman in STEM.” Despite feeling this pressure to approach being a *Good Representative* Kim also described the pressure to avoid poorly representing Black women by fulfilling negative stereotypes.

I said “seven would be smart.” He was like, “No, that's too high.” The next person said, “Seven would be smart”... two minutes later! He was like, “Oh, you're correct. That makes sense.” I was so shocked...I had to ask him, “What is the difference between what he said and what I said?” He couldn't even speak. He was like, “Oh, he just understood what I was saying now.” I was like, “Is it my accent? Is it because it came out of a woman's mouth, it's not comprehended in your head?” [...] I didn't want to – not make him feel bad – but target him, or make him feel targeted, but I felt so angry when that happened. [...] Because we're in a team. I don't know. [...] We're on a team, and I'm the only girl. When I asked him what was the difference, he made me sound like I was overreacting. Then they also have this idea of the mad Black woman. I don't want to be seen as a stereotype there so that they have to now be acting differently around me, or pretending like everything I'm saying is so, so wrong or wild! I let it go, but I was so angry.

Kim's descriptions highlight an important balance between proudly representing one's culture well but being careful not to fulfill others' stereotypes of that same culture. For all students, being a *Good Representative* expressed ties to students' identities through their desire to be competent representatives and/or avoid being incompetent representatives.

Theme 2 - “The Only” and Belonging

The second pattern of how students spoke about how their racialized and gendered experiences informed their identity and motivation negotiation processes included experiences of being “*The Only*” and *Belonging* ($n = 5, 62.5\%$). Students' experiences of being “*The Only*” included experiences of being the sole representation of or one of few students from their race/gender. Although Jonathan was still working out how he feels when he realizes “I'm the only Black person here,” Shark shared how he found it isolating and hard to see his place in computer science since:

I think the only time I've ever been to an academic institution that wasn't a PWI would be my eighth grade in middle school. That was the one grade! Other than that, I was always kind of stuck out for one reason or another. I would like to say it's my wacky personality but other people say other things. So, I think that that has always kept race as something I've kind of had to balance [...] I don't see a lot of reflections. There's not a lot of different cultures in there. But I don't see a lot of people sharing the same path as me [...] I don't see a lot of reflections of myself. I don't see a lot of African Americans or people of- actually there are plenty of people of color, but they're just not, they're not African. So I don't see a lot of that in class. So it does feel a little isolated sometimes

Juniper's isolation was magnified since choosing to be an engineer, especially during the COVID-19 pandemic, meant choosing to be apart from her history:

You know, these people who hold, like, everything that makes you who you are in your tribe, like your language, your culture, the stories and everything, like when they pass away, it leaves with them. And that's also been an issue I've had on campus because there's very little amount of Native Americans, especially Native Americans who are culturally involved. And so it's very hard to connect with anyone on campus because it's like, well, like I'm the only person that's like me on campus. And so I just feel isolated, like on top of things [...] Living in modern society and knowing that the more time I try to spend here, trying to be an engineer and try to get a job to live and afford a house and to eat, the less time I have to be involved with my culture, soak up all of the good information from my elders.

Kim reflected on how she would like to experience belonging in engineering by working with other Black students but found that impossible to do as the only Black student in her classes. Luke struggled being a racial minority (i.e., Black) both in the nation and in his engineering classes.

Despite feeling isolated by being “*The Only*,” many students were able to find a space of belonging. For example, Alex was able to negotiate his engineering identity by prioritizing his professional identity as a connector and finding a place of belonging with the Spanish-speaking operators and being a connector. Finding limited opportunities to connect with fellow Native Americans, Juniper sought out other racial affinity groups:

I have been a lot more adamant about being involved with other communities that are like minority. I'm a part of NSBE [National Society of Black Engineers] [...] because it reminds me of my community back home. Everyone sees me as family again, or they they come from like a similar background as me. So it's very comforting to be around that. Or I volunteer with the Native American Cultural Center. That's always very comforting as well, because the director, she does speak some of her language. And she was raised like on I think the Navajo reservation and her dad speaks it fluently. So it's like I have someone who kind of understands how I feel coming to The University [...] So I guess overall I like going to the cultural centers and going to different organizations that are for minorities because if I can't find someone who is Native American, then it's always easier for me to find community in those different, I guess centers and like within those communities.

Luke also spoke about finding community in the Minority Engineering Program with other Black engineers but wished their presence extended to his classrooms. Luke struggled to experience belonging with the Asian community because “Most people look at me. And unless they've seen

people who are Black and Asian before... they don't think that I am Asian and even when they find out and they believe me, they think I'm not Asian enough.”

After being placed on probation, Juniper felt the “example I'm setting might not be the best.” However, Juniper reflected on some trailblazers of color who also experienced setbacks:

They had like a lot of these seminars, like for like Black trailblazers in engineering. And so I attended one of them. It was with a woman. Her name was Dean Adams. Well her name wasn't - well it was Dean Adams. And she was explaining that she dropped out of college twice [...] She was like "You know my my SAT scores there were super low. And I didn't originally get to do this and this and had all these all these, like, struggles that came up and they hit me." But, you know, she just kept going and eventually she got to be like the person that she wanted to be. And it might have been a little bit harder for her to get there. But she got there and now she really gets to live how she wants to because she just kept she kept moving through it. And so that's one thing that I always try to remember is that, like, obviously I have a different journey than other people. And so, yes, definitely. That's one thing I do think about to, I guess feel better.

Thus, Juniper was able to negotiate her engineering identity by finding belonging with trailblazers who took different journeys to success.

Theme 3 - Support Marginalized Groups

Many students ($n = 5$, 62.5%) reflected on their identification with and motivation for engineering being rooted in a desire to *Support Marginalized Groups*. This pattern included *Using Disciplinary Skills to Give Back to Marginalized Communities*. This theme extended beyond the utility of their degree and instead is an Attainment Value since being a professional who *Gives Back* was central to who students saw themselves to be. For example, Alex negotiated his Attainment values by extending his connector identity as an engineer to include bridging the communication gap between Spanish-speaking operators and English-speaking bosses. Juniper's reasons for pursuing Chemical Engineering were to help minorities fight climate change using alternative energy. Similarly, Kim's continues to value the utility of engineering for “broadening the road” for people from her home country to enter engineering.

Students also spoke about *Paving the Way* for students of color coming after them. For example, despite being on probation, Jonathan feels "it's also a little empowering, like I made it here. And so other people [minorities] can too." Similarly, Shark views the cost of feeling isolated in computer science now as worth it in helping marginalized students in the future: “I'll

take what I need to if that means other people get to come down this path with far less complications [...] don't have to experience what I've experienced doing this”

Theme 4 - Dissociation with Race, Ethnicity, and/or Gender

Although students gave rich explanations of how their race, ethnicity, and gender influenced their journeys these explanations needed to be prompted for all but one student and there were multiple students who explicitly stated there was no influence. For example, Alex, Jorge, Jonathan, and Pico did not reflect on their race, ethnicity, nor gender unless prompted. Pico stated that “there's nothing really cultural that I found that pushed me to be in this type of field [...] [to be a Hispanic or Latino in engineering at The University feels] Frankly, the same way it feels to be everywhere.” All six men stated that they did not attend to their gender in their discipline. It was only the women who viewed their genders as having an influence. For Kim it was her intersecting African x Black x Woman identity whereas for Juniper it was a drive to challenge “people would put me into a box” because she was a girl.

