

Minoritized Students In STEM Pathways at Community Colleges

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A dissertation
submitted in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy

University of Washington
2017

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Program Authorized to Offer Degree:
College of Education

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Abstract

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Community colleges are a prominent academic pathway for future scientists, engineers, and mathematicians, and serve as a gateway to higher education for traditionally marginalized student populations. Because of this, community colleges are uniquely positioned to combat the underrepresentation of African American, Latino/a, Native American, and Pacific Islander students in STEM. Research on students of color in STEM, however, has traditionally focused on K-12 schools and four-year colleges and universities, leaving a gap in our understanding about the role of community colleges in shaping student intentions to pursue STEM careers.

To address that gap, this study examined students as they pursued a degree in STEM at a community college, for the purposes of contributing to our understandings of students of color in these environments. Utilizing science identity framing and longitudinal multi-case study methods, this study followed thirteen students as they navigated the community college and made decisions regarding their pursuit of a future in STEM fields. Specifically, this study illuminates the racialized nature of STEM at a community college, student thinking around choices to opt into or out of STEM, and the decision-making around choices to persist.

Insight into the social and contextual factors underlying students' persistence demonstrates that students of color (especially women of color) do encounter hostile experiences within STEM contexts at community colleges, but how they respond to those hostilities

influences persistence. Students who attribute hostilities such as micro-aggressions to the biases of others are more likely to persist. Students who do not attribute those hostilities to others are more likely to assume their experiences are attributable to the fact they do not belong in STEM. The findings establish the importance of recognizing and acknowledging the racialized and gendered nature of STEM, both in academic settings and at home, for those working to find belonging in fields where they have traditionally been excluded.

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Acknowledgements

This research would not exist were it not for the mentorship and support of so many people. Academically, I must thank Mark Windschitl, Jessica Thompson, Craig Scott, and Ken Zeichner in particular. Mark, I am forever indebted. It may have taken me eight years, but any less and I don't think I would have learned so much about writing, teaching, and learning. I will forever remember "can you unpack that for me." Jessica, you've shepherded me from skepticism about the triangles of CHAT to the depths of identity theory, and for that I'm so very appreciative. Craig, I so appreciate you're letting me in to observe, study, and take part in medical education. Ken, your insight into the complexities of education opened my eyes, while your commitment to social justice framed the way forward. Thank you so much.

I would be remiss if I failed to acknowledge the incredible opportunities to learn provided by scholars Robert B. Howsam, Donna Kerr, Steve Kerr, Morva McDonald, Patricia Wasley, Mike Copeland, Betsy Hasegawa, James Banks, Sue Nolen, Cap Peck, and Walter Parker. There have been many other professors, but it was under your tutelage that I learned so much.

Beyond the opportunities to learn from academics, I must acknowledge the unwavering support of friends and family; eight years and three kids needs a lot of support, and you were always there. To Anne Browning, Adiam Tesfay, Ryan Burt, and Laura Chen...wave those CLUE scarves for me. To Dave S., Dave H., Dean, Ed, Sharron, Gene, Jeannie, Johnny, Kristine, Misty, Curt and Ron; thank you.

To the Itles and the Babcocks-Joe and Gina-Marilyn, Steve, Rob, Erin, Kristen, Kelly, and Lisa-know I love all of you, and wouldn't be here without each and every one of you. Finally, I must acknowledge the instrumental role that Amber, Cecelia, Lila, and Austin played in this process. Words cannot say how grateful I am for your support in this process. We've been

through so much over the last eight years and are have only grown stronger. Nothing has stopped us so far; not broken legs, babies, or biased bosses...let's see where the next eight years gets us.

On to the next adventure!

Dedication

To men and women of color pursuing a future in STEM; don't let anyone say you don't belong.

INTRODUCTION

At present, there is an unmet need in the United States for college graduates in the science, technology, engineering, and mathematics (STEM) fields (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010). One of the strategies proposed for increasing the number of domestic STEM graduates focuses on the role community colleges play in preparing students for these degrees. Over 1,100 community colleges exist within the United States, serving 45% of all U.S. undergraduate students (American Association of Community Colleges, 2016). These play a prominent role in the post-secondary education of science, technology, engineering, and mathematics professionals in the United States, with over 40% of science and engineering graduates completing at least some of their coursework at a community college (Tsapogas, 2004).

Running parallel to concerns regarding the number of domestic STEM graduates, and the role community colleges play in their preparation, are concerns about who is earning those degrees. Students earning bachelors degrees in STEM are disproportionately White and East-Asian, with significant underrepresentation for African American, Latino, Native American, and Pacific Islanders (National Science Board, 2015). This overrepresentation of White and East Asian persons in STEM is characterized by Tate (2001) as a violation of the civil rights for those who have traditionally been marginalized, as their ability to participate in high-paying and prestigious STEM affiliated careers is constrained. Complicating this picture is the fact that, community colleges play a significant role in the post-secondary education of students who have been historically marginalized because of their racial or ethnic identities (American Association of Community Colleges, 2016; Bailey, Jenkins, & Leinbach, 2005). Community colleges have been identified as uniquely positioned to help increase both the number of citizens receiving a

degree, the proportion of natural science and engineering degrees granted, and the number of minoritized persons earning degrees in STEM fields (Olson & Labov, 2012).

While research is beginning to inform our understanding of experiences underlying the disparate representation of minoritized students in STEM at the university level, there exists a need for parallel research at the community college level. Community college populations, however, are demographically dissimilar from 4-year institutions. Their students are proportionately more diverse, from lower income levels, have more part-time attendees, and include higher numbers of non-traditionally aged students than universities (Bailey et al., 2005). If community colleges are to construct tools and programs to address racial disparities in STEM career participation, they need to understand early post-secondary academic experiences for students holding non-dominant racial and ethnic identities. There exists a need to understand how those experiences interact with students' identities to shape decisions regarding entrance into, persistence in, or dropping out of STEM academic tracks. This work must build on current understandings of how racial identities shape decision-making around persistence. By following minority students as they work towards intended STEM degrees, this study illuminates the nature of racialized experiences encountered at a predominantly white community college. Longitudinal multi-case study research methods were used to juxtapose the strategies and relationships of those who persist with those who abandoned efforts to pursue a STEM degree. This study informs policies and processes supportive of students of color early in their academic experiences in STEM by illuminating the racialized nature of STEM pathways in a community college context, and the ways that students persevere in settings potentially hostile to their non-dominant racial/ethnic identities.

REVIEW OF LITERATURE

In this review of literature, I begin by establishing the underrepresentation of persons of color in STEM disciplines, and the unexplained post-secondary racial disparities associated with unequal participation in STEM academic pathways and careers. I will then establish how community colleges are uniquely positioned to address racial disparities in STEM. To take advantage of this positioning, we need to understand how students in community college make decisions to opt into, persist in, and opt out of STEM academic pathways. I argue that identity is a powerful tool for understanding the processes students use to form decisions regarding persistence in STEM. Identity allows an examination of people's racial and ethnic identities within and across contexts; as well as students' identification with, and feelings of belonging in, STEM disciplines. Identity is largely absent from research on community college students in STEM. At the same time, conceptualizations of identity have been powerful in providing an understanding of how students navigate STEM in K-12 and 4-year college contexts. I intend to demonstrate a gap in our understanding of how students in K-12 contexts, and those who have successfully navigated post-secondary settings. Within this gap exists a distinct shift in how students are seen determining their sense of belonging in STEM. I will argue that theories conceptualizing how students come to make meaning from their experiences offer a powerful insight into that gap. In doing so, I will establish that longitudinal qualitative research situated in community colleges is necessary if we are to address the persistent underrepresentation of persons of color in STEM fields.

Minority Representation in STEM: Workforce and Post-Secondary Education

Communities of color in the United States are underrepresented in the Science, Technology, Engineering, and Mathematics (STEM) degrees earned and the STEM careers held. For African American, Hispanic, Native American, and Pacific Islander demographic groups, participation in both post-secondary STEM education and in the STEM workforce is far below their representation in the greater population. White and East Asian demographic groups' STEM participation is disproportionately large.

The National Science Board (2015) reported that only 5.7% of science and engineering degrees were awarded to Black individuals while this demographic made up 11.5% of the population. Hispanics earned 6.8% of the science and engineering degrees while composing 13.9% of the national population. Native Americans compose 0.6% of the population and earn only 0.2% of the science and engineering degrees. This underrepresentation runs counter to trends for Asian Americans and Whites. Asian Americans comprise 4.9% of the population, but 13.9% of the science and engineering degrees; Whites 67.5% of the population yet earning 71.5% of science and engineering degrees. Further examining this disparity, the inequity is not merely a reflection of different rates of participation in the larger workforce. Blacks make up 10.8% of the nation's workforce, but only 6.4% of the STEM workforce. Hispanics are 14.9% of the workforce and only 6.5% of the STEM workforce. In both the rates at which they earn science and engineering degrees, and the rate at which they participate in the STEM workforce, African American, Hispanic, Native American, and Pacific Islanders are disproportionately underrepresented. Conversely, Asians and Whites are overrepresented. Demographic data illustrating these disparities are summarized below (see Table 1).

Disproportionate participation in STEM is problematic, as traditionally marginalized populations are excluded from careers that have the fastest growth, lowest unemployment, and highest earning potential. While some may point to increases in the numbers of marginalized populations participating in STEM, it is important to note that population demographics change at the same time increasing numbers of minoritized individuals are seen in STEM.

Table 1- Disaggregated population, workforce, science & engineering degrees, and STEM workforce percentages by demographic group

Demographic Group	Proportion of the population (National Science Board, 2015)	Proportion of the U.S. workforce (Landivar, 2013)	Proportion of the U.S. STEM workforce (Landivar, 2013)	Proportion of the S&E degrees earned (National Science Board, 2015)
Black & African American	11.5%	10.8%	6.4%	5.7%
Hispanic	13.9%	14.9%	6.5%	6.8%
Native American	0.6%	0.6%	0.4%	0.2%
Pacific Islander	0.1%	4.6%	1.4%	0.3%
White	67.5%	66.9%	70.8%	67.5%
Asian	4.9%	5.5%	14.5%	13.9%

Claims that participation in STEM for persons of color is increasing disregard shifts in population demographics. When adjusting for an increased population, marginalized groups continue to struggle to participate in STEM. Examining non-Asian minority participation in Biology, Lewis, Menzies, Nájera, & Page found that, “when the percentages are weighed against changes in the racial/ethnic distribution in the U.S. population, the patterns of representation have changed very little” (2009, p. 971). Despite increasing numbers of STEM graduates and employees, historically excluded populations continue to be underrepresented in STEM fields today. This exclusion is linked to historic marginalization of communities of color in arguments

by Tate (2001), who claims that access to quality science education should be considered a civil right, and in turn, a lack of access is a violation of civil rights.

Tate's claim is powerful in illuminating how structural inequalities such as disparate educational opportunities are manifest in post-secondary STEM education and the STEM workforce. The idea of unequal educational opportunities gains traction when the realities of STEM participation are compared to levels of interest in STEM for non-White students. A report by the American Council on Education found that among incoming freshmen, "African Americans and Hispanics enter higher education with the same level of interest in STEM fields as their peers" (Anderson & Kim, 2006, p.1). The same report found that students from non-dominant backgrounds were less likely to persist than their White or Asian counterparts. These findings echo those of Bonous-Hammarth (2000), who studied the persistence of students of color in STEM at four-year institutions. Bonous-Hammarth found that 44% of African American, American Indian, and Chicano/Latino students switched out of science, mathematics, and engineering majors while only 26% of Asian and 25% of White students switched out of those same majors. It is therefore important to note that differential levels of participation in STEM are not wholly attributable to differences in interest among demographic groups. Factors must exist that cause non-White students to have higher rates of attrition than their White and Asian peers

While I will review broad explanations for disparities in post-secondary STEM persistence, it is worth noting that much of the research informing the navigation of these academic pathways by marginalized populations focuses on 4-year colleges and universities. This focus risks oversimplifying explanations for disparities in STEM degree attainment as the research largely overlooks community colleges. Over 40% of science and engineering graduates

report attending a community college (public 2-year) at some point in their post-secondary education (Tsapogas, 2004). Community colleges also serve as prominent post secondary pathways for traditionally marginalized student populations (Bailey et al., 2005). Tsapogas (2004) found that community colleges were attended by 44% of Black, 51% of Hispanic, 45% Native American, and 40% of Pacific Islander students who attained degrees in science and engineering. Malcom (2010) found that 61% of Latino students who earned STEM degrees attended community college, with a majority being the first generation students. This data, while informative of community colleges' role in preparing students for futures in STEM, does little to inform understanding of how students navigate STEM at those same schools. Given the prominent role that 2-year public institutions play in the preparation of students typically underrepresented in STEM, understanding underrepresentation of marginalized populations in STEM fields requires examination of community colleges. It is important to review both the literature specific to the role of community colleges in STEM education, as well as research on students of color in STEM academic pathways.

Community Colleges: Demographics and The Student Experience

Community colleges play a significant role in the education of traditionally marginalized populations. Baily et al. (2005) note that, "Among all undergraduate institutions (including less than two-year institutions), community colleges enrolled by far the largest proportion of Black and Hispanic students" (p. 23). Additional research builds a more complete understanding of the student populations in which two important themes arise: 1) the demographic nature of student populations and 2) the nature of the student experience at community colleges. When compared to four-year institutions, community colleges include more students with factors identified as barriers to the attainment of a degree, including:

- Being the first in their family to attend college (Bailey et al., 2005)
- Coming from households with lower incomes (Bailey et al., 2005)
- Enrollment as a part-time student (Ma & Baum, 2016)
- Less-rigorous pre-college coursework, requiring remediation prior to college level courses (Bailey et al., 2005).