The likely explanation for why results revealed gender did not have significant impact is that the majority of participants in my study were men who recognize their privilege. As raised by Alex, Jorge, Luke, Pico, and Shark, STEM and society have historically privileged the experiences of men. For example, Luke shares “I mean we all know it's kind of a male-leaning society we live in right now. It comes with certain advantages. Um, so it's never been something I've had to worry about.” Moreover, Jorge shared that in his home country, engineering is dominated by men and that “It's very hard to find a woman that's an engineer back in my country.” As stated by Luke, being part of the majority, both in numbers and in the norms of their field, potentially released male participants from considering how their gender influences their journeys except to accept the “advantages” that comes with being male in STEM.

Results Summary

Academic probation marked a time of uncertainty for students’ disciplinary identities and motivations. All students reported an impact on at least one variable of their disciplinary identity, expectancies, or values. The majority of this impact can be characterized as students maintaining similar advantageous ratings between their *Start* and *Probation Identities* and *Motivations*.

Meaning that most students reported that their *High Start Identities* and *Motivations* were either *Reconceptualized*, *Reprioritized*, *Increased*, and/or *Unchanged* (see Table 8). With each of these changes, the student maintains the same advantageous qualitative characterizations but changed the way they thought about it (*Reconceptualized*), changed the order of prioritization (*Reprioritized*), experienced more of a variable (*Increased*), or had no change (*Unchanged*). This suggests that students either experienced some advantage in maintaining a consistently high perception between their *Start* and *Probation Identities* and *Motivations* or that although academic probation triggered some uncertainty it was not enough to completely destabilize and change most students' identities and motivations.

Even for students who specified a disadvantageous decrease or vulnerability in their disciplinary identity and/or motivations, the boundaries of my case (persisters) allowed me to capture how students negotiated this disadvantageous change to persist in their discipline. Students negotiated their *Decreased Expectancies* and their *Vulnerabilities* primarily by increasing their effort but also by turning to role models, contextualizing their competencies, and negotiating their disciplinary identity. The one student (Luke) with *Decreased Values* negotiated by creating a timeline to graduation and improving his mental health. Students engaged in similar negotiations. Thus, although probation may have initiated disadvantageous periods of decreased and vulnerable disciplinary identity and motivation, students were able to draw on internal negotiation processes to make persistence decisions, even if the negotiations were ongoing.

An examination across students of how their disciplinary identity and motivation negotiations intersected revealed that there are multiple pathways students can take to persistence. Specifically, there were three patterns of negotiation: Identity → Motivation, Motivation → Identity, and Identity x Motivation. The most frequent pattern was the Identity → Motivation pattern depicted in the SEVT model (see Figure 1).

Students shared how their race, ethnicity, and/or gender impacted their disciplinary identity and motivation negotiations. Students identified barriers, such as the challenge of being *The Only* and the pressure of needing to be a *Good Representative*. Students found it difficult to identify with a discipline where they were one of “*The Only*” members of their race, ethnicity, or gender. Sometimes that membership led to prejudice and discrimination (i.e., Kim's teaming experiences). The pressure to be a *Good Representative*, more importantly the pressure to avoid

being a poor representative, challenged students' expectancies for success. Despite these challenges, students spoke of using these experiences to their advantage. For example, students used being "*The Only*" to support their disciplinary identity of being *Good Representatives* to other students. In a way saying that there may not be many of us but I am an example that we can do this.

Students also perceived their race, ethnicity, and gender as affording them opportunities that enhance their disciplinary identity and support their motivations. For example, students' desire to *Support Marginalized Groups* supported their disciplinary identity by offering an alternative definition of what it means to be an engineer or computer scientist: Engineers and Computer Scientists support marginalized communities. Additionally, this theme supported students' attainment values by helping students see how engineering allows them to fulfill important parts of who they see themselves to be: individuals who *Support Marginalized Groups* by *Using Disciplinary Skills to Give Back to Marginalized Communities* and by *Paving the Way* for students of color coming after them. When deciding whether to persist after being placed on probation, these identities and attainment values supported students' decisions to stay, primarily through making the costs of persistence worth it.

CHAPTER 5: DISCUSSION

This study examined undergraduate students' STEM identity and motivation negotiation for persisting in their discipline after being placed on academic probation. Previous research has primarily used variable-centered analyses to examine change over time (DeCuir-Gunby et al., 2016; Eccles & Wigfield, 2020; Fong et al., 2019; Nolen 2015, 2020; Tonks et al., 2011). In this study, I selected a time when students' identity and motivations were susceptible to change (i.e., after being placed on academic probation). In semi-structured interviews, students described their disciplinary identity and motivations from when they started in their major. I examined how they changed and negotiated those identities and motivations after being placed on academic probation. While previous research has established that changes in disciplinary identity and motivations occur, this examination sought to uncover the processes of how the change occurs. Additionally, previous SEVT research is based on findings from predominantly White participants (DeCuir-Gunby et al., 2016; Usher, 2018). I sampled from Black, Latinx, and Indigenous students to investigate how students' racialized and gendered experiences informed their disciplinary identity and motivation negotiation processes.

Findings from the thematic analyses used in this project revealed that students' disciplinary identity and motivation negotiation processes provoked by the probation experience interacted in three ways. The Identity → Motivation pattern was the most common and described four students' approach of first negotiating their disciplinary identities then their disciplinary motivations. The Motivation → Identity pattern described two students' approach of first negotiating their disciplinary motivations then their disciplinary identities. Finally, the Identity x Motivation pattern described two students' approach of concurrently negotiating their disciplinary identities and motivations.

Students also reported that their racialized and gendered experiences informed their disciplinary identity and motivation negotiation processes in three primary ways. The majority of students reflected on a need to be a *Good Representative* of their race and/or gender. Their pursuit of being *Good Representatives* impacted their identity and attainment value negotiations. A second theme summarized students' experiences of being "*The Only*" and *Belonging*. Some students found being the sole representation of or one of few students from their race/gender in their classrooms as isolating and influential to their cost evaluations. However, students also

sought out spaces to experience *Belonging* by joining social organizations or connecting with coworkers who share their cultural experiences. Finding spaces of belonging supported students' identification with their disciplines. The third theme was students' sense of responsibility to *Support Marginalized Groups* and had impacts on their utility and attainment value negotiations. This theme had two subthemes for *Using Disciplinary Skills to Give Back to Marginalized Communities* and *Paving the Way* for students of color coming after them. Although these were three distinct themes, the relation between them is evident. For example, by students' sense of responsibility for *Supporting Marginalized Groups* is likely tied to being "*The Only*" and having experienced marginalization themselves. Further, as "*The Only*" one representing their cultural group, it is understandable that students feel pressured to be a *Good Representative* and avoid poor representation.

In the following sections, I discuss the meanings and theoretical contributions behind my primary findings, study limitations, and implications of the findings.

Finding 1: Students' hierarchical values and meanings change over time

A primary contribution of this work is uncovering three processes students engaged in when reevaluating their hierarchical values as well as their expectancies and identities. Evidencing that students' processes differ supports calls to treat the SEVT model as dynamic (Eccles & Wigfield, 2020; Nolen 2015, 2020; Tonks et al., 2011). More research is needed to examine whether these processes are upheld in larger samples in varied disciplines.

Students described their values as having differentiable importance to their decisions both to pursue their major and persist in their majors. Further, some students entered their major valuing the same motivations as after being placed on probation (i.e. *Unchanged*) while others reported *Increased*, *Decreased*, *Reprioritized*, or *Reconceptualized* values after probation. For example, Shark initially pursued computer science attributing his highest value to the interest and utility he saw in solving challenging problems and saw low value in the opportunity to attain an important part of his identity. After his most recent placement on academic probation, Shark most valued how computer science allowed him to attain his identity as a connector and problem solver. Thus, Shark *Reprioritized* his values by *Increasing* his *Low Start Attainment Value* to *High*. The fact that students could identify changes in their values over time suggests that they had weighted hierarchical values before and following probation. Moreover, this suggests that

these hierarchies are malleable, especially in response to a significant event. The potential for the existence and reprioritization of hierarchical structures of values contributes to a need for research examining hierarchical structures and change over time (Eccles & Wigfield, 2020).

While we learn and deepen our understanding related to what values hold more importance for whom and in what contexts, further research is needed describing the most common hierarchical values and whether certain hierarchies are more advantageous in certain situations.

In addition to hierarchies between values, there may be distinctions within values that are relevant for extending theory. This study and others reveal the prevalence of communal values for women and ethnic minorities in STEM fields and in collectivist cultures (Brown, et al., 2015; Gaspard, et al., 2015; Shin et al., 2019). In this research, the communal nature of students' attainment and utility values were conceptually close in meaning. For example, Juniper valued chemical engineering for allowing her to provide renewable energy to minoritized communities. Traditionally, this would be characterized as a utility value because of Juniper's reference to the utility of her chemical engineering skills to her future career. However, Juniper also emphasizes how her responsibility to help minoritized communities is an integral part of her personal identity. Eccles' (2009) distinction of identity-relevant values creates space for Juniper's commitment to giving back to instead be an attainment value. As we continue extending SEVT by including racial groups that historically hold more communal goals (Gray et al., 2020; Smith et al., 2015), more work is needed to consider how and where to incorporate communal values.

Finding 2: Students experienced a period of vulnerability and solicited resources, informing their identity and motivation negotiations

There was an intermediate stage described by students between receiving their probationary letter and the time of our interview when students either completed negotiations or were in the process of negotiating their disciplinary identities and motivations. A majority of students experienced *Vulnerability* during this time where they questioned or doubted their science or engineering identities or motivations. For example, being on probation left Shark questioning his interest in approaching challenge (*Vulnerable Computer Science Interest*) and his decision to major in computer science (*Vulnerable Computer Science Identity*). Previous research reveals changes in motivations and identity as common primarily in the first-year college transition period (Corpus et al., 2020; Eccles, 2009; Robinson, Lee, et al., 2019; Robinson,

Perez, et al., 2018) but also extending throughout college (Robinson, Lee, et al., 2019; Robinson, Perez, et al., 2018). Less research has explored the reasons why these changes occur or the processes by which students change their motivations (or not). Findings from this study suggest three important contributions. First, students in this study revealed their various reasons for changes in their disciplinary identities. Although probation was the primary source of vulnerable expectancies, vulnerable and changed values and identities were attributed to other sources. Students reported sudden shifts in instruction and mental health challenges caused by isolation as causes of changes in identity and values.

Second, students revealed intentionally employed processes for negotiating their disciplinary identities and motivations during times of vulnerability. Some students spoke about individuals that supported their [re]identification and [re]valuing of their discipline. Some students intentionally sought guidance from advisors, parents, and current and potential trailblazers in their fields. Others received timely support from project managers, recruiters, and instructors. Students also spoke of internal processes such as increasing one's effort, finding additional sources of competence, making a success plan, reflecting on science podcasts, and reflecting on their disciplinary identities and values.

Finally, the fact that students persisted in their disciplines despite these times of vulnerability suggests that the importance is less on *that* students' disciplinary identities and motivations are vulnerable and instead on *how* students interpret, respond to, and negotiate these vulnerabilities (Eccles et al., 1983). This extends to studies reporting on students whose quantitative reports would suggest stability over time (Robinson, Lee, et al., 2019; Robinson, Perez, et al., 2018). Further examination of that stability may reveal times of vulnerability that students negotiated to maintain stability over time.

These contributions add to a larger conversation seeking to understand students' persistence decisions. Although the processes that lead to dropout are important to understand, my focus on students who decided to persist provides insight into the individual and social assets that learners draw on to persist. More importantly, as institutions move to be student-ready, there remains much to learn from the adaptive processes and resources students draw on when faced with high-risk academic challenges. Focusing on processes calls for qualitative and mixed methods approaches to research design (Merriam & Tisdell, 2015; Wigfield et al., 2020). As shared through student interviews in this study, the negotiation pathways and resources vary.

Continued qualitative research can explore whether there are additional patterns of negotiation and whether certain pathways hold unique advantages.

Finding 3: *Students' negotiations are situated in time and culture*

Students reported that their race, ethnicity, and gender influence their negotiations in three primary ways: feeling pressure to be a *Good Representative* of their race, being “*The Only*” paired with a need for *Belonging*, and feeling responsible for *Supporting Marginalized Groups*. Further, students spoke about these themes with mixed feelings. Some took their minoritized status as a call to action, others shared how it raised challenges to belonging and identification, while others were still figuring out what to make of it. By taking a situated approach to identity and motivation, we can consider the larger systems that help to make sense of the identity and motivation conflict students described. Nolen (2020) describes a situated perspective as one that “seeks to understand individuals as part of multiple, partially overlapping and socially constructed systems of meaning in which people do what they do” (p. 1). In this study, students’ multiple, overlapping, socially constructed systems of meaning included disciplinary systems (i.e., science and engineering), institutional systems (i.e., college, academic probation), race systems, and gender systems.

Students’ negotiations were situated in the norms of what it means to be an engineering or computer science college student. Science and engineering have historically been dominated by men and the norms of masculinity (). This likely explains why the majority of the students in this study, 75% of whom were men, did not report an impact of their gender on their science and engineering experience. Moreover, these fields have historically marginalized the access and knowledge of people of color (NSF, NCES, 2019; Rainey et al., 2018; Wegemer and Eccles (2018)). Kim, a double minority as a Black African woman in engineering, felt this marginalization most in her teaming experiences where her contributions were sidelined and even ignored. Interestingly, few students considered the interaction of their race/ethnicity and gender identities with their disciplinary identity. Meaning, few students considered how they can use their experience as a Latino to inform their approach to engineering for example. Instead, most students spoke about these identities as separate, only reflecting on both when speaking about experiences of [a lack of] fit and belonging. This may be attributable to the norms not only of their discipline but also of college. Seldom are students given the opportunity to consider the

import of their social identities in college, especially in science and engineering. Providing opportunity structures that supports such intersectional identity exploration may have unique benefits for students of color and women whose identities have been marginalized in STEM (Gray et al, 2018).