In addition to the challenges faced by many students at community colleges coming to school, students often live off campus, as most colleges do not offer on campus housing (Cohen & Brawer, 1996). The fact that most students commute to campus means that opportunities for students to engage socially on campus are constrained. These constraints can also make it harder to access support services, harder to build relationships with academic peers, and harder to access instructors (Tinto, 1993). Further complicating access to instructors for students, community colleges rely on part-time adjunct faculty, who teach 53% of the students and teach 70% of the remedial courses (Center for Community College Student Engagement, 2014).

While serving large numbers of students who have traditionally been underserved by 4-year institutions, we cannot assume that the access afforded to traditionally marginalized populations can be equated to socially just outcomes. Community colleges focus on equality at the point of enrollment and not on equality in the outcomes for students. As Dowd (2007) notes, “the uses of the community college are stratified by students’ racial/ethnic and socioeconomic background” (p.6). The role of community colleges is often bifurcated. Students, often White, from higher socio-economic origins utilize the colleges as a low cost means of obtaining credits prior to transferring to a 4-year institution. Alternatively, students from traditionally marginalized populations have fewer post-secondary options, and do not obtain degrees at the same rates as their more affluent peers. Outcomes are not the same for all students. Students

from higher SES backgrounds are much more likely to transfer than those from lower SES (Dougherty & Kienzl, 2006; Wood, Nevarez, & Hilton, 2011). Part-time students, students who don't come to college immediately after high school, students from lower SES, and students with less rigorous pre-college academic preparation are less likely to transfer (Dougherty & Kienzl, 2006).

The role of race/ethnic identities in cases of transfer is less clear. While Dougherty & Kienzl (2006) found that race was not a factor in transfer, Wood et al. (2011) found race to be a significant factor in the likelihood of transfer. The degree to which race/ethnicity informs decisions to transfer is not clearly understood. Disproportionate overrepresentation of marginalized populations in lower SES means those populations are less likely to successfully transfer to four-year institutions, but it is tough to tease apart the influences of racial identity from social class. Wood et al. (2011) found the odds of White students transferring to be 71% higher than those for non-White students. The intersecting influences contributing to the success of students at two-year institutions are murky at best; what is certain is that, on average, non-White student populations do not obtain the same level of education as White and Asian students.

Research informing understandings of minority students in community college STEM pathways is rare. This scarcity is problematic given the prominent role gatekeeping role community colleges play in post-secondary education for students of color in STEM fields. There exists research looking at minority students in community colleges, and another body of research studying STEM interested students at community colleges, but very little that examines minorities within STEM at community colleges. Looking specifically at post-secondary students interested in STEM fields, Wang (2013) notes that minority students at community colleges have

similar levels of interest in STEM to White peers, but, “their low completion rates speak to something quite alarming along the educational journey of these students” (p. 686). At the moment, little research exists to explain these disparities.

We know that when compared to four-year institutions, community college students are disproportionately students of color who attend part time (Van Noy & Zeidenberg, 2014). We also know that 49% of community college STEM students switch into STEM after their first year of enrollment, compared to 38% of four-year STEM students (Van Noy & Zeidenberg, 2014). Van Noy & Zeidenberg also report, “Community college STEM students switch out of STEM at a higher rate than four-year STEM students (33% versus 28%)” (2014, p. 11). Add to that the fact that community college students typically live off campus (96% of students commute to campus compared to 41% of four-year students (Cohen & Brawer, 1996)), and it becomes apparent that the educational experiences of STEM interested students at community colleges may be quite different than students at four year institutions.

When individuals’ racial/ethnic identities interact with campus contexts, explanations developed for students at four-year institutions may prove inadequate. Van Noy & Zeidenberg (2014) note, “more research on the actual experiences and decision-making processes of community college STEM students is needed to understand the reasons why they enter and exit these programs” (p. 11). Goldrick-Rab, Carter, & Wagner (2007) echo this sentiment when they note, “we still need to know much more about the formation of degree expectations, particularly among community college students (especially with regard to the timing and sequencing of events such as degree choice, college choice, and the decision to persist)” (p. 2448). It is clear that the educational research community has not adequately worked to understand the dynamics

at play for minority community college students interested in STEM, despite those institutions' central role in the preparation of these same students for futures in STEM.

To understand the disparate outcomes for students of color in STEM at community colleges, it is worth reviewing the educational research that has provided understanding in the school contexts that bookend the community college. An understanding of the theoretical framing and the findings from research examining students in STEM at K-12 schools and at 4-year colleges and universities can illuminate potential mechanisms responsible for students of color opting out of STEM at rates higher than their White and Asian peers. While research from these settings will be reviewed shortly, it is important to examine identity as a powerful framing for understanding students' relationship to STEM across contexts. In the sections that follow, I will begin with review of identity that is grounded in socio-cultural theory, and well established in educational research. I will follow the review of identity with a survey of research investigating how minority identities are treated in educational contexts. This survey of the experiences non-dominant identities encounter in STEM classrooms will provide an understanding, and a vocabulary, necessary to understand what it is like to be a person of color in classrooms that have been traditionally occupied by White men.

Identity: A tool for understanding people in contexts

Whereas traditional psychology views identity as something contained within an individual, social psychology positions identity as emanating from, "embedded subjects situated in different locations in turn, that is, as situated participants in structures of social practice" (Dreier, 2009, p. 196). Such a view of identity requires a focus on both the individual and the context in which they are situated. This approach of using identity to addressing both an individual, and the context they are in, aligns with recent trends in science education research

that has shifted from traditional psychological approaches examining decontextualized individuals or simple correlations between students' demographics and their achievement in favor of social psychological and sociocultural approaches (Lee, 2012; Tytler, 2014).

One such attempt to focus on social conceptualizations of identity is offered by Burke (1991), who suggests that identity construction is a continual process. Burke suggests that multiple identities (professional, racial, gender, etc.) exist for each individual, and those identities are activated through disruptions of existing perceptions. The salience of identities is context dependent, and continually shaped in response to experiences. Disruptions that activate identities might include feedback critical of an individual's performance relative to an identity. That feedback, linked to performance, conceptually links a person's practice and their identities together.

Building on the idea that identity is situated in practice and continually shaped, Ashforth & Schinoff (2016) suggest that, "individuals derive a situated sense of self by comparing themselves and the groups to which they belong to other individuals and groups" (p. 120). At the same time, this framing of identity suggests a dynamic nature for identity; identity becomes something that changes over time in response to a context. Ashforth and Schinoff suggest that individuals within organizations constantly work to construct identities. The processes by which these identities are constructed include the interpretation of cues from individuals and environments. Behaviors are often motivated by individuals' work towards becoming the people or *possible selves* they would like to become. This work is not straightforward, and requires the validation by community members within a context, indicated by cues. The validation by community members is complemented by the individuals, who are capable of constructing coherent narratives that:

make sense of the messiness in a manner that resonates with prevailing discourses and the demands of the context as well with one's own identity motives, desired selves, and emergent affect, behavior, and cognition...because narrating is not a process of passively reporting every experience; it is an active and motivated process of abstracting from day-to-day events to make sense of oneself in the local context in a manner consistent with salient identity motives. (Ashforth and Schinoff, 2016, p. 123).

The ideas that identity is actively constructed in response to environmental cues, oriented towards possible selves, and established in ways that make sense to individuals is powerful in understanding how people negotiate who they are and who they want to be.

Swann, Johnson, & Bosson (2009) conceptualize this negotiation process as taking place between individuals and their community members. Individuals hold some elements of their identities to be longstanding *chronic* elements while less established identities are *situated* identities. Long held identities have alternatively been labeled Critical (Sfard & Prusak, 2005; Thompson, Windschitl, & Braaten, 2013), and Core (Gee, 2000), with more tentative and developing identities characterized as possible selves (Archer et al., 2010), or contextual discourses (Thompson et al., 2013). While the nomenclature varies, it is worth noting that there are multiple identities, some long held and stable while others are relatively recent and evolving. These more recent situated identities are seen as evolving during negotiations between individuals and their communities using interpersonal discourse and situational cues. It is important to note that identity is viewed as resulting from complicated dynamic social processes involving individuals trying to makes sense of interpersonal interactions.

Building on the idea of identity as constructed and modified by negotiations and cues, Sfard and Prusak (2005) more clearly define identity as being composed of stories. It is

important to note that stories in this sense are neither a byproduct of internalized identity or an internalized cognitive architecture that results from exposure to stories. Instead, the authors claim that identity itself can be conceptualized as composed of stories, existing in the discourses communities engage in. In this framing, the authors, “suggest that identities may be defined as collections of stories about a person, or more specifically, as those narratives about individuals that are reifying, endorsable, and significant” (p. 16). These stories, or discourses, can be told by or about persons, and can be conveyed to and from those persons, or between other people. Community members serve as narrators who elevate particular narratives and perpetuate them within communities of practice. In this story-based identity, narratives exist as either actual identities or designated identities. Actual identities are told in the present tense, with storytellers noting, “I am a strong student,” “they are good at science,” or “I am good at math”. Designated identities differ in that they express want or a possible future such as, “I want to be a better student,” “they are going to go to a good college,” or “I am going to be a scientist”. In this sense, designated identities provide direction for identity development over time.

By looking at the discourses put forward by individuals, by others about those individuals, and at how those discourses change over time, researchers have managed to better understand the processes by which students’ identities change over time. In one example Nasir & Cooks (2009) looked at student participation in a high school track team, and the role of social interactions in identity formation. Central to the adoption of an identity by an individual were social interactions with peers and authority figures that facilitated the adoption of identities like that of a sprinter. Discourses introduced in those social interactions were maintained in the social contexts individuals were embedded in. Nasir & Cooks’ study was not limited to discourse. The authors watched how students participated on the track team. As students adopted identities, they

were observed shifting how they utilized artifacts like the starting blocks. This combination shifting practices of runners, and the adoption discourse based identity served as a link between discourse-based-identities and identities-in-practice.

Initially conceptualized by Holland (1998), identities-in-practice approaches have also proven useful in framing identities and then understanding how contexts can influence identity development (Aschbacher, Li, & Roth, 2009; Carlone, Scott, & Lowder, 2014; Lee, 2012; Nasir & Saxe, 2003). Tan & Calabrese Barton (2008) clearly explain these identities-in-practice and the processes by which those identities are negotiated when they note that:

the term “identities in practice” rather than “identities” is an important distinction because we believe that the environmental factors of the specific community in practice, in this case, the science classroom, exert significant influence on how novice members, such as students at the start of the school year, adopt their in-class identities-in-practice...How novice members negotiate their relationships with the official authority (e.g. the science teacher) and more established members of the science class community (e.g. recognized good science students) determine how their identities-in-practice evolve in the classroom (p. 47).

It becomes clear in this framing that science identities are dependent upon positioning relative to, and recognition by, those sanctioned to evaluate a person’s fit in STEM disciplines. There is influence on those identities by the individuals who hold them and by those they interact with. This positioning by individuals working to change their identities has been described by Calabrese Barton et al. (2013) as “identity work” in which individuals attempt to assume more central roles in science classrooms, or to integrate out of school STEM experiences with opinions of their own place within the disciplines. Identities-in-practice have successfully

illustrated shifts in STEM identity by looking at individuals as socially imbedded actors. Such a framing draws attention to an individual's sense of place within STEM, the communities an individual participates with, and the changing nature of that participation.

Focusing specifically on the changing nature of peoples' more tacit identities, it is worth noting that identities are constantly evolving, strengthening or eroding over time. Shifts in identity happen as people work to alter their identities and find recognition from other individuals. These shifts have been characterized by Nasir and Cooks (2009) as trajectories, which are inbound (strengthening), outbound (weakening), or peripheral (never strengthening). Jackson & Sellers (2013) describe a similar trajectory specific to STEM, with identities moving towards identification or disidentification with STEM disciplines.

It is worth taking a moment to recap the nuances of identity before moving on to discipline specific STEM identities and racial/ethnic identities. Individuals are seen as holding multiple identities, some they choose and others ascribed to them. Those identities can be well established or relatively tacit. Regardless of how well they are established, those identities exist in the discourses between community members, and in the practices people engage in. These discourse-based identities, and identities-in-practice, can shift over time. These shifts in identities are dependent on positioning by individuals within contexts, and on sanctioning by identified authority figures within those communities. Individuals engage in identity work to shift their positioning and the discourses about them within communities. Examined longitudinally, identities are seen to have trajectories that can strengthen or weaken as they evolve in contexts over time.

The application of Identity theory: STEM Identity and Racial & Ethnic Identity

To address the complexities inherent in understanding the racial and ethnic disparities in educational attainment in STEM at a community college, identity theory is applied to students' affiliation with STEM disciplines, and to their racial/ethnic identities. This idea that students can identify with STEM disciplines has been conceptualized for over fifteen years, and will be a focus of sections that follow. For the time being, it is important to understand that identity theories can be applied to students' identification or disidentification with STEM disciplines.

Just as it is necessary to establish conceptualizations of STEM identity prior to reviewing identity-based science education research, it is also important to establish common experiences for students with non-dominant racial and ethnic identities in school settings. Doing so establishes a vocabulary and conceptual clarity that can be use for more nuanced understanding of research exploring students of color in STEM education. It is important to note that racial and ethnic identities are constructed over long periods of time through everyday social interactions with other people (Lewis, 2003). It is also important to acknowledge that these interactions take place within a social context that is historically situated.

Identities such as race, gender, and social class have been, and are used, to subjugate entire subsets of the population. This historical subjugation is not by chance, but instead the product of structural inequality manufactured and maintained by dominant social groups. To reflect the fact that subjugation is something inflicted on non-dominant groups, Harper (2013) shifts the language used to describe students with non-dominant identities, using minoritized in place of minority. His justification is repeated here.

“Minoritized” is used instead of “minority” throughout this chapter to signify the social construction of underrepresentation and subordination in the U.S. social institutions,

including colleges and universities. Persons are not born into a minority status nor are they minoritized in every social milieu (e.g. their families, racially homogeneous friendship groups, or places of religious worship). Instead, they are rendered minorities in particular situations and institutional environments that sustain an overrepresentation of Whiteness.” (Harper, 2013, p.207)

The semantic shift is powerful, and used from now on to maintain a focus on the history and structural inequalities that underlay the focus of this study. “Minoritized” is not intended to imply some monolithic experience for African Americans, Latinos, Native Americans, or Pacific Islanders. It is important to understand that these identities, and their subordination in social institutions, influence a person’s lived experiences. That experience ranges from outright verbal and physical violence to far subtler marginalization. For the purposes of this research, overt racism, while a potential influence at a community college, is of less interest than the subtle dynamics underlying race within STEM. Instead, the day-to-day realities that come from existing in a racialized space are of interest.

To provide an understanding of the experiences of individuals with minoritized identities, I begin by establishing *social identity contingencies* as the “possible judgments, stereotypes, opportunities, restrictions, and treatments that are tied to one’s social identity in a setting” (Purdie-Vaughns, Steele, Davies, Dittmann, & Crosby, 2008, p. 615). These are not the judgments or stereotypes themselves, but the possibility of those things happening because of the identities a person has. This means that students walk into new settings and engage in threat assessments relative to their minoritized identities. The ability to evaluate a setting for contingencies is learned through socialization, and frame individuals’ perspectives. They watch for cues that indicate contingencies may be present.

To envision a student's attention to cues, it is worth considering a hypothetical classroom. The classroom, is a calculus based physics course, and two different students walk into the course. The first is a White woman. The woman, knowing White men have traditionally dominated physics, surveys the student body for the gender composition of her peers. She checks on the gender of the professor and teaching assistant. If the class, instructor, and teaching assistants are disproportionately male, then the contingencies associated with her female identity, sexist assumptions about her mathematics ability, or assumptions about women's belonging in STEM become prominent. The second student, an African American man, also surveys the classroom upon walking in. Unlike the woman, the man is surveying the racial and ethnic composition of the classroom. His male identity is not associated with negative contingencies in this context. Instead, if he sees that the composition of the room is largely White, there are cues that he may encounter racist assumptions based on negative stereotypes about his racial identity. Contingencies associated with an individual's social identities can determine feelings of belonging, as, "cues can determine-independent of any personal experience in the setting-the extent to which a person will trust and feel comfortable in a given setting" (Purdie-Vaughns et al., 2008, p. 615). Cues indicate how an individual might be treated within a context.

Individuals are aware of their minoritized identities, the contingencies that come with those minoritized identities, and are socialized to watch for cues of how their identities is important for understanding persistence in STEM. The impact of those cues is subtle. One study of African Americans in a prospective workplace found that, "professionals focused largely on concerns about their degree of fit within the setting" (Purdie-Vaughns et al., 2008, p. 622). The importance for understanding students of color in predominantly White and male STEM disciplines is further illuminated when the authors note, "In workplaces where prototypical

behaviors are often linked to American majority groups, colorblind cues should activate threat” (Purdie-Vaughns et al., 2008, p. 627). This means that classroom norms, aligned to White male hegemonic norms, in contexts traditionally dominated by White persons, indicate that persons of color may not be welcome. It is possible that cues, conveyed through pedagogies endemic in of STEM, might tell students that they are not going to belong in STEM.

While cues are subtle in nature, when combined with microaggressions, it becomes possible to understand the messaging students with minoritized identities experience in STEM. Solorzano, Ceja, & Yosso (2000) identify microaggressions as “racialized encounters and messages” rooted in negative stereotypes about a particular identity. These microaggressions are rooted in racist assumptions, and include low academic expectations, assumptions of academic inferiority, or exclusion from academic peer groups. These microaggressions serve as a reminder for minoritized individuals of identity-based social hierarchies. Microaggressions manifest themselves when White students disregard the contributions of a student of color during group work, implicitly questioning their academic competence. Alternatively, assuming that a dark skinned Latina in mathematics is Vietnamese or Cambodian reinforces racist assumptions about who belongs in math (Asians) and who does not (Latino/a).

Research examining the underperformance or failures of minoritized student populations, *stereotype threat* has been demonstrated to diminish an individual’s performance as they attempt to avoid conforming to negative stereotypes (Steele, 2010). Within this theory, working to defy to negative stereotypes reduces a students’ capacity to perform, as a portion of their cognitive capacity is consumed worrying about that stereotype. Stereotype threat provides a mechanism by which the academic performance of minoritized populations within STEM is potentially negatively impacted because they are not stereotypically associated with those disciplines. While

it is important to note that the experiences of individuals holding minoritized racial/ethnic identities are diverse, there are social processes like peer pedagogies, stereotype management, and stereotype threat associated with those identities in STEM academic pathways that produce responses demonstrated as common among minoritized students.

Utilizing anti-deficit frameworks, which aim to understand the success of minoritized populations by studying successes as opposed to failure, Harper (2013) noted that African American students at PWI's regularly experience discriminatory interactions with peers and faculty. In response to the routine discrimination, Harper found that more veteran African American students sought out newly enrolled ethnic peers, attempting to provide supportive *peer pedagogies* that illuminate racial issues at an institution and provided strategies to overcome potentially harmful effects. While Harper's findings are not suggestive that all students' experiences are the same, the fact that these pedagogies existed across multiple four-year institutions suggests similar racialized experiences, and corresponding coping strategies for minoritized populations navigating post-secondary academic pathways.

Using a similar anti-deficit approach, McGee (2016) and McGee & Martin (2011), found that minoritized individuals felt a constant need to proving themselves, to disprove stereotypes in places where minoritized identities were severely underrepresented. These students felt hyper-visible yet excluded from STEM classrooms based on their minoritized racial identities. The authors characterize this omnipresent stress as *stereotype management*, contrasting their finding with stereotype threat, which largely exists during high-stakes events such as tests. Research on stereotype management appears to indicate that this strategy for coping with negative stereotypes is common among post-secondary students pursuing STEM.

I would be remiss if I did not note that isolation, and the corresponding alienation experienced by minoritized students on the basis of race/ethnicity, is further compounded for women of color. Many STEM disciplines are dominated by men, forcing women of color to deal with isolation and discrimination on the basis of both race/ethnicity and gender; a compounding of alienation and discrimination characterized as a “Double Bind” (Malcom, Malcom, 2011). Ong, Wright, Espinosa, & Orfield (2011) note that women confront “multiple systems of oppression” (p. 182), which complicate their navigation of STEM pathways. In a survey of 1,250 women of color and 891 White women in post-secondary STEM fields, Espinosa (2011) found that women of color reported fewer interactions with faculty outside of class and more instances in which faculty expressed racial/ethnic stereotypes in class.

It is worth noting that not all individuals with similar racial or ethnic backgrounds share similar opinions about how central their race/ethnicity is in their experiences. Looking at the salience of racial identity at two and four-year colleges, Hurtado, Alvarado, & Guillermo-Wann (2015) found that the relevance of race for students’ ranged among racial/ethnic peers. At the same time, non-White students were far more likely to think their race/ethnicity than White students. The fact that minoritized students are more likely to find their race salient suggests that there is a continuum of salience, with some minoritized individuals finding race/ethnicity to be central to their student experience and others to find race/ethnicity to be a nonfactor. Within that salience, the meaning ascribed to racial/ethnic identities varies, with no monolithic interpretation of what it means to hold a minoritized identity (Martin, 2009; Nasir, McLaughlin, & Jones, 2008).

While identity salience, stereotype management, peer pedagogies, stereotype threat, microaggressions, and identity contingencies can appear unrelated to questions about students of

color in STEM at community colleges, these terms afford a means of conceptualizing racial and ethnic identities-in-practice. We need robust ways of thinking and talking about minoritized identities if we are to understand how those identities respond to contexts where they are traditionally excluded. Understanding how traditionally marginalized populations navigate STEM academic pathways requires an understanding of developing STEM identities, and an understanding of their concurrent racial and ethnic identities. Informed by literature on identity-based educational research, and minoritized identities, a review of research investigating the navigation of STEM contexts by persons of color becomes possible.

Community College Research into STEM Identity Development

Research into the experiences of students of color in STEM at the community college level is sparse. This is problematic given that academic pathways in public two-year colleges are so prominent for minoritized populations. Awareness of the importance of community colleges in the production of STEM graduates is growing (Boggs, 2010; Olson & Labov, 2012; Tsapogas, 2004; Van Noy & Zeidenberg, 2014), but research specific to marginalized populations is largely reliant on large data sets (Salzman & Van Noy, 2014; Wang, 2013; Wood & Williams, 2013) and surveys (Hagedorn, Chi, Cepeda, & McLain, 2006). Additionally, much of the existing research on minoritized community college students in STEM looks at the population once they have transferred to four-year institutions (Packard, Gagnon, LaBelle, Jeffers, & Lynn, 2011; Reyes, 2011; Wawrzynski & Sedlacek, 2003). Zamudio's (2015) study of nine women of color is one of the few studies examining the experiences of minoritized students in community college STEM settings.

Zamudio (2015) interviewed women of color who started their post-secondary education at a community college level and earned a degree after transferring to a four-year institution. All

of the women identified as Latino, and were the first in their families to attend college. Utilizing interviews, the researcher noted that the successful women exhibited grit, and felt that their minoritized status was a point of pride, which aided resilience. It is worth noting that interviews were completed after students had earned their bachelor's degrees. Because of this, the pride reported by participants is necessarily retrospective. It is difficult to ascertain how much of the pride is attributable to hindsight, and how much pride was felt at the time participants were attending community colleges.

Zamudio's participants reported being recognized within their families as role models capable of advising others on educational matters. It is important to note that, "all participants were part of support programs and student organizations that promoted Latino success in STEM" (p. 58). Participants noted that many of their friends arose from these support programs, with some noting the small peer group composing their community of friends. One participant referred to this cohort as her, "own band of, I guess, misfits" (p. 59). Zamudio's findings attribute students' success to, "the overarching theme of grit" (p. 67). The author claims that grit allows participants to, "perceive a potentially negative environment in a way that was used to motivate and challenge themselves to overcome odds" (p. 67). While Zamudio's findings offer insight, a reliance on grit as a mechanism to explain success fails to adequately address the interpersonal processes necessary for the construction of a STEM identity. The "band of misfits" implies more complex social processes were occurring within the cohort of participants.

Beyond Zamudio's research, there is little to inform an understanding of how students of color navigate community college settings. Descriptive statistics tell us that students of color are interested in STEM but not successfully navigating STEM academic pathways at rates similar to

their White and Asian peers. To emphasize how under-theorized this disparity is, I want to revoice three quotations from research cited earlier in this review:

- “their (students of color) low completion rates speak to something quite alarming along the educational journey of these students” (Wang, 2013, p. 686).
- “more research on the actual experiences and decision-making processes of community college STEM students is needed to understand the reasons why they enter and exit these programs” (Van Noy & Zeidenberg, 2014, p. 11).
- “we still need to know much more about the formation of degree expectations, particularly among community college students (especially with regard to the timing and sequencing of events such as degree choice, college choice, and the decision to persist)” (Goldrick-Rab et al., 2007, p. 2448).

Given the paucity of research into the navigation of community college STEM pathways by students holding minoritized identities, it becomes necessary to examine research informing our understanding of STEM identity development for students of color at the K-12 and 4-year college and university levels.

K-12 STEM Identity: Students are told who they are

In K-12 settings, studies looking at individuals-in-contexts have developed powerful findings explaining processes by which students chose to pursue STEM. In many instances, identity is utilized as a theoretical frame to help interpret findings. Almost thirty years ago, Oakes (1990) summarized the state of education research into the underrepresentation of women and minoritized populations in STEM. The review focused on how students decide against degrees and careers in STEM from kindergarten through college, providing insight into causes of departure which still resonate today. Oakes (1990) began by looking at individual traits like

ability, interest, and motivation before moving to more social explanations for disparities in STEM. Oakes' claim that social factors strongly influence disparities in STEM participation is insightful. Subsequent research continued to describe the individual and sociological factors that correlate with decisions by students from minoritized backgrounds to opt into and out of STEM pathways (Carter, 2006; Chen, 2013; Huang, Taddese, & Walter, 2000; Maple & Stage, 1991; Wang, 2013a; Wang, 2013b).

Nearly a decade after Oakes (1990) wrote her summary of research into women and minorities in science and mathematics, Brickhouse and Porter (2001) published a study that followed two young girls of color as they navigated school science classes from 7th grade through 11th grade. In this early study, students were observed shifting their interest in STEM subjects in response to their context. One girl going from a "model science student" to uninterested in STEM, while the other shifts from mediocre in STEM to highly successful. The adjustments in *who these girls were* relative to STEM responded to communities available at school, prior experiences, and resources at home. The girl who drifted from science felt marginalized as a new student of color in an all-White class participating less than she had previously. Her new instructor saw the participation as indicative of lower interest and ability, and had no problem allowing her to shift into a vocational program. Similar interplays between an individual and her context were observed for the girl who increasingly identified herself with STEM. Brickhouse and Porter's study is of use in this review of literature, as it demonstrates the complicated ways that minoritized students decide the role of STEM disciplines in their future. In particular, this study displays the strong role that influential people have in determining whether or not a young student decides to pursue a future in STEM.