Students' negotiations were also situated in their understanding of how to operate in these systems. Drawing on Holland and Lave's (2001) descriptions of "histories-in-person," there is a "residue" of students' various socializing activities (Nolen, 2020). The residue of racism and prejudice likely was enacted as a pressure to be a *Good Representative* and a responsibility to *Support Marginalized Communities*. To clarify, students did not talk about these themes as personal desires of wanting to represent their race well or wanting to support other marginalized groups. Instead, students spoke of these themes as pressures and responsibilities.

Similarly, the residue of values for community and affinity was likely rooted in students' cultural histories communalism and family (Boykin et al., 1997; Guillory & Wolverton, 2008; Campos et al., 2014; Steidel & Contreras, 2003). These values proved beneficial for students' persistence decisions primarily by sustaining and/or increasing students' disciplinary attainment values, utility values, and identity. For example, Alex's responsibility to be a *Good Representative* of his immigrant and Spanish-speaking "gang [family]" sustained his value of engineering for helping him attain his personal identity of being a proud representation for his family and culture. Further, the opportunity and psychological costs that Shark discussed were worth it if he fulfilled his responsibility to *Support Marginalized Groups* by ensuring that "other people get to come down this path with far less complications." These findings support calls from scholars to consider the assets that marginalized students bring into educational contexts (DeCuir-Gunby & Schultz, 2016; Fong et al., 2019; Kumar et al., 2018; Matthews & López, 2020; Tonks et al., 2011; Usher, 2018). However, this does not dismiss the responsibility of institutions claiming a commitment to inclusive excellence from relieving students from this pressure to be "Good" and responsibility to broaden the STEM pipeline.

Students were placed on academic probation for their performance during the fall 2020 and spring 2021 semesters. During their interviews in 2021, students reflected on the impact that the two global pandemics had on their academic performance. Alex Palmer, III; Jonathan; Juniper; Luke; and Pico all reported being placed on probation due to challenges navigating the online learning system that The University provided in response to COVID-19. The police

brutality pandemic influenced Luke to seek out his college's Minority Engineering Program before deciding to enroll in The University. Police brutality in Kim's home country provided yet another distraction from her studies as she worried about the safety of her parents and even herself since she fit the description of individuals being targeted by police.

Study Limitations

This study's contributions and implications are limited to the bounds of this case study. I intentionally selected students who already decided to persist in their discipline because of my interest in students' persistence decisions after a setback. Although much can be learned from the experiences of students in this study, further research is needed that examines whether these findings can be generalized to students who change majors or who depart the university. Additionally, the current findings rely on a single interview with retrospective accounts with each of the eight students in the sample. Bounding the study as a single case of the phenomena (undergraduate students of color on academic probation in science and engineering) with eight participants allowed me to find overlap in students' experiences. However, the small sample pool did not allow me to continue sampling until saturation was reached. Findings from this study would have been strengthened by using a longitudinal design that allowed for multiple interviews with each student or by continuing to interview additional students until saturation was reached.

Methods are still being developed on how to critically examine the influences of race, ethnicity, and gender on students' motivation negotiations. Thus, the findings from the present research related to this question may be limited. For example, several students shared that their race and/or gender did not influence their disciplinary motivations. Students also spoke in mixed ways about the impacts the global police brutality pandemic had on their science and engineering experience. Some students reported no impact. Luke spoke of how the political context that The University is situated in temporarily influenced his admission decision. Others spoke of how the movement sparked inner reflection on their space in higher education and society. Since methods to interrogate racialized and gendered motivation experiences are still being developed, it is not safe to say that there was *no* influence of race nor gender for students who stated so since there may have been some subconscious influence that could not be examined due to limitations in the methods employed. Supplemental methods, such as cued recall through longitudinal journaling,

might have helped students to consider experiences that shaped their motivations that seemed trivial at the time but have deeper meaning upon recall.

Although less of a limitation due to the situated nature of this study, these findings should be interpreted with caution due to the significant impact of the COVID-19 pandemic on students' experiences. It is unclear whether students would have been placed on academic probation or would have interpreted their negotiations in the same way had they not been navigating a global pandemic. Additionally, as a qualitative instrument I acknowledge that my interpretation of students' responses is informed by my positionality. I made intentional efforts to reserve my bias to the researcher memo. For example, although I was never on probation, Shark's experience resounded with my brother's experience on probation. I reserved my assumptions about the significance of Shark's experience to my researcher memo for Shark. Doing so allowed me to return to Shark's words and interpret his responses, as opposed to using my experience supporting my brother through academic probation. In other instances, my experiences allowed for deeper examination. For example, I am familiar with the country Kim is from. This knowledge allowed me to contextualize my interview questions about Kim's experiences in current national events. Nevertheless, my experiences, identities, and prior knowledge may have over- or underinformed my interpretation. Lastly, this study relied on students' self-reports of their experiences. The study could have been strengthened by using multiple data collection methods - such as observations, cued recall, and/or content analyses - to triangulate students' voiced experiences.

Theoretical and Methodological Implications

This study contributes to SEVT by positing considerations to take when situating students' motivations within time, race, gender, discipline, and setbacks. First, findings from this study suggest a need to further disentangle attainment from utility value. Continuing Eccles' (2009) distinction of attainment value as having personal meaningfulness to one's identity, students in the current study spoke of things traditionally measured and theorized as utility values in attainment ways (Conley, 2012; Fong & Kremer, 2020; Matusovich et al., 2010). For example, students' valuing of the application and skills focus of science and engineering could be interpreted as a utility value. However, when this application and skills focus is paired with

who students see themselves to be it may conceptually align as an attainment value (Eccles, 2009).

The blurry line between utility and attainment value tended to surround students' communal goals. The elaboration of utility and attainment to include communal forms contributes to the race-reimagining of SEVT. By situating students' identity and motivation negotiations in their race and ethnicity experiences allowed for a reimagining of the traditionally individualistic values in SEVT. These communal forms of utility and attainment value likely hold additional benefits for students from cultures with strong values for family and community.