A similar study, which followed three students from fourth through 6th grade, looked at how students' relationship with STEM subjects changed over time. Carlone et al. (2014) found differences in how classrooms afforded children opportunities to identify with science. Early in the study, students 4th grade classroom allowed individuals holding diverse social identities to participate in scientific processes like, "thinking critically, persisting, problem-solving, making unique observations, and creating scientific explanations and also being empathetic and nurturing with peers" (p. 85). This 4th grade classroom was juxtaposed with the same students in a 6th grade classroom utilizing lectures, triadic discourse patterns, and worksheets, with little epistemic authenticity. Carlone et al. watched as girls and boys in the 6th grade classroom were pushed away from authentic epistemic practices towards compliant behaviors. The study is of particular interest because a girl, identified in fourth grade as talented in science, was marginalized on the basis of both her gender and her race. The shifting nature of pedagogies between students' fourth grade class and their sixth grade class were seen to offer fewer opportunities to identify themselves with STEM disciplines. Carlone et al. also found that race, class, and gender each influenced students and their relationship with science. Sixth grade science consisted of following rules and complying with the teacher's demands.

Similar research examining minoritized students within K-12 STEM contexts has demonstrated how a variety of interactions between school settings and an individual can influence orientations towards or away from STEM. This research indicates important roles for minoritized identities as funds of knowledge in the classroom (Tan & Calabrese Barton, 2008). Research also illuminates the role of recognition and positioning by peers and instructors in classroom communities (Calabrese Barton et al., 2013). To look at how seemingly small classroom interactions can have an influence on minoritized students ability to participate in

STEM, Kurth, Anderson, & Palincsar, (2002) provide insight. Using a sociolinguistic analysis of a single student group in science, White sixth grade students were found to marginalize the contributions of an African American girl named Carla who was in their group. The marginalization was subtle, never overt. Carla's contributions to the group were discounted by her White peers, with the authors note that small signals within the group, "affected Carla's perception of herself as a science learner and her opportunities to practice scientific genres in speech and writing" (p. 311). Carla's ability to participate in science, and her ability to identify with the discipline, was constrained because of the marginalization by her peer group.

Taken together, the body of research at the K-12 level demonstrates the ways in which minoritized students, and the school contexts in which they are situated, influence one another. Importantly, research examining students' affiliation with science at the K-12 level establishes how decisions to identify or disidentify with STEM subjects are the result of a complex interplay of individual characteristics, their cultural experiences, and their social settings. Students at this level are often seen crafting a sense of belonging in STEM that is shaped by external influences, in the form of instructors or peers, who frame students' perceptions of self. This dependent construction of STEM identity runs counter to studies situated in post-secondary settings that indicate more mature students, who have successfully navigated post-secondary degree pathways, are able to mediate the messages about their belonging in STEM, amplifying discourses that are supportive and dampening those that are not.

4-Year Colleges and Universities: Students decide who they are

In addition to research investigating minoritized K-12 students in STEM settings, a separate body of research explores the experiences of similar students in post-secondary settings. While large quantitative studies have identified perceptions of prejudice as influential in

decisions to persist in higher education (see Nora & Cabrera, 1996), a study by Cabrera, Colbeck, & Terenzini (2001) was one of the first to address the experiences of minoritized students in post-secondary STEM pathways. The study utilized a survey to evaluate classroom environments in engineering programs at seven universities. It demonstrated that women and minoritized students perceived a “chilly classroom climate” attributed to White male peers. The research illuminated that students’ perceptions of post-secondary learning environs was dependent on the identities they brought to class.

While the chilly classrooms findings illuminated perceptions of post-secondary STEM classrooms, the research did not afford opportunities to understand how universities and the minoritized students influenced one another. Subsequent research, reviewed below, investigated post-secondary students situated in colleges and universities to better understand how being a minority in academic settings traditionally dominated by White men influenced the navigation of academic pathways. In a study involving 23 Black mathematics and engineering students, McGee and Martin (2011) found that participants encountered high levels of stress, simply trying to manage their racial identities in STEM settings where Blacks are underrepresented. Participants reported feeling as if they were not free to make mistakes; as if they had to continually disprove the stereotypes held by their White instructors and peers.

At the same time, the participants in McGee & Martin’s (2011) research were subjected to messaging which continually questioned the appropriateness of their participating in higher-level STEM classes. These messages ranged from surprised looks, to deeply offensive statements from non-White peers. These, “racialized encounters and messages” (McGee & Martin, 2011, p. 1380), were microaggressions, and were common across both academic and social spaces in 4-year colleges and universities. These microaggressions clearly and regularly conveyed a hostile

learning environment specific to STEM for students with minoritized identities, requiring the study's participants to constantly deal with the hostility. McGee & Martin refer to this constant coping as Stereotype Management. Despite the need for continual stereotype management, it is worth noting the participants had managed to remain enrolled in STEM disciplines at high levels.

McGee & Martin (2011) noted that participants in their study reported persisting in STEM disciplines to maintain perceptions of their intelligence that began long before college. To cope with hostilities encountered at college, participants were observed constructing racial identities that promoted self-worth and were dismissive of other's racist narratives. Some of that self-worth manifested itself when participants identified themselves as role models for subsequent minoritized students who would follow a similar path. The adaptations of students in response to their experiences as minorities in STEM disciplines observed by McGee & Martin are further illuminated by McGee (2016). Looking at the experiences of 38 students successfully navigating STEM academic pathways, McGee reports that 35 students abandon portions of their racial and cultural selves to minimize the racism encountered. At the same time, students were forced to deal with racist actions and statements without the active support of faculty or administrations at their colleges. McGee notes that:

The findings suggest that racial stereotyping and other biases were functions of STEM education at the university level and that academic success for students of color included learning how to navigate racism cleverly with a set of tools that soften the blow of stereotyping but never eliminate it (p. 1652).

The idea that students in post-secondary settings learn to manage the marginalization of their racial identities and within STEM academic settings is consistent across research examining successful STEM students from marginalized backgrounds.

The need for stereotype management in STEM academic settings for minoritized populations is consistent with prior research examining experience of students of color at predominantly White institutions (PWI's) more broadly. Research has examined the experience of being a visible racial/ethnic minority in post-secondary settings, and found students hold feelings of alienation and isolation. Davis et al. (2004), describes these experience of minoritized students in college classes as one in which the individual experiences the extremes of visibility and invisibility. The visibility comes at times when minoritized students are expected to represent their entire race, and the invisibility coming when students are excluded or isolated from participation in student communities. Davis et al. note that the polar extremes effectively reduce minoritized students' ability to construct their own identities when they write,

the theme of invisibility captures student experiences of an absence of validation for who they experience themselves to be whereas the theme of super-visibility expresses student experiences of having one's identity defined by other, usually more powerful, persons in the present setting. In neither case does the student feel primary authorship for the identity attained (p. 440).

The reduced agency resulting from being a numerical minority in the classroom is complemented by research by Baber (2012), who examined the experiences of African American college students at PWIs. Utilizing a conceptual framework that included *racial centrality* (how central race is in student's sense of self) and *racial salience* (how important race is in a particular context), Baber found dynamic shifts in how students viewed race during their first year at college. For many, friendships with racial/ethnic peers were supportive during the transition to college, providing opportunities to be included in communities within academic settings where racial identities had formerly made them outsiders. Baber notes that individuals' inclusion into

communities of racial/ethnic peers offers a mechanism of support that affords resiliency against racist events that could erode persistence in academic pathways. Within STEM courses at the post-secondary level, this critical mass of racial/ethnic peers is often lacking, leading to the isolation experienced by some in higher-level STEM courses.

To better understand how interpersonal interactions might facilitate increases in persistence, the work of Carlone & Johnson (2007) is illustrative. Carlone & Johnson studied fifteen women of color who were successful in post-secondary STEM. The authors proposed a three-part model composed of recognition, competence, and performance. This three-part model included recognition by others and recognition of oneself as a “science person”. Carlone & Johnson found that recognition by others was instrumental in decisions to persist. That recognition was not imposed upon the women, instead the successful women had a measure of agency allowing a redefinition of whose voices mattered in establishing the success of their academic careers. For some, this support was from established STEM community members. Others relied on the recognition of friends and family they deemed meaningful. The importance of recognition by persons deemed important to a student is important in that it provides a means by which women deal with the discrimination attributable to intersecting gender and racial/ethnic identities.

Following the 2007 study looking women of color who successfully navigated STEM majors, a more substantial examination of women’s methods for coping with the Double Bind was published. Johnson, Brown, Carlone, and Cuevas (2011) worked with three women of color who had been successful in STEM fields. The authors found that the participants regularly had a number of identities ascribed to them. It was the women’s agency in elevating narratives supportive of their STEM goals and suppressing narratives that were sexist or racist in nature

that allowed these three women to persist. The women did not accept statements from peers or supervisors who were not supportive of the ambitious STEM goals they had for themselves. The work of deflecting some narratives while elevating others was seen as constant, and something the women learned over time. The women reported that this learning allowed improved proficiency in authoring their own identities as women, and as scientists, as they progressed through their programs. Minoritized women were observed deciding who would be an authority considered valid for shaping STEM identities, exercising agency in how their identities-in-practice were shaped. These women were not merely passive in allowing their identities-in-practice to evolve.

This idea, that successful women of color filter incoming messages about their place in STEM to their benefit, is consistent with the findings from McGee in which students learned to filter discrimination based on stereotypes in ways that reduced the negative side effects. Research appears to indicate that minoritized students in post-secondary STEM settings learn to utilize agency in their interactions with academic peers and faculty members. That agency allows supportive messages to resonate while corrosive messages are cast aside. At the same time, minoritized post-secondary students, in STEM and more broadly, rely upon social relationships to mediate the isolation and discrimination they encounter. At times, these relationships are peers with similar racial/ethnic backgrounds. When peer relationships are not available, students rely on supportive faculty, friends, and family to provide recognition supporting their belonging in STEM.

Meaning Making: Determining whether minoritized identities belong in STEM contexts

Research informing understanding of how minoritized populations successfully navigate post-secondary STEM pathways demonstrates student agency in the construction of racial and

STEM oriented identities. This effective identity work is something not typically observed in the young boys and girls in studies on K-12 STEM education. Instead, the futures of K-12 students in STEM were strongly influenced by their instructors and peers. Students were engaged in identity work to positioning themselves as potential persons in STEM, but that work required recognition and support from others to indicate belonging (see Calabrese Barton et al., 2013). Unlike K-12 students, successful post-secondary students in the research have been seen selectively amplifying voices indicating they belong in STEM, while pushing back against the microaggressions and situational cues that indicate they don't belong. Successful minoritized students in post-secondary STEM settings were able to cope with racism while pushing forward.

This difference in the way K-12 and post-secondary students respond to STEM settings seem to indicate a shift that occurs between students' K-12 experience and graduation from college. It suggests that those who manage to persist in post-secondary STEM pathways learn to recognize racism, and then appropriate cognitive tools for reducing the ability of that racism to damage ideas about their futures in STEM. Literature suggests differences in how K-12 and 4-year college students navigate STEM. K-12 being influenced by instructors and peers while post-secondary students are seen having more agency. Identity illuminates affiliation with STEM and experiences as a minoritized individual, but fails to understand how the intersection of these two identities in STEM contexts. We can see what happens in large quantitative studies, how it happens in the social contexts, but there doesn't exist a good model to explain why students. Meaning-making appears to offer mechanism underlying decisions to persist.

Meaning-making capacity, alternatively known as authoring identity, self-authorship, or the evolution of consciousness (see Abes, Jones & McEwan, 2007, Evans, Forney, Guido, Patton, & Renn, 2010; Holland, 1998; Johnson et al., 2011), is the means by which individuals

make sense of themselves in light of their experiences. Separate lines of research by Kagan, and Baxter Magdola, establish that people shift how they make sense of themselves they mature (Evans, Forney, Guido, Patton, & Renn, 2010). This shift is sometimes characterized as developmental stages, but is better thought of as a progression in ability to make meaning that is learned over time. Teenage children and young adults are typically at a stage where they, “do not have a clear sense of self” (Evans et al., 2007, p. 185). Their understanding of self, coined *Formulaic*, is constrained to the messages they receive, conveyed by friends and family, teachers, media, and stereotypes. As people develop, they begin to question identities that have been attributed to them. Students question discourses that run counter to who they want to be. People become able to rely less and less on external interpretations of who they are, and more able to construct their own meanings in response to experiences. This more mature meaning-making is coined *Foundational*. An additional *Transitional* meaning-making stage exists between Formulaic and Foundational meaning-making, as an intermediate stage which includes elements of both stages. It is important to understand that how people come to understand who they are shifts over time. When they are younger, outside messages about their identities are seen as valid.

It is worth noting these shifts in meaning-making tie back to identities-in-practice established earlier in this framework. Summarizing the work of Mikhail Bakhtin, Holland (1998) illuminates these shifts in the ability of individuals to author their own identity when she writes, “differences between the neophyte, given over to a voice of authority, and the person of greater experience, who begins to rearrange, reword, rephrase, reorchestrate different voices and, by this process, develops her own ‘authorial stance’” (p. 181). The idea that people learn the ability to

interpret, amplify, or filter the messages they receive about who they are is important for thinking about how students come to see themselves as belonging in STEM.

Research by Abes et al. (2007) utilizes meaning-making ability to provide insight into the interplay between students' experiences and the multiple identities they hold. Within this framing, individuals hold multiple identities, and the salience of those identities is dependent on where a person is situated. Discourses informing identity are envisioned as contextual influences (see Figure 1). These influences are depicted as directed towards an individual's identities. Individuals with Formulaic meaning-making abilities are unable to filter these messages, allowing their identities to be shaped by the contextual influences.