Additionally, the emergence of communal values could result from the situative approach taken in this study, compared to the foundational EVT theories that were developed separate from contexts (Atkinson, 1964; Crandall, 1963; Crandall et al., 1964). Eccles et al. (1983) originally defined attainment value as how important it is that a student does well on a task and the ability for a task to confirm the student's self-concept of their ability. Eccles has since updated this definition to focus more on valuing a task or discipline because it fulfills one's personal and social identities (Eccles, 2009; Eccles & Wigfield, 2020). However, quantitative measures of attainment value, especially those measuring disciplinary attainment values, continue to measure individualistic values focused on the importance of possessing the abilities valued by one's discipline. For example, Conley's (2012) widely applied mathematics attainment value scale used items asking about how important it is to an individual that they are good at math, can solve math problems, and can reason mathematically. Robinson, Lee, et al. (2019) used similar items measuring engineering attainment value as how strongly an individual agreed that it is important that they are someone who is good at engineering, are involved in engineering, and consider themselves an engineering person. These items focus on students' assessment of their self-concepts of ability and, thus, assume that the only self-concept that informs students' attainment is their self-concept of ability. This is consistent with the original conceptualizations of expectancy-value theory but does not yet account for the additional self-concepts and identities that students find personally meaningful.

Gaspard and her colleagues (Gaspard et al., 2015) differentiated mathematics attainment value into two facets of (a) importance of achievement, which measured the importance of high achievement, and (b) personal importance, which measured the importance of content mastery and the relation of math to one's identity. The Importance of Achievement items were similar to

the ability self-concept versions of attainment value scales presented above. Personal Importance items asked how much students agreed that they care about remembering math content, it is important to know a lot of math, are keen on learning in math, math is important to them, and did not care about math or find it meaningful. Gaspard and her colleagues' items extend attainment value beyond ability self-concepts to measure how personally meaningful students found mathematics learning and content. However, the focus is still on individualistic or self-focused values and does not yet account for more social utility values. These social or other-focused values can be similarly central to who one sees themselves to be, such as valuing one's discipline because it provides them the skills needed to fulfill their personal identity as a *Supporter of Marginalized Communities*, as identified in the current study. Continued research is needed to understand how to extend the self-concepts that are included in the assessment of attainment values to include more social forms of conceiving oneself within their discipline.

Secondly, more research is needed that examines the relationship between self-concepts, like disciplinary identity, and attainment values. Previous quantitative research has used measures of disciplinary identity and disciplinary attainment interchangeably (Fong & Kremer, 2020; Robinson, Lee, et al., 2019; Robinson, Perez, et al., 2019). In the current study, I differentiated between disciplinary identity as who the student saw themselves to be in their discipline as distinct from how the student valued their discipline helped them fulfill their personal and/or social identities. This qualitative distinction revealed disciplinary identities related to (a) effort and achievement (high performing engineering student, engineer who puts in minimal effort) and (b) disciplinary skill sets (i.e., problem solver, creator, connector who approaches challenge). The first focus on effort and achievement suggests that ability self-concepts are important to students' disciplinary identity and are worth borrowing from attainment value literature. The second focus on disciplinary skill sets suggests a need to further contextualize identity measures in the skills identified by students and professionals as meaningful to the discipline. Such skills can be integrated by scholars conducting disciplinary identity research using card sorting methodologies (Carlone et al., 2011; Mosyjowski et al., 2020) and examining latent engineering identities (Benedict et al., 2017, 2018).

Findings from this study call for motivation researchers to take a more situated approach to examine disciplinary identity by considering not only the importance of achievement but also the importance of possessing skills characteristic of their discipline. By situating identity in

disciplinary knowledge and skills, researchers can differentiate attainment as how possessing said competencies helps an individual fulfill an important part of their identity. For example, instead of asking *how important* it is that a student is good at engineering, engineering identity items could ask how strongly a student agrees that they are good at engineering, are a creator, are a connector, or can evaluate potential solutions. Attainment items would then assess how important it is that they are an engineer who is good at engineering, is a creator, is a connector, or can evaluate potential solutions. The challenge that arises, and that may explain why skill sets have not been integrated previously, is that there are numerous potential skills to list on items. Mosyjowski et al., (2020) listed 26 skills in their card sort, of which some cards held two related skills (i.e., analyze a problem and define the constraints). However, Carlone and her colleagues (2011) situated approach drew on ethnographic case study methodology of two science classrooms. Situating their definitions of science into two classrooms, as opposed to a whole field, allowed for them to narrow the list to six science skills. The work to develop situated identity and attainment value scales will be extensive but not impossible. Drawing on an exploratory sequential mixed methodology can support this work.

Study findings revealed there could be multiple pathways to persistence decisions, primarily that the direction from identity to motivation may be bidirectional or even concurrent. This pattern stands in contrast to the linear relation assumed among the identity and motivation constructs, indicating that these components of SEVT could be interdependent and nonlinear. This possibility is most visible with the Motivation x Identity pattern where students described concurrent and interdependent negotiations as opposed to being linear and dependent. While the other two patterns suggested a linear relation, students described multiple, smaller points of negotiation that resulted in their identity and motivations at the time of the interview. However, an alternative explanation may be that during times of change students' identity and motivation negotiations are dynamic and complex. This points to the need for future research to investigate how identity and motivations inform students' persistence decisions. The potential of motivation and identity negotiation as more complex and dynamic is showcased in current theorizing by Kaplan and Garner (Kaplan & Garner, 2017; Kaplan et al., 2019). Ultimately, these results suggest that motivation researchers should consider whether a bidirectional and dynamic representation of identity and motivation negotiation better aligns with students' experiences in authentic contexts.

By examining students' identity and motivation negotiations during periods of vulnerability I was able to extend our understanding of negotiation processes. Although previous research has shown that college students' greatest period of development and change is the first year of college (Chen, 2013; Jones, et al., 2010; Lee & Blankenship, 2019; Robinson, Lee, et al., 2019), my study supports research that suggests there are additional times of transition and vulnerability (Robinson, Lee, et al., 2019). These periods offer opportunities to examine the negotiation processes of students who decide to persist despite life challenges or setbacks. Further research is needed that examines what experiences initiate instability. The current study revealed academic probation, sudden shifts in instruction, and isolation as three such destabilizing experiences. While the first is a common challenge, the latter two resulted from an unprecedented global pandemic. More research is needed to identify experiences that more commonly result in destabilization, such as significant family or life events, negative social interactions related to one's major, or poor performance on a task integral to one's major. Understanding these processes can inform timely interventions and other practical applications.

In addition to continued work exploring processes on the right side of the SEVT model, there remains work to be done that updates our conceptualizations of concepts on the left side of the model. Students in the current study referenced a variety of Socializers that influenced their identity and motivation development. Most of these were meaningful adults, such as parents, program directors, and supervisors. Students also spoke of how media (i.e., podcasts, movies, and television shows forefronting technological innovation) communicated norms and activities of their discipline that caught their early interest. Although not currently included, the influence of media could fit into the left side of the model (Figure 1) as a Socializer or possibly within the cultural milieu depending on the messages being sent. As technology continues to advance, our conceptualization of Socializers should be extended. For example, children and teenagers increasingly use social media platforms that did not exist when the EVT model was developed (Anderson & Jiang, 2021; Auxier et al., 2020; Stockdale & Coyne, 2020). Through these platforms, students have access to influencers, professionals, "trailblazers," and other individuals that socialize them into various norms (Anderson & Jiang, 2021; Auxier et al., 2020; De Veirman et al., 2019; Stockdale & Coyne, 2020). Continued work is needed to update who and what we consider socializers and whether their influence on students' perceptions of their disciplines consciously or subconsciously influences their academic decisions.

Additionally, we as the motivation research community have much to learn about the opportunities gained from situating achievement motivations in race, ethnicity, and gender. Previous research has shown that there are assets from cultural histories that Black, Latinx/Hispanic, and Indigenous students of color draw on when making achievement-related decisions (DeCuir-Gunby & Schutz, 2016; Fong et al., 2019; Kumar et al., 2018; Matthews & López, 2020; Tonks et al., 2011; Usher, 2018). In this study specifically, some of these assets were directly related to students' negotiations of their disciplinary identity, expectancies, and values. For example, Jorge integrated his culture's prioritization for building relationships into his group interactions. This supported his initial identity development in his major. Students also shared a value for being role models and paving the way for future students of color. It is important to note that since higher education institutions were not created for students of color, many of these assets and participation structures do not organically exist (Gray et al., 2018). Although asset-based instruction that seeks to integrate students' cultures into the classroom has gained popularity in K-12 education, these practices have not become part of the undergraduate educational experience, especially in STEM courses. Continued research is needed that examines what culturally sustaining practices look like in STEM undergraduate courses and how integrating such practices impacts students' disciplinary identity, expectancies for success, and values.

While students found ways to integrate their culture into their science and engineering journeys, they also spoke about instances where their race, ethnicity, and or gender resulted in marginalization. This raises a need to directly examine institutional and disciplinary contexts that perpetuate maladaptive norms for Black, Latinx/Hispanic, Indigenous and female students in STEM. For example, some of the students in my study had experiences in science and engineering that are similar to experiences from decades ago (Hall & Sandler, 1982; Robnett, 2016; Smith et al., 2013; Widnall, 1988). Despite being introduced more than 40 years ago, students' reference to pressures to be a *Good Representative* and the responsibility of *Supporting Marginalized Groups* speaks to the persistence of stereotype threat (Steele, 1997; Steele & Aronson, 1995). Moreover, students' stereotype threat persisted despite their high, continued identification with their discipline.

The fact that women and students of color face negative, persistent stereotypes specific to their capabilities and responsibilities in their major has implications for adopting situative

methods. Situating students' motivation negotiation in their gendered and racialized experiences in their discipline allows motivation researchers to engage in more intentional examination of how students negotiate these negative stereotypes with their high expectancies, values, and identity. I gave a brief example of how this could be done with this study, but future research could incorporate multiple qualitative designs and data sources to triangulate students' experiences. Longitudinal designs could allow for the examination of how students' negotiations evolve over the course of an academic year, throughout their college journey, or as they transition from student to professional. Observational video recordings or auto photography methods could be used to depict how students' experience marginalization and integration during class, teaming, and working experiences. The visual information can be used for cued recall to further contextualize the racialized and gendered experiences that support or challenge students' identity and motivation negotiation.

Recommendations for Practice

After being on probation, students reflected on the learning environments that supported their identification with and motivation for their major. These included research-based high-impact practices like collaborative projects and internships. Given students' valuing of how their discipline allows them to develop a part of their personal and social identities, program coordinators can include more formal opportunities for students to reflect on their vulnerable identities. These identities can be used as guides in classwork to help students actualize their attainment and utility values. For example, once Alex *Reprioritized* his engineering identity to focus on being a high performing engineering professional, he began to rediscover his attainment values through internships.

Like most students in this study, Alex underwent this negotiation process on his own. However, the negotiation processes presented in this study can be applied to instruction and advising. When presenting a final project, instructors can incorporate an identity and value exploration assignment to help students select a project that is personally meaningful to them. When meeting with students on academic probation, academic advisors can guide students through identity and value activities to refocus them on who they want to become as professionals in their field. These practices support students' sense of autonomy and invite students' various other identities and competencies into their work. Inviting students to bring

their full selves into their disciplinary work can lead to innovative design solutions and promote the agency that science and engineering professionals are expected to possess.

When considering experiences that supported their identification with their discipline, students in this study pointed out how important it is to collaborate with diverse student groups since that is a more accurate reflection of the work environments they will enter. Further, diversity and global learning should be integrated into courses so students understand how the skills they are learning will make a meaningful contribution to society or be useful in their future careers (utility value; Ndubuisi et al., 2022).

Finally, faculty and student affairs professionals should not approach students on academic probation as failures or employ low expectations for students' academic success. Students in this study did not feel they were incapable of succeeding in their disciplines. Alex, Jorge, Juniper, Kim, and Pico attributed their probationary status to difficulty transitioning to online learning. Jonathan, Juniper, Kim, and Pico acknowledge that they just needed to make behavioral changes and increase their effort to return to being successful students. Juniper was overambitious by working full time and taking 17 credit hours whereas Kim found the instruction to be misaligned with the course deliverables. Luke's underperformance was attributed to mental health challenges, not a lack of knowledge or understanding. Shark's challenges were procrastination and aiming for the bare minimum. I list each of these to emphasize that most of these challenges, from students' perspectives, included behaviors that are malleable.

Academic probation is set up as a system to inform or signal to students that there is reason to be concerned about their current performance. The aim is not to communicate to students that they are a failure. Rather, the aim is to alert students that now is a good time to draw on resources and set goals to return to good academic standing (Academic Probation). It is important that faculty and student affairs workers take this approach as well to support students on academic probation. Many universities continue to use weed-out programming that aims to identify students who are not cut out for the discipline (Weston et al., 2019). However, based on students' responses in my study, using probation as an indicator of not having what it takes would be weeding out students who are indeed capable of success but experienced a temporary setback.

Conclusion

The goal of this study was to examine students' disciplinary identity and motivation negotiation processes during a time of potential destabilization. Specifically, I described how (a) students changed and renegotiated their disciplinary identity and motivations and (b) how students' racialized and gendered experiences inform their identity and motivation negotiation processes. My primary reasons for engaging in this investigation were in response to calls from motivation researchers to (a) explore processes of motivation during times of destabilization and (b) refocus motivation research on race and gender. Situated expectancy-value theory formed the foundation of this investigation with explicit considerations of students' disciplinary identities, expectancies, and values. As opposed to examining these concepts in isolation from the contexts in which they occur, I situated students' negotiations in their science, engineering, race, and gender experiences.

Examining the negotiation processes students engaged in to reconcile their *Start* and *Probation Identities* and *Motivations* introduced the possibility of hierarchical values. Additionally, students described periods of *Vulnerability* that did not always result in changed identities or motivations. Further, situating students' disciplinary identity and motivations in time, science, engineering, race, and gender provided insights into the contextual influences on negotiations. Specifically, students reflected on the influences of the COVID-19 and police brutality pandemics that influenced their journeys to and through their discipline, identified *Integrated STEM Characteristics* that contextualized their science and engineering identities, and shared how their race and gender [did not] influenced their conceptualizations of a social attainment value.