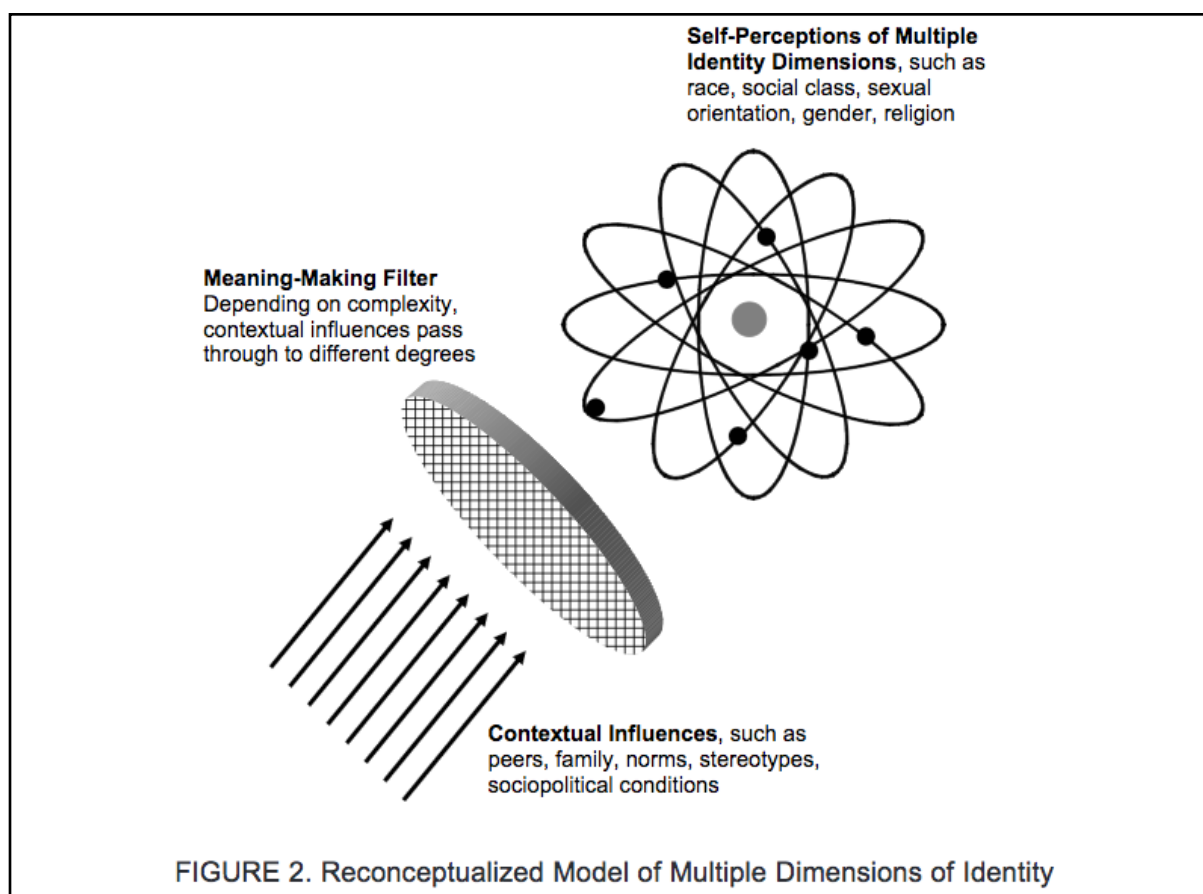


Figure 1: Model for identity development reproduced from Abes et al. (2007)

As meaning-making abilities mature, individuals are able to more effectively filter incoming messages in ways that allow for selective interpretation of experiences. The graphic depiction of this meaning-making process appears to conflict with identity-in-practice approaches to identity because individuals seem to be filtering incoming messages without any means of acknowledging the importance of participation in identity construction. It is important to note the authors go to great length to clarify that practice is central to their framing.

Participants actions were not representative of identity; instead, actions created identity...Participants who utilized more complex meaning-making demonstrated an awareness of the performative nature of their identity rather than a reliance on fixed and externally defined meanings. Those utilizing less developed meaning-making were not always aware of the performative nature of their identity; still, it was this unacknowledged performativity that lay beneath their attempts to fit into others' socially constituted expectations (Abes et al. 2007, p. 14)

With performance central to the construction of identity, the framing of Abes et al. (2007) is particularly complementary to discourse-based identity and identities-in-practice. In particular, the framing affords opportunities to explore the intersection of minoritized social identities and students' developing STEM identities. The framing additionally allows the study of how contextual factors influence those intersecting identities.

While the nuance of the components within this literature review will be used to inform the theoretical and conceptual framing that follows, I feel it is worth reviewing and justifying the necessity of very diverse bodies of research. First, we know that community colleges are positioned at the nexus of pre-college and bachelor's granting schools for traditionally marginalized populations pursuing STEM. We know that those same populations are not

realizing degrees and careers in STEM despite interest in those disciplines equal to their White and Asian peers. We know little about the dynamics of decision making by minoritized students interested in STEM at community colleges, but we can make inferences based on research on these same populations in K-12 and 4-year colleges. That research has demonstrated that identity is a powerful framing for understanding how non-dominant racial/ethnic identities interact with and influence the developing of STEM identities. We can see how the ways students make meaning around their experiences in STEM shift as they get older. For younger students, with formulaic meaning-making abilities, stereotypes and the racialized treatment arising from those stereotypes signal they don't belong in STEM. For older students, with Foundational meaning-making abilities, stereotypes and the racialized treatment encountered is mediated by coping strategies that promote discourses of belonging in STEM. It would appear that students at a community college are at a critical juncture where they shift from Formulaic to Foundational meaning-making.

Given the critical shift in meaning-making that appears to happen between K-12 settings and earning a Bachelor's degree, it is necessary to investigate the decision making by students of color interested in STEM at community colleges. This dissertation aims to address three questions about minoritized students in STEM pathways at the community college including:

- Are STEM disciplines at the community college level hostile to minoritized identities in ways similar to those found in four-year colleges and universities?
- How do the strategies utilized by students who successfully navigate STEM pathways at the community college level different than those utilized by students in K-12 schools and four-year colleges and universities?

- What cognitive tools do community college students employ to persist in STEM settings potentially hostile to minoritized racial/ethnic identities?

Theoretical Framing

This study intends to utilize identity trajectories to describe the identification or disidentification with STEM. People are seen as holding multiple identities including those ascribed to them early in life (e.g. race, gender, religion, social class) and co-occurring identities they develop over time (athlete, good student, fan of a particular sports team, STEM person). Critical and situated identities are utilized in concert with contextual discourses to frame both the identities held by individuals and the process by which those identities shift. Situated identities are used to describe nascent STEM identities, while critical identities are used to describe racial/ethnic or gender identities. Contextual discourses are envisioned as the messaging that students receive about their situated STEM identities. Those messages come to students through conversations, interactions, and events that influence students' situated identities. Contextual discourses that erode situated STEM identities would therefore be causing a disidentification with STEM, whereas contextual discourses that bolster situated STEM identities would cause identification with STEM.

The idea of different and evolving abilities to author oneself, while not present in the initial conceptual framing of this study, gained prominence through the analysis process, and came to speak directly to the findings of this study. While multiple ways of framing meaning-making exist, I intend to utilize Formulaic and Foundational meaning-making. I do not utilize Transitional meaning-making in the framing of this study for the sake of clarity.

Conceptual Framework

The conceptual framework for this study focuses attention on the intersection of individuals' critical racial identities and contextual discourses targeting students' situated STEM identities. Critical discourses in this framework include messages that signal belonging in STEM. These messages can come from peers, instructors, or friends and family, and can indicate belonging, or a lack-of-belonging. Similar contextual discourses might come from the grades that students earn and the stories that come from those grades, or the advice given by an advisor. The signals perceived as coming from these discourses are envisioned as shaping situated identities. By situated STEM identities, I mean the discourse-based identities and identities-in-practice students hold. Discourse-based identities incorporate stories about belonging in STEM disciplines, stories about being, "good at science" or a "future mathematician". Identities-in-practice might include participating in an engineering club or tutoring someone in STEM subjects. These situated STEM identities are the sum of a set of contextual discourses about whether a person is a "science person" or a "math person". It is important to note that the conceptual framing does not envision the relationship between contextual discourses and situated identities as direct. I envisioned discourses as being filtered in some way by the communities students were a part of, and the minoritized critical racial/ethnic and gender identities that they held.

It is worth noting that the initial conceptual framing for this study failed to incorporate the salience of minoritized identities. The research of Hurtado et al. (2015) had yet to be published when my work on this study began. The initial framing included contextual discourses, situated identities, and critical identities. The idea that someone's racial, ethnic, or gender identities would vary between individuals, and vary within individuals on the basis of context,

was something I had not accounted for. When this study started, and participants were reporting wildly different experiences, I was forced to seek out a more powerful explanatory framework. Salience afforded a means of accounting for the different experiences participants were reporting. Salience considers how central an individual's social identities are in their experience; indicated by how frequently someone considers their identity in a given context and how important they feel that identity is. For this research, the minoritized identities of concern included race, ethnicity, and/or gender. While salience offers a tool to avoid treating diverse populations monolithically, the impact of shifting and context dependent salience complicates how salience might influence students' identification with STEM.

There is a need to understand how these critical racial/ethnic identities interact with contextual discourses to cause identification or disidentification with STEM. For the purposes of this study, racial identities will be considered to be relatively critical and unchanging, while STEM identities will be considered situated and dynamic. The reality is that intersecting identities have the ability to shape one another, and contextual discourses may influence both critical racial identities as well as less established situated STEM identities. A model presented below (see Figure 2) attempts to more clearly envision how contextual factors interact with socially embedded minoritized identities to influence developing STEM identities and decisions regarding persistence.

The right hand side of Figure 2 includes descriptors of the elements of the diagram on the left. At the top are factors influencing a STEM trajectory, *contextual discourses* arising from an individual's experiences and interactions that include; academic communities of practice, early experiences in STEM, college instructors, grades, financial considerations, advising, family & friends. The central portion of the figure includes the *critical identities* of race and gender and

the influential voices arising from community's students are a part of. Within this model, interpretation of contextual discourses experienced is dependent upon individual's socially constructed racial identities and social actors who help interpret events. Because contextual discourses can be interpreted differently depending on how an individual regards the salience of race, the model includes multiple ways that discourses might impact trajectories. Meaning-making about what contextual discourses mean for a student's belonging in STEM is influenced by communities and minoritized identities.

Meaning-making of contextual discourses in Figure 2 is thought to be informed by the critical identities students hold and shaped by social interactions with influential voices. Meaning-making determines whether a particular discourse supports or degrades situated STEM identities. Situated STEM identities are represented at the base of this model as an arrow, and exist as a trajectory that can strengthen or weaken over time in response to contextual discourses. These different impacts on trajectories can bolster, erode, or have no influence on students STEM identity trajectories. Positive discourses push trajectories towards identification, neutral discourses don't influence trajectories, and negative discourses push trajectories towards disidentification with STEM. The base of the model includes a timeline of community college student experiences. The events included in the timeline indicate that trajectories can exist prior to post-secondary enrollment and after graduation from community college. Trajectories are conceptualized as continually influenced by contextual discourses, and the timeline is not intended to imply trajectories are altered at specific stages.

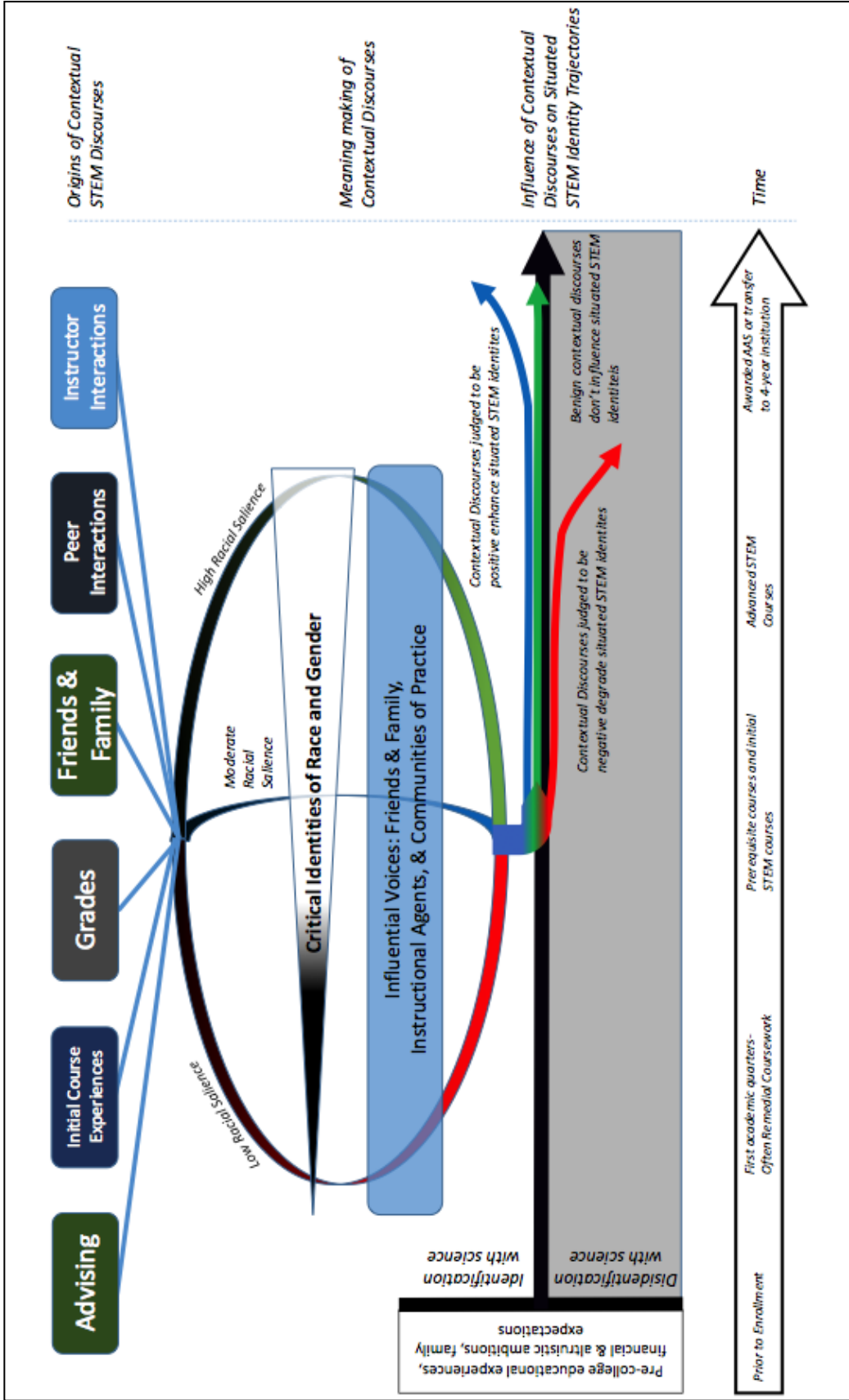


Figure 2: Conceptual framework describing the interaction of contextual discourses, critical racial/ethnic & gender identities, and communities of practice on situated STEM identities

METHODS

Researcher's Statement

As a white, heterosexual man from a middle-class background, I recognize the research I engage in follows troublesome patterns established over centuries, in which privileged white men “studied others” to establish a body of knowledge perceived to be fact. I understand how many might be skeptical of the credibility of research, given it was undertaken by someone with my set of identities. Because of this, I feel it necessary to be transparent about my background, and the work I’ve done regarding my own identities, in order to establish trustworthiness. Thirty years ago, my family’s privilege allowed me to leave the economically and racially diversifying schools of southwest Houston, Texas for the affluent suburbs of Bucks County, Pennsylvania. My experience in the late 1980’s and early 1990’s are the embodiment of white flight. Through university coursework, and the national discourse initiated by Rodney King’s beating at the hands of police officers in the mid 1990’s, I started becoming aware of the dynamics of race and racism.

Over the decades that followed, I continued learning about systemic oppression as I taught science at K-12 schools. My experiences watching talented male and female, Black, Hispanic, and Native students fall into familiar oppressed roles made me question my identity within the education system, and my own role within that system. I tried radical approaches to organize and empower Hispanic and Native students, only to find my teaching position had been reassigned for the following year. A subsequent return to graduate school found me teaching academic skills and social identity to academically struggling students at a large R-1 institution. I worked alongside lesbian, transsexual, and African colleagues, teaching Black and Brown

students the works of Audre Lorde and Edward Said, which in turn forced me to reflect upon my own intersecting privileged identities as I worked with others.

My understanding of discrimination on the basis of social identities has continued as I culminate my studies at the University of Washington, and work at Whatcom Community College. I am fortunate, in fact, to be employed in a leadership role at the community college. I have sought to utilize my position as a means of affording opportunities to those who have traditionally been marginalized. I work closely with colleagues in a variety of campus centers, and regularly volunteer my time to chaperone events and conferences where minoritized students can enrich their understandings of who they are. I have honest and frank discussions about identity with non-white peers. These discussions range from the individual to the social, and I hope that my efforts convey honesty and transparency to those I work with.

In conducting this research, I have routinely sought out the perspective of scholars and students who hold minoritized identities. At every stage, conversations about my research with diverse students and colleagues have afforded insight. My perspectives have been shaped by these conversations in ways not possible, were I to rely solely on my experiences growing up. These conversations arose from relationships and friendships, and my efforts to build supportive relationships involve many of the students participating in this study. I maintained those supportive relationships and friendships with this study's participants after the study concluded or they transferred to a four-year institution. I check in to ask about how family members are doing, how university is going, or to offer advise about pursuing a degree with a new baby in the home.

These relationships will no doubt influence the dynamic between the researcher and participants. There is a threat that participants will skew their responses in an attempt to support

my research, or students might avoid responding to questions in ways that would cause me discomfort. At the same time, I feel that these relationships afford opportunities for more honest conversations about sensitive racial and ethnic experiences than would be possible between strangers.

Still, I recognize that the identities I hold will influence both the interactions between participants and myself, and what I am able to see as a researcher. I recognize that my perspective is forever tied to a worldview shaped by my identities. I understand that a reader of my findings might be skeptical, and to address this skepticism I rely heavily on the voices of students in the findings that follow. I hope that by sharing extended, unedited portions of interview conversations, the claims I make will be construed as less dependent upon my privileged identities, and seen as more closely reflective of the experiences of those students with whom I worked.

Research at a Community College

Prior to recounting specific methodological details, it is worth taking a moment to identify some of the constraints that come with qualitative case study methodologies at a community college. To begin, many students are at an institution for a limited period of time. Community colleges are typically attended for two academic years. This short period of attendance relative to four-year colleges and universities reduces the window during which an individual might be followed. Students also change their majors and career intentions as they progress through early college coursework. In many cases, participants in this study were found to identify STEM as a degree pathway of interest in the final months of attendance, having been initially undecided or considering alternative majors. Community college students are also more likely to attend college on a part-time basis, and to skip enrollment for a quarter or longer when

compared to students at four-year institutions. This irregular attendance, combined with dynamic commitments to STEM pathways, has implications on what constitutes a case for this research. Those implications will be highlighted throughout this section.

Context

Research took place at Cedar County Community College (CCCC), a predominantly white institution in a city of 80,000 people in the Pacific Northwest. The county is 80% White, 9% Hispanic, 1% Black, 3% Native American, and 0.3% Hawaiian/Pacific Islander. CCCC serves 6,600 students seeking college level credits each year. The student body composition parallels the county's demographics with a student body that is 75% White, 9% Hispanic, 2% African American, 3% Native American, and 7% Asian/Pacific Islander. 26% of students receive PELL Grants, and 43% of students report they are the first in their family to attend college. CCCC is accredited by the Northwest Commission on Colleges and Universities, and awards five different associates degree options including an Associate in Science intended to prepare students to transfer to a four-year institution. The college also offers fifteen professional-technical certificates in subjects like computer information systems and medical assisting.

There are no large lecture halls on campus, instruction at CCCC takes place in relatively small classrooms. Class size is typically capped at thirty-five students in a section. Courses are taught by a 78 full-time and 180 adjunct faculty. STEM faculty typically possess a M.S. in their area of instruction, though the full-time faculty does include PhD's in mathematics, physics, chemistry, engineering, mathematics education, science education, and biology. CCCC offers a broad range of STEM courses that include Biology, Chemistry, Physics, Geology, Engineering, and Mathematics. Mathematics courses range from remedial pre-college courses through linear algebra and differential equations. Chemistry classes include a general chemistry sequence and a

three-course organic chemistry sequence. Physics courses include general physics and engineering physics. While these STEM courses are organized so that students can earn an Associates of Science degree, many students who take these classes transfer to a four-year institution without earning a transfer degree.

Participants

This research utilized a multi-case study approach (see Creswell, 2013; Green, Camilli, & Elmore, 2006; Merriam, 2009). Cases were all selected from the same institution, and included only students who were pursuing their first undergraduate degree. All individuals who identify as a minoritized racial/ethnic identity (African American, Latino, Native American, or Pacific Islander) and who indicated an intention to pursue a future in STEM were included. To answer the questions of interest, this study required flexibility in the semester status of participants. Students decide to pursue STEM at different points of their academic career. Some start college knowing they want to be in STEM, while others decide after completing a number of semesters at college. To capture this variability, it is necessary to incorporate any STEM interested individual into the study.

That flexibility meant the time period during which individuals participated in the study varied. No conditions regarding semester status were placed upon participants to allow any student opting into STEM pathways to be included; meaning students in their first quarter and students in their last were included. Because it takes time to develop the trusting relationships necessary for meaningful conversations on issues of race, ethnicity, and gender, minoritized students were not asked to participate without prior interactions with the researcher. This meant that individuals were asked to participate in the study after the researcher was able to engage in at least a couple of non-research related conversations.

Participants were included in the study from the point they agreed to participate. Participation ended when they transferred to a four-year university, they decided to abandon the pursuit of a STEM pathway, or the time data collection for this study ended. Eleven participants with diverse identities and backgrounds agreed to participate in this study. While attempts were made to maintain gender parity, disproportionate overrepresentation of men in STEM fields skewed the ratio of men to women in this study. Only three women of color were identified for this study. Participants were not compensated, though the researcher offered support in navigating post-secondary academic pathways and in accessing academic supports available to all students. For the purposes of this study, STEM disciplines excluded degrees and careers in medicine.

Participants' attendance at CCCC ranged from two to thirteen academic quarters. Five participants were part time for a portion of their enrollment and eight were full time. Three participants had inconsistent enrollment, having at least one academic quarter during their attendance for which they were not enrolled.

Data Collected

Semi-structured interviews

Participants were asked to engage in semi-structured interviews (Merriam, 2009) each quarter they were eligible to be part of the study. Interviews took place in a quiet office and were recorded for later transcription. First interviews for all participants included a common series of questions (see Appendix 1 for Interview Protocol). Questions were organized according to themes, and corresponding sub themes. The first theme included pre-college and non-school related experiences in STEM to better understand what sorts of STEM identities students brought with them to college. The first theme sought to explore participants' motivations for pursuing

STEM, experiences in middle and high school and an individual's exposure to friends or family working in STEM careers.

Table 2: Participant demographic information

Name	Quarters Enrolled	Degree/ Career Intent	Opted into STEM pathway	Reason for exit from study	Gender, Racial/ Ethnic Identity	Other	Enrollment
Carlos	13	Petroleum Engineer	After matriculation to college	Transferred to university	Male, Latino		Some part time, Discontinuous
Sofia	13	Applied Mathematics	After matriculation to college	Transferred to university	Female, Latina		Some part time, Continuous
Daniel	8	Prosthetics Engineering	Prior to college	Transferred to university	Male, Black	Veteran, Returning Student, Parent	Full time, Continuous
Juan	2	Engineering	Undecided between law and engineering	Dropped out of pathway	Male, Latino		Full time, Continuous
Jose	11	Mechanical Engineering	Prior to college	Dropped out of pathway	Male, Latino	Returning Student	Part-time, Discontinuous
Ken	8	Aeronautical Engineering	Prior to college	Currently enrolled and pursuing STEM	Male, Mixed Race		Full-time, Continuous
Dylan	10	Electrical Engineering	Prior to college	Dropped out of pathway	Male, Mixed Race	Veteran, LGBTQ	Full-time, Continuous
Martin	4	Engineering	After matriculation to college	Currently enrolled and pursuing STEM	Male, Latino	Veteran	Full-time, Continuous
Miguel	3	Engineering	Prior to college	Dropped out of pathway prior to enrollment in STEM coursework	Male, Latino		Full-time Continuous
Pedro	7	Electrical Engineering	Prior to College	Dropped out of pathway	Male, Latino	Veteran	Full-time, Continuous
Asher	5	Prosthetics Engineering	After matriculation to college	Transferred to university	Male, African/ African American		Part-time, Discontinuous

The second theme aimed to explore the development of existing STEM identities at the community college, and explored a variety of factors that might be supportive of students who had decided to pursue STEM pathways. Included in the second theme of questions was a card sorting exercise. Index cards were presented with potential influences written on them. These influences represented contextual discourses from the Conceptual Framing of this study, and included grades, interactions with instructors, interactions with peers, financial aid & advising, friends & family, and initial experiences in STEM courses. Additional *blank cards were made available* for students to identify factors influential in decisions regarding persistence in STEM pathways that were not already present on index cards provided. Participants were asked to sort these influences into categories that represented the relative influence on their decisions to persist in STEM. These categories included *very influential, moderately influential, and not influential*. It is important to note that participants were told influences might be supportive of futures in STEM, or might discourage a future in STEM. This distinction between influential or not influential and supportive or not supportive was conveyed to students, and initial probing questions asked if an influence was supportive or not. Questioning then probed then reasons for each categorization.

The final theme asked specifically about factors that may have influenced how students viewed things like grades or interactions with instructors. These mediators of influential factors included the communities that students participated in, friends and family, and students' racial/ethnic and gender identities. Questions regarding race and gender were asked last to see if students brought up issues of minoritized identities without prompting. When individuals were interviewed several times, questions from the first theme were skipped. Subsequent interviews started with the second theme, asking how college was going broadly before presenting

interviewees with cards arranged how they had been during the first interview. Participants were asked if anything had changed regarding how influential factors had been over the last few weeks. Participants were asked to explain any changes in how influential an influence was ranked. Interview questions from the third theme then asked to probe changes in participants' interpersonal interactions and the role of race and gender in their college experience. Interviews were transcribed, and member checks were used to verify interpretations of transcriptions.

Researcher Notes

Researcher notes were taken during and immediately after interviews. Within-interview notes focused on themes emerging during the interview. Post-interview notes typically included researcher reflections and impressions summarizing what was heard regarding STEM, gender, and racial/ethnic identities. Researcher notes were also compiled during the course of data analysis, with thinking captured through diagrams and written statements.

Academic Transcripts

Academic transcripts were obtained for each participant. Transcripts were analyzed for a variety of factors including, how long a student had been enrolled at CCCC, full-time vs. part-time enrollment trends, overall college GPA, STEM specific GPA, and the number of times a student retook a STEM class.

Data Analysis

Codes for analyzing data were initially derived using deductive processes reliant upon extant research and the conceptual framework guiding this study. An inductive process in which an initial read of transcripts from the first three interviews was then utilized to identify emergent themes. Transcripts were annotated with researcher notes attempting to identify when participant

answers aligned with previously identified codes, or offered opportunities for new codes. This combination of deductive and inductive process was used to construct an initial list of codes. That list was then sorted to establish larger themes. These themes were used to establish code families (Creswell, 2013; Merriam, 2009; Miles, Huberman, & Saldaña, 2014)

These code families included influential people, academic community of practice, unrelated constraints, institutional structures, institutional norms, STEM identity, and minoritized identity. Code families were combined when appropriate. Codes derived from deductive processes, but not found in the data, were abandoned (see Appendix 2 for coding scheme). Of particular interest are the codes associated with *Meaning Making*, *Racial Salience*, and *STEM Identity*, due to their eventual centrality in the findings. For meaning making, attention was paid to student reasoning about their race or their belonging in STEM. Quotes often attempted to explain why students made certain decisions, or tried to infer the reasoning behind the actions of other people. This reasoning contradicts identity based quotes associated with race, gender, or STEM identities. Within STEM identity quotes, participants were typically speaking of their abilities in STEM classes, their plans for a future in STEM, or experiences within disciplines.