The results of this study contribute to the theoretical work needed to disentangle generally meaningful utility values from personally meaningful attainment values. Additionally, the findings of this study have promise for extending SEVT's examination of the influence of socializers. Concurrently, this study has implications for examining the dynamic relationship between self-concepts, like disciplinary identity, and attainment values. Considering that all the students in this sample decided to persist, there may not be a particularly useful hierarchy of values or process for persistence after a setback. Instead, considering the multiple motivational pathways to persistence may be a useful strategy for student success personnel to employ when

working with students experiencing academic setbacks. but more research is needed to confirm this in larger, more diverse samples.

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APPENDIX A. EMAIL TEMPLATE FROM ADVISOR TO STUDENT

Dear [Student Name],

Your previous semester grades indicate that you have had academic difficulty. Given this, you have been placed on Academic Probation.

I know that being on academic probation can be challenging. At [The University], we believe that every student has the potential to succeed. In fact, we recently asked students who returned to good standing what encouraging words they might share with others students on probation:

- It is stressful and scary to find out that you are on academic probation, however, it can help turn your academic performance around.
- To the students who are currently on probation, do not give up. You were accepted into [The University] because you are capable of achieving great things. Do your best and it'll show.
- Don't give up! One difficult semester does not define who you are as a student or as a person. You are not alone and there are many people who are there to help you and are waiting to support you and aid your recovery.

There are several resources available to support you. One of the key resources is meeting with me. As your academic advisor, I am committed to helping you return to good academic standing so you can continue making positive progress towards degree completion.

Below I have initiated a Plan of Action for you to follow to help you succeed:

1. Please review your transcript. If you believe any of your grades from the previous semester are incorrect, contact your professor immediately.
2. Review your upcoming semester classes and ask yourself, "Do I need to add, drop, or repeat any courses?" If the answer is "yes" or you are unsure, do not make any changes until you have confirmed these changes with me.
3. Complete the **Probation Survey**.
4. Schedule a meeting with me during the first two weeks of the semester. (schedule here: **UniversityConnect**)

During our first meeting, our discussion will focus on:

- What Academic Probation means
- How you can return to good academic standing
- Possible schedule changes
- Campus resources to support you

Students placed on Academic Probation can and do succeed. Therefore, your return to good academic standing should be one of your top priorities. Do be aware that continued academic probation could lead to a lack of progress toward degree, or ultimately being dismissed from the

university. I know that external factors beyond academics can make this challenging, so if you are struggling with additional stressors please consider utilizing the **university resources** available to you.

Sincerely,

Academic Advisor

APPENDIX B. STUDY ENROLLMENT FORM

Start of Block: Student Recruitment Block

Q9 Email address

Q18 Are you currently on academic probation?

- ☐ Yes, based on my Cumulative GPA (CGPA) (1)
 - ☐ Yes, based on my Major GPA (2)
 - ☐ Yes, based on my Spring 2021 GPA (7)
 - ☐ Yes, based on a combination of GPAs (3)
 - ☐ No but I was in Spring 2021 (4)
 - ☐ No, but I was another semester (5)
 - ☐ I have not been on academic probation at The University (6)
-

Display This Question:

If Are you currently on academic probation? = I have not been on academic probation at The University

Q24 Thank you for your interest in this study! We aim to learn about the experiences of students currently or formerly on probation, thus you do not qualify to participate. You can close this window.

Q14 Are you currently enrolled in the Polytechnic Institute, College of Engineering, or College of Science?

- ☐ Yes, but I was in another college (1)
 - ☐ Yes, and I've always been this college/institute (2)
 - ☐ No (3)
-

Q5 Race(s)/Ethnicity(ies)

- ☐ Asian/Asian American (8)
- ☐ Black/African American (1)
- ☐ Hispanic/Latinx (2)
- ☐ Native/Indigenous American or Pacific Islander (6)
- ☐ White (3)
- ☐ International: (7) _____
- ☐ Self-Identify: (4) _____
-

Q2 Gender

- ☐ Male (1)
- ☐ Female (2)
- ☐ Rather not say (3)
- ☐ Self-Identify: (4) _____
-

Q21 Age

- ☐ Under 18 (1)
- ☐ 18 - 22 (2)
- ☐ 22 - 26 (3)
- ☐ 26 - 30 (4)
- ☐ 31+ (5)
-

Q20 Estimated family income

- ☐ Less than \$30,000 (1)
 - ☐ \$30,000 - \$59,999 (2)
 - ☐ \$60,000 - \$79,999 (3)
 - ☐ \$80,000 - \$99,999 (4)
 - ☐ \$100,000 - \$149,999 (5)
 - ☐ More than \$150,000 (6)
 - ☐ Unsure (7)
-

Q19 What college(s) are you currently enrolled in?

- ☐ Engineering (1)
 - ☐ Science (18)
 - ☐ Polytechnic Institute (19)
 - ☐ Other: (20) _____
-

Q25 Major

Q16 Classification?

- ☐ Sophomore (2)
 - ☐ Junior (3)
 - ☐ Senior (4)
 - ☐ Senior+ (5)
-

Q17 How many semesters have you been on probation?

Include this semester. So if this is your first semester on probation select 1.

- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5+ (5)
-

Q8 Current GPA (4.0 Scale)

If you do not have a GPA based on courses in your major or from Spring 2021 type "NA" in those fields.

- ☐ Cumulative GPA (1) _____
- ☐ Major GPA (2) _____
- ☐ Spring 2021 GPA (3) _____
-

Q11 Please leave any additional information that you would like us to know in the space provided below.

End of Block: Student Recruitment Block

APPENDIX C. INTERVIEW PROTOCOL

WELCOME: Hi my name is Temi Adeoye and I'm a doctoral candidate in Educational Psychology here at The University. During this interview I'll ask you questions about your engineering identity and motivations to stay in engineering after being placed on academic probation. The interview will take approximately 60 minutes. As a reminder, you can skip questions you don't want to answer and you can stop the interview at any time.

CONFIDENTIALITY: To keep this interview confidential, I will only be transcribing the audio from our conversation. If you'd be more comfortable you can turn your camera off too. Do you have any questions before we begin? *Answer any questions.*

Great! Now, before I start recording, can you pick a name that you'd like to be referred to on this call and in my writeups? (*give participant time to pick a name and post it in the chat. If the function is available, have participant change name to selected pseudonym*) Great! Is it alright if I begin recording now?

-----[begin recording once consent is given]-----

BEGIN INTERVIEW

Hello, this is Temi and I'm here with [participant's pseudonym]. We'll be talking today about your engineering identity and your motivations for engineering. Are you comfortable being audio recorded?

This interview will be broken into 3 larger sections: Your engineering journey, your engineering identity, and your engineering motivations. So beginning with your journey...

Engineering journey

1. Could you tell me your story of how you became who you are today?

Follow-up prompts to encourage elaboration:

- a. You mentioned . . . ,
- b. Tell me more about...
- c. Can you give me an example of ...?
- d. How did you experience this moment?