Quotations regarding the salience of minoritized identities often spoke of noticing one's minoritized identities within STEM contexts, or statements about growing up as a person of color. It is important to note that the degree to which participants spoke about their minoritized identities, and when they brought those identities into conversation during an interview was significant. Participants who shared stories about their minoritized identities prior to any questioning, and continually throughout the interview, were seen as having more salient minoritized identities than those who only spoke about those identities in response to questions about those identities. Only two individuals never brought up their minoritized identities during

questioning and, with prompting, reported those identities had no influence on their student experience. The role of meaning making, racial salience, and STEM identity is explained within the findings that follow, but it is worth noting their importance and providing explanation here.

Researcher notes were coded by hand, and all interview transcripts were coded using ATLAS.ti, with emergent codes continuing to be identified and incorporated into existing code families during transcription and coding efforts. Themes were then used to develop hypotheses that were tested against data collected. Confirming and disconfirming evidence was sought to refine and strengthen these hypotheses.

In addition, a series of respondent matrices (Miles et al., 2014) were constructed using demographic data, transcript data (including GPA, enrollment consistency, part vs. full time status, STEM GPA, and STEM courses failed), and the presence (or absence) of codes in interview transcripts. These matrices were used in conjunction with quotes that were exported according to the dominant themes arising. These quote lists, exported from ATLAS.ti included quotes coded with meaning making, quotes coded with salience of race, and quotes coded with STEM. Multiple attempts to conceptualize the relationships between the dominant themes include the construction of semiotic squares (Feldman, 1995) and graphs that worked to understand how themes interacted with one another. Hypotheses that arose from this data analysis were continually compared to the data in an attempt to strengthen or disconfirm each hypothesis generated.

Beyond data analysis at the individual level, conversations with a variety of other individuals provided insight. There existed two academic advisors who helped to make sense of the patterns I was seeing. Similarly, nascent hypotheses were shared with a variety of individuals. One participant from the study (Daniel) provided insight after he transferred to a

four-year institution. A number of colleagues and scholars from the community college where I work also helped develop, evaluate, and refine the hypotheses that arose from the data. My efforts to utilize member checks and debriefing sessions with more experienced researchers were sincere attempts to achieve credibility (Shenton, 2004). I hope that when combined with the trusting relationships I formed with participants, my reliance on participants' own words throughout the findings, my efforts to triangulate data sources, my analysis of negative cases, and my reliance on a robust review of previous research, I have conducted a study that is perceived as credible for those who read it.

FINDINGS

This research intended to investigate experiences and responses influencing persistence in STEM pathways for students holding minoritized identities. Three different themes arose from the data analysis. I start the findings with STEM identity development for latecomers to STEM (those who decided to pursue STEM after matriculating to college) intentionally. Doing so allows insight into the nature of contextual discourses used in STEM identity construction, and the way those stories are offered to, and taken up by, the communities that students are embedded in. The first of these findings will demonstrate how academic success in initial STEM courses allowed students to opt into STEM academic tracks.

Given the power that academic success had on latecomers to STEM, I follow by exploring the power of academic struggles as an explanation for why students might choose to opt out of STEM. With academic success being important for entering into STEM, it would seem that academic struggles would be a strong influence in decisions to opt out of STEM. This, however, was not observed to be true; students did not opt out of STEM because they were failing STEM

classes. The second finding will illuminate how academic struggles were an inadequate explanation for decisions regarding persistence in STEM.

With academic struggles insufficient for understanding decisions to opt out of STEM academic pathways, there is a need for a better explanation of how students with minoritized identities (identities that are underrepresented in STEM because of social structures and norms that advantage white men) made decisions regarding persistence in STEM pathways. The third finding introduces a new mechanism to understand decision making for people with minoritized identities in STEM. It was found that how students navigated the intersection of SEM and minoritized identities was important in decisions to persist. Keeping in mind that students have numerous social identities that include religion, social class, gender, sexuality, and race, these findings focused on participants' STEM identity and those social identities that are underrepresented in STEM (women and persons of color). The findings will illustrate how students who problematized the intersection of their minoritized identities and their STEM identities were more likely to persist than those who attempted to disregard or segregate their minoritized identities and their STEM identities.

It is important to note that the role of academic successes and struggles, the utilization of discourses in social settings, and the way minoritized identities intersect STEM identities are interconnected and co-occurring. For the sake of clarity, they are presented in what follows independently.

Impact of academic success and course placement on STEM identities

Latecomers to STEM

The findings begin by looking at those who came to STEM *after* matriculating to college. The process of identity construction is most easily seen in these participants, as many of the influences on those nascent identities are evident in the interview data. Four participants (Sofia,

Carlos, Asher, and Martin) decided to pursue STEM after starting at the community college with non-STEM or undecided academic goals. None of these individuals who came to STEM late stopped pursuing a STEM pathway. Rather, all of these latecomers persisted in STEM, with Sofia, Carlos, and Asher successfully transferring to a university, and Martin earning A's as he progressed through college level STEM coursework at the conclusion of this study.

For these four students, success in community college mathematics sparked their identification with STEM—before college, these four students had no plans to pursue degrees and careers in STEM. As these students started encountering success in their STEM coursework, they utilized narratives about that success in social interactions. Participants reported sharing their success with peers, friends, and family. Participants played an active role in the construction of STEM identities. I begin with Sofia, who's initial career intentions involved early childhood education. Sofia was selected as the first case because she so explicitly identified the role that early success in mathematics played in her decisions to pursue STEM. At the same time, she is also clearly employing stories of her success as she interacts with peers and with her family. Sofia starts by establishing that her success in early mathematics was, “influential in a positive way” and fundamental in her decision to switch into mathematics. Recalling her reaction to success in pre-college level algebra classes, Sofia shared:

I was like “oh yeah, I'm such a wizard”... You know, things like that started making sense more now than they did in high school. I feel in high school, yeah I was getting good grades, but it was more like, oh just come and just turn it in and, you know if you get it wrong, turn it in again and you'll get extra credit. Whereas in college I felt like it was more, I

felt like I was getting good grades, but I felt like I understood the material.

In that same exchange, Sofia explained how her academic success was so important in her decision to pursue STEM. She can be heard reinforcing discourses regarding her ability in mathematics in social settings involving academic peers. Fellow students were coming to Sofia, asking her questions that allowed her to demonstrate her conceptual understanding to others.

Sofia noted this more social element of her developing STEM identity when she shared:

People who I was in class with, they would ask me things, and you know it makes you feel, “Wow, I know what I’m doing,”...And it’s like, you know, being in college and having people ask me questions, it taught me that I knew more than I was given credit for, and I think that had a big impact on why I also went the math way.

Sofia found that recognition in college classes from her peers regarding mathematics ability called into question high school math classes where her grades were assigned by completing assignments as opposed to content understanding. In addition to amplifying discourses about her competence in mathematics among peers, Sofia could be heard bringing those discourses home to family members who helped strengthen her STEM identity. Sofia noted:

My parents would always put my test on the fridge and it felt good. You know my brothers would come in, they’s be like “Sofia, all I see is a bunch of letters and numbers, what does all this mean” I was like, “oh yeah, I’m smart.” And sometimes my brother used to call me, “You’re such a geek,” and I like it. A lot of people don’t like it, but I like it.

The support Sofia recalls receiving for her newfound STEM identity at home served to bolster the identity. In this sense, Sofia was more than a passive recipient of messages about her

capabilities in mathematics. Her grades indicated she had understanding, but by interacting with peers and explaining problems, and by making her grades public at home, Sofia was taking up discourses about her STEM identity and working to perpetuate them. In this way, Sofia's STEM identity was seen to arise from discourses available because of early success in mathematics courses.

Similar to Sofia, Carlos also spoke about the role of math grades as a means of entering into STEM. Recounting how he was initially undecided with regards to his major, Carlos shared, "at the beginning of my college career, I was, I didn't get good grades. I remember I got an F in a math class because I stopped going." Unlike Sofia, who encountered academic success from the very first courses she took at college, Carlos started community college by failing STEM classes. It was only when he started to succeed that he envisioned petroleum engineering as a possible career. Carlos noted, "when I came back I started to get good grades, so that really like, when I started getting good grades, it really influenced me to keep going."

It is important to note that Carlos did not have the very supportive family or peers asking for assistance Sofia had. Instead Carlos was heard using discourses about his STEM identity to justify his place in STEM. While Carlos's initial success sparked his intentions to pursue engineering, his STEM identity was dependent on him introducing that identity into social spaces. He could be heard leveraging success in STEM coursework to counter the narratives of those who might be skeptical. Carlos recounted how he ended up sharing his success in STEM during an argument with his mother:

Just one time I told my mom. I was still living with her, and she was saying, "You should just focus on school, don't focus on girls, and just do your stuff." I probably think you're not doing anything. And I remember that winter quarter I got a 4.0. In got three classes I

got a 4.0 and I was like, “I’m not doing anything?” (slapping his grades down on the table), I put it in her face!

While not as agreeable as Sofia’s parents posting grades on the refrigerator, Carlos’s making his grades public in an argument brought an additional person into the construction of his STEM identity. A similar utilization of discourses surrounding his STEM identity was heard in another exchange in which Carlos notes how he pushes back against unsupportive his family members who were skeptical of his taking advanced STEM classes:

they all told me go take, saying, “You don’t have to take all those hard classes. You’re going to fail.” If I fail, I can just maybe in the future take it again. You know, I guess it’s just me and, I don’t know, I just don’t like when they say, “You can’t do this” because maybe they’re saying I’m not smart enough. Or I guess I’m not capable enough. I guess I like to prove people wrong.

By utilizing his success in mathematics in conversations with his family members, Carlos was bringing contextual discourses supportive of his STEM into prominence. These discourses started with his early mathematics coursework and continued as he encountered success in subsequent math courses. At the same time, he is working to disregard the corrosive discourses coming from family. The sense making that Carlos is heard using indicates that he is able to reify his sense of self in STEM by relying on supportive discourses while discounting those that are harmful.

Whereas Carlos appeared to be using discourses regarding his competence in STEM to justify his pursuit of engineering in conversations with his family, Asher did not encounter the same skepticism from his family. Similar to Sofia, Asher had parents who were supportive of his intentions to pursue STEM. Like Sofia and Carlos, Asher noted that it was success in

mathematics that pushed shared in his calculus class were sufficient to shift his degree intentions from biological sciences to engineering. Asher noted that he had been earning B's and C's in his biology science classes, but it was extreme success on a mathematics test spurred his move to engineering. Recalling the test, Asher shared:

I knocked it out of the park. I think I got a 98 or something. No, take that back, I got a 101. I got extra credit for something. Yeah. It was crazy, I said What? So that I think that was one that was big and then the rest of his tests I aced throughout the quarter and it was nice.

Asher's academic success continued throughout the course that quarter and information about his success was not confined to that math class. Asher recounted how he was quick to share his success with his family, "Oh yeah, picture sent to mom, it was a picture sent to mom." At the same he reported sharing his academic successes with peers within the math class. In sharing his successes with his family and with his classmates, Asher was taking a discourse regarding his ability to achieve in STEM and making it public.

The discourses were made available through a grade on a test, but it is Asher's taking this discourse and making it public that leads to his increasing identification with STEM. Asher's case differs from Sofia and Carlos in that he can be heard rationalizing his decision to pursue engineering. In a separate exchange, Asher explained how he was utilizing his grades in mathematics to bolster his developing STEM identity as he explained the relationship between his interest in math and the grades he was earning. Asher can be heard using discourses from his grades in an exchange supportive of his STEM identity relative to mechanical engineering.

I think my interests are taking me in a direction, but then my grades are like confirming that I want to go that way. It's like, okay, I'm interested in this, I really like math, I think

I'm better at math than the sciences, so I'm going to take some math classes and see where this goes. And then I'm doing well in my math classes; I'm getting good grades.

It's like hey, maybe this is the way I should be going cause I seem pretty good at this and I seem like I can go far with this.

By encountering academic success, sharing that success with his parents and peers, and in rationalizing connections between his interests, and academic success, Asher was observed constructing a STEM identity that arose from success in calculus.

While Sofia, Carlos, and Asher were quick to note when they had introduced their success in mathematics into social settings, Martin seemed to be more reluctant to note how he had made his successes public. Like fellow latecomers, the role of success in mathematics was heard in interviews with Martin. Martin shared that his experiences in STEM prior to community college were not supportive of a STEM identity. Recalling his initial elementary algebra class, he shared his grades, noting, "I got an A, so it was in the 90's every time." Martin's academic success was then juxtaposed with his high school experiences in math.

In high school I took that same class I think, I remember my senior year I would do the quadratic formula but I was just like, "what is this?" After that, with Mr. Smith, I was like "okay, this isn't too bad," but I got like a D in algebra 2 in high school, but I finished with an A now.

It was Martin's initial success in pre-college mathematics that opened up the option of considering mechanical engineering as a possible degree pathway. Martin did not keep his math grades to himself. Later in that same interview, Martin can be heard sharing his success in mathematics with friends from his military career and with his family. Not wanting to come across as if he was bragging, Martin noted, "I don't know, I haven't really...I told my friend, we

were in the navy together...I told my mom, she's just like, 'yeah'." While Martin seemed dismissive of how he shared his successful grades, it was apparent that he had not simply kept discourses arising from his grades to himself. At the same time, Martin sought out the support of faculty and staff at the college. Martin regularly asked his math instructor and myself if we thought he was capable of pursuing engineering. Each person Martin asked was supportive of his working towards a future in engineering.