2. What role did your race or gender play in your journey?

If story/journey does not mention engineering generally:

3. How did you first get involved in engineering? Were you involved in any formal/informal engineering programs?
4. How did you select your major? **BE SURE TO WRITE DOWN MAJOR**
 - a. Did you consider other majors?
 - b. *IF YES: What made you think of majoring in_____? How did you decide on engineering?*
5. How has your experience in engineering at The University been so far?
 - a. How did your T2M process go?

- b. 2020 was a tough year to say the least. Did the COVID-19 pandemic impact your engineering journey?
 - i. IF NO: move to Q4c
 - ii. IF YES: How so?
 - iii. Did the rising racial unrest impact your engineering journey?
 1. IF NO: move to Q5
 2. IF YES:
 - a. Can you start by telling me what you include as “racial unrest?”
 - b. What aspects of that were most important to you?
 - c. What impact did those experiences have on your engineering journey?
6. What did it mean to you that you were placed on probation?
7. What would say are the reasons you were placed on probation? OR What led up to you being placed on probation?
 - a. What did you do after being placed on probation?
 - i. *If further prompting is needed:* How did you respond to being on probation? Who did you talk to, what changed for you?
8. How has your engineering journey been shaped by being on probation?
 - b. How has your engineering journey been shaped by being on probation? What parts of your life were impacted by being on probation?
9. Tell me about where things are now with your engineering/major coursework.

Identity negotiation

1. What does engineering mean to you?
2. How does engineering fit into your sense of who you are?
3. How did you come to this perception of yourself as an engineer?
Follow up prompts to encourage elaboration:
 - a. Who decides whether you’re an engineer?
 - b. How do they communicate that to you?
4. Are there any resources that have helped you form your engineering identity?
 (Examples: projects, family, membership in organizations, social media, classes)
5. Would you say there are other important characteristics of engineers that are not part of your sense of yourself as an engineer?
 - a. Does not having these as central to who you are impact your view of yourself as an engineer? How so? OR Why not?
6. What types of skills or knowledge do you need to be considered an engineer?
7. You’ve already finished ___ years in engineering. Tell me about some of the engineering skills and knowledge that you’re developing already.
8. Have you ever thought engineering wasn’t right for you? IF YES: “Tell me about that time.”
9. Has being on probation influenced how you see yourself as an engineer?
 - a. IF NO CHANGE: “What helped you maintain your engineering identity?”
 - b. IF YES CHANGE:
 - i. How would you better describe your engineering identity after being placed on probation?

- ii. How did you come to this new/revised/adjusted sense of yourself as an engineer?
- 10. *If not already discussed*: What role does race and gender play in your engineering identity?
- 11. Tell me about what it is like to be a [insert gender + racial/ethnic identity] engineering major at The University?
- 12. Is your fit or belonging in engineering important for your identity as an engineer? Why/why not?
 - a. Who decides whether you fit in engineering?
 - b. How do they communicate that to you?
 - c. What role does race and gender play into whether you fit in as an engineer?
- 13. **BLACK STUDENTS**: Have you seen the College of Engineering's [We Support Black Engineers](#) campaign?
 - a. IF NO: offer to share a link to campaign after interview. Move to Q13
 - b. IF YES: Were you involved?
 - i. IF NO: What did you think of the campaign?
 - ii. IF YES: What did participating in this campaign mean for you?
 - iii. ALSO IF YES: Did the campaign impact your engineering identity?
 - 1. IF NO: move to next question
 - 2. IF YES: Tell me about this impact.
- 14. **LATINX STUDENTS**: Are you familiar with the *Somos The University* campaign?
 - a. IF NO: Move to Q13
 - b. IF YES: What does *Somos The University* mean to you?
 - c. ALSO IF YES: Are there any The University events that have impact your engineering identity as a Latina/Latino?
 - i. IF NO: move to next question
 - ii. IF YES: Tell me about that event and its impact.
- 15. How important was belonging in engineering to your decision to stay in engineering?

Engineering motivations

Expectancies, values, and costs as tied to behavioral choice (persistence to degree)

- 1. How confident were you that you'd be successful in engineering when you began in [insert engineering major]?
- 2. Earlier you shared that your identity [changed, stayed the same]. Thinking about your engineering identity, how was your confidence impacted?
 - a. *If expectancies were LOWERED*: How did you balance these new plans with your [new] identity?
 - b. *If expectancies were INCREASED or STABLE*: Can you share more about how your [new] identity helped you maintain/increase your confidence expectancies?
 - c. *If struggling to answer question*:
 - i. Think back to a time when you thought about your [new] identity as an engineer after getting your letter. With that identity in mind, what were your plans for yourself? OR With that identity in mind, how motivated were you to continue in engineering?
 - ii. Would you say there were other things happening that better describe your motivation to continue in engineering?

3. *There are a range of reasons people might have for choosing engineering. Let me ask you about a few. Prompts below for attainment, interest, and utility value if not discussed.*
 - a. Would you say you chose [insert engineering major] because you found it interesting or enjoyable?
 - b. Would you say you chose [insert engineering major] because of the pay or the skills you could gain?
 - c. Would you say engineering coursework allows you to solve important problems or make a meaningful contribution?
 - d. Would you say majoring in [insert engineering major] helped you to fulfill an important part of who you were? *If more prompting is needed:* You talked about seeing engineering as [insert from journey or identity]. Did you choose engineering for that reason or not really?
4. You talked about [list values]. Which of these were most important to you?
5. Thinking about the time since probation and your [changes to your] engineering identity, how have these values been impacted? OR Did your [insert value that was most important] shift with your engineering identity?
 - a. How did your valuing of [insert values] influence your decision to continue in engineering?
6. Did you think there were any drawbacks to staying in engineering? Why/Why not?
7. How did these drawbacks play a role in your decision to continue in engineering?
8. Did your race or gender influence these reasons or perceived drawbacks?
 - a. *IF YES: How?*
 - b. *ALSO IF YES FOR BLACK STUDENTS: Did the College's [We Support Black Engineers](#) campaign influence your motivations to stay in engineering? IF YES: How?*
 - c. *ALSO IF YES FOR LATINX STUDENTS: Has the [Somos The University](#) campaign influence your motivations to stay in engineering? IF YES: How?*
 - d. *ALSO IF YES: Did the racial unrest in the nation influence your motivations? IF YES: How?*
9. Let's focus now on a course that you took recently, while you have been on probation. What motivated you for that course?
 - a. How did your expectation for success influence how you persevered in that class?
 - b. How did your reasons for choosing engineering influence how you persevered in that class?
 - c. How did some of the drawbacks involved influence how you persevered in that class?
10. How did others support your motivation to stay in engineering?

Closing

1. I've put a lot of emphasis on your probationary experience because that's where my interest is. Would you say that this experience is a salient part of your story?
2. Is there anything else that was important to figuring out who you were after receiving your probation letter?

Thank you [participant pseudonym] for all your responses! I'm stopping the recording now.

END INTERVIEW

-----[stop recording]-----

Clarify that their probation/failure is not a summary of who they are as a student

Ask participant again if there's anything they'd like to share now that recording is complete. If yes, ask whether it's okay to note their responses. If so, take notes; if not, listen attentively.

Thank them again for their time and end the call.