Like Martin, all four of the latecomers to STEM in this study encountered success in mathematics as a situated discourse, a story about academic ability that established their belonging in STEM. In addition they all utilized that discourse in support of STEM identities in the communities they were embedded within. Given the important role STEM grades appeared to play for latecomers to STEM, the influence of grades was explored for those who intended to pursue STEM prior to attending the community college. It appeared that failing grades were *not a strong predictor* of persistence.

Impact of academic struggles on intentions to pursue stem

I found that students' initial mathematics placement, indicating their level of math knowledge at the beginning of their community college, did not factor into students' decisions to opt out of STEM. Only Juan, Asher, and Isabella were able to enter the community college taking college-level mathematics coursework. The remaining ten individuals started in precollege math (algebra or basic mathematics). Participants included students who went from elementary algebra through advanced mathematics coursework to transfer, and those who went from precollege math to calculus only to opt out of STEM. Students opted to drop their pursuit of a STEM pathway at multiple points, from basic math to calculus.

Given the influence that academic success in STEM courses (particularly mathematics) played in bringing latecomers into STEM, the impact of academic struggles was investigated as

an mechanism underlying decisions to opt out of STEM pathways. Only one student who opted out of STEM (Miguel) cited STEM coursework that was too difficult was only cited as a reason. It is noteworthy that each of the students who opted out did fail a STEM course. It is also worth noting that many of those who persisted failed a STEM course as well. Daniel, Sofia, Carlos, and Asher failed courses in STEM during their community college career, but persisted in pursuit of STEM. Of those who dropped out, all but Miguel felt as if they were academically capable of any courses required of a STEM pathway. In cases where failing grades preceded a decision to opt out of STEM, participants were most likely to attribute the grades as indicative of shifting interests.

It is important to note that there is no effective means of assessing whether students grades are a reflection of effort and interests, or if those grade influence students' efforts and interests. In asking students, attribution for failing a course was routinely given to shifting interests. This confidence in academic ability is exemplified by Dylan, who in talking about his failing grades in mathematics stated, "I know I can do the work, I know I can do it." Juan shared similar sentiments when he noted how he was simply no longer interested in a computer science degree as he was intending to shift to law. Jose, Mariana, and Pedro were similarly confident in their ability to succeed in STEM classes. Given students' assertions that academic performance didn't lead to departure from STEM, and given the persistence of those who failed a course but stayed in STEM, academic struggles in STEM classes was not found to be a strong predictor of student persistence.

Academic struggles, including academic placement in remedial/pre-college coursework, or the failure of a course that required it be retaken, no doubt influence the trajectories of students in STEM.

Table 3: Participant math progression relative to decisions to persist in STEM

	Basic Math	Elementary Algebra 1	Elementary Algebra 2	Intermediate Algebra	Pre-Calculus 1	Pre-Calculus 2	Calculus 1	Calculus 2	Advanced Mathematics	Key
Pedro							⊕ ●			Transferred →
Dylan							⊕ ●			Stopped out — ●
Jose							○ ●			Persisting at conclusion of study →
Carlos		○							○ →	Class retake/failure — ◆
Juan							●			Discontinuous enrollment ○ →
Sofia								○ →		Non-STEM degree intentions →
Daniel					○	○	○	→		Intentions to pursue STEM degree —
Ken									◆	
Martin									◆	
Isabella									◆	
Asher									○ →	
Miguel	●									
Mariana				○ ●						

These struggles extend the time it takes to graduate, require additional financial expenditures, jeopardize financial aid, and introduce stories about STEM competence that run counter to existing STEM identities. I do not suggest that failing a course or starting out in remedial mathematics are not influential, but they are not adequate explanations for students' departure from STEM pathways. Because of this, and given the centrality of identities in decisions to

pursue STEM outlined in the first finding, it is necessary to more closely examine the role of students' minoritized identities within STEM pathways.

Minoritized Identities in STEM

To explore the role that intersecting minoritized and STEM identities might have on persistence, it was first necessary to establish that minoritized identities, situated within STEM, encountered marginalization from others. Establishing that individuals with minoritized identities encountered racialized and gendered STEM settings at community colleges, similar to the settings identified at K-12 and four-year institutions, was essential. It was possible that non-dominant racial or gender identities wouldn't incur any marginalizing treatment. It was only after establishing that participants with minoritized identities were subject to marginalization that subsequent analysis of the intersection of STEM and minoritized identities makes sense.

The presence of hostile discourses about minoritized identities in STEM

I found that minoritized populations did face marginalization from a variety of sources, including peers, instructors, and advisors. The way participants responded to these micro-aggressions will be reported later in the findings, but the following section intends to establish that many of the participants had experiences that made their minoritized identities salient within STEM. This is not to say that all students with minoritized identities encounter hostilities. Two individuals, Ken and Martin, reported not even noticing their minoritized racial identities within STEM. Another participant, Miguel, who's academic career never ventured beyond basic arithmetic, simply noticed that there were a lot of white people on campus. This lack of noticing was not the norm for most. For the majority of participants, minoritized identities were salient to experiences within STEM; experiences that were hostile.

To begin, Daniel shared a description of his experience as a Black man in an upper level mathematics classroom. Daniel shared how his minoritized race was central to his experience as

a student. This centrality was apparent when he recalled how his experience as the recipient of doubtful gazes from his peers. “Sometimes you may assume or someone may get that look, you see that look, like “Why is that person in this class?” you know, like someone may assume that you don’t belong there.” Taking those looks one step farther, Daniel noted that his identity as an African American led some to question his abilities in mathematics. “Yeah, like people will do it...I mean honestly sometimes you know, you feel as though people expect you to drop out of that class; I mean you know?” Daniel shared that this marginalization, for him, was largely coming from other students. It is important to note how the subtlety of a questioning glance served as a barometer as to the racialized nature of the students in his class. Daniel reported that students never talked explicitly about race in class or outside of class. A similar inference of his classmates’ beliefs was expressed when Daniel shared how discourse regarding Donald Trump was a lens into the beliefs of his peers. Noting that statements by peers were, “full of dynamite,” Daniel explained how a peers defense of a politician who alleged that Mexican immigrants were drug dealers and rapists, was an indicator of thinking that would similarly marginalize him as an African American man.

This unspoken or subtle signaling nested in glances or comments was common for a number of participants. Asher, a Gambian man pursuing engineering reported similar doubts about his intellect coming from his peers. When asked whether he thought his peers recognized his African identity within his STEM classes, Asher noted that peers more than noticed, they required him to prove his academic abilities.

Do they notice? Oh, I think they do too. I think they, I don’t know if they do, in the terms of oh hey...Ah, if it was another white guy maybe I’d go up to him and, hey you want to study? Like you want to help me out with this? Because I’m a black guy, if that

influences their outlook that, “Hey, do you want to help me out with this?” until maybe after a test. It’s like, “oh, hey he actually knows what he’s doing. Well maybe we should interact.”

Asher went beyond noting the racial consciousness of his peers to include the contingencies that came along with that consciousness. Whereas a White or an East Asian student might not have to prove their belonging in a STEM class, Asher and Daniel felt as if it was incumbent upon them to prove themselves to peers if they wanted to be accepted.

Unlike Daniel and Asher, who reported classmates as the primary sources of racist discourses in STEM, Sofia reported encountering discrimination from professors and advising staff in addition to students. To begin, Sofia recounted how instructors were surprised by her abilities in an algebra class. Recalling, “I just felt like there was always that, you know, me being there and being a minority and doing good, I felt like it was weird for them, it was like ‘wow this girl really knows what she’s doing.’” The treatment by her instructors is never something blatant, but instead it was a feeling. That perceived racially tinged treatment was similar to treatment by her peers who similarly doubted her abilities in mathematics.

I don’t feel judged, but I feel, for example I had this class where every single time I got a test back I did really good and no one understood that question, and I did, and a couple people were asking, not everyone, but only a couple people around me, and I turned around and I was explaining why it was the way it was, and they were like “oh, she actually gets it?” you know like you get those looks, like oh...

The persistent nonverbal discourses Sofia perceived to be coming from instructors and classmates was complemented by microaggressions that implied Hispanic women didn’t belong in mathematics. Sofia encountered similar racist messages from advisor who questioned her

desire to take advanced mathematics classes just as she was considering switching her major from early childhood education to a major in engineering or mathematics. Sofia notes her awareness of the racist assumptions embedded within her conversation with an advisor, noting,

It's like, no I gotta prove these people, that me being a minority and a woman and minority, I can do this classes. I'm not going to let them tell me "are you sure that's a class you want to take? What about other classes? You don't need this to finish your transfer degree," and it was like I feel like if they would let me take more classes in what I wanted to take, which was more math instead of like art or like other classes, that I think are not relevant to my major, I think I would have done better.

Sofia recognized an advisors reluctance to support enrolling in additional mathematics classes as influenced by her identity as a Hispanic woman. For Sofia, the racist messaging from instructors, classmates, and advisors was verbal and nonverbal, but ubiquitous. Racist treatment was also seen to intersect with negative contingencies associated with her female identity and gender stereotypes in mathematics. Sofia noted, "there's times in classes when I do feel like there is a certain bias. And not just because I'm a minority, I feel intimidated when there are so many guys in the class. And there's two or three girls." Within this statement, Sofia indicates more than just an awareness of her gender identity situated within the mathematics class. Sofia is clear to note intimidation associated with her identity. Sofia is well aware of gender stereotypes, just as Sofia is well aware of racial stereotypes, and her feeling of intimidation in class is evidence of the fact that students holding minoritized identities face hostilities in STEM academic pathways.

Sofia was not alone in her perceptions of marginalization on the basis of gender identity. Mariana, a Hispanic woman who had managed to teach herself CSS and HTML in high school, noted marginalization and isolation in computer science classes. While reluctant to identify her

Hispanic identity as the basis of marginalization, she did feel as if her gender was discriminated against. Mariana was very conscious of her female identity as one of three women in a class with twenty-five men. Reporting on her experiences in computer information systems courses, she noted social isolation arising from gendered assumptions. “A lot of people that are into that field (computer science) are like gamers and stuff, and so I’m sure they don’t think I’m as smart as them, but I don’t care.” While Mariana may not have cared about sexist assumptions about women’s intellect relative to computers, she clearly perceived marginalization from her male counterparts.

For other participants, the hostilities lay in the assumptions of peers who assumed participants held identities traditionally associated with STEM. Isabella, who identified as a Mexican woman, noted peers who thought she was Indian. Dylan, who identified as mixed-race (Hispanic-Vietnamese), reported peers assuming he was Indonesian. Such simple misidentification might seem innocuous, but the hostilities are founded upon assumptions held by academic peers about who belongs in STEM. Seemingly simple assumptions that Sofia, a Hispanic woman, was Cambodian or Vietnamese brought with them all of the racist assumptions about who belongs in mathematics. In the following exchange, Sofia shared one such experience.

Some of my classmates, and I’m finding this a lot, they think I’m Cambodian...I had someone come up to me and say what is your nationality? And I’m like what do I look like? And they are like, “Um, Asian? Cambodian? Vietnamese?” And I’m like, “I’m Mexican, or I’m Hispanic.” It comes out that way.... and I think a lot of it has to do with the fact that I’m in a math class. I really really think so.

While the misidentification of Isabella, Dylan, or Sofia’s backgrounds seem harmless, it is the intersection of their Hispanic identity and the discipline of mathematics that doubts their identity

as a person of color in STEM. Assumptions that a dark skinned successful math student is of East-Asian, or Indian descent instead of Hispanic descent, are predicated on racist assumptions about mathematics ability and who belongs in STEM.

Though these findings seem to implicate students and staff as promoters of discourses hostile to minoritized identities in STEM, it is important to note that discourses hostile to minoritized identities within STEM can also reside beyond the college campus. Carlos noted skepticism of his STEM pursuits from an uncle. Similarly, Mariana noted that discourses hostile to her pursuit of computer science were largely coming from Mexican men and women in her local community. Mariana can be heard identifying corrosive discourses introduced by other Hispanic community members; these discourses targeting both her gender and ethnic identities as they intersect with her STEM identity.

They don't expect that, because a lot of the time, you know Hispanic girls get married early or get pregnant, or they go to beauty school, or they just don't do anything STEM related. So I know when I was about to graduate high school, a lot of people are like, "oh are you going to go to beauty school?"...it would always hurt my feelings when they would assume that.

While Mariana's community members are not situated within the community college, the discourses arising from Hispanic community members about her belonging in STEM are contributing to hostilities she encounters as a woman of color pursuing STEM. Mariana's experiences are a clear indication that minoritized identities within STEM can encounter hostilities away from the college campus.

Assumptions that a young woman would go to beauty school, the assumptions of racist peers, an academic advisor who questions a student's STEM intentions, the intimidation

encountered just sitting in a classroom; taken individually, these experiences might be chalked up to innocent mistakes, or even an overreaction by a student who is racializing non-racist interactions. It is only when the entirety of students' experiences, the constant subtle messaging coming from a broad range of sources is examined, and when these students' experiences are compared to the experiences of their peers, that it becomes apparent STEM academic pathways within community colleges are actively hostile to minoritized identities.

While the evidence to this point reports specific identifiable hostilities to minoritized identities within STEM, there existed a second line of evidence that inferred participants perceived their minoritized identities as incurring negative treatment from others. These participants never went so far as to accuse anyone of overt racist or sexist treatment. Instead, participants note actions they undertake because of perceptions associated with situating their minoritized identities in STEM. Whereas the evidence to this point noted subtle discrimination from others, requiring them to prove their belonging in STEM, students like Carlos and Jose focused more on themselves than their peers. In the following exchange, Carlos noted how aware he was of his Hispanic identity in STEM courses, negative stereotypes about his mathematics ability, and the racist assumptions of his peers.

Well I always sit in the front, first because I can't see, second, because if I ask something to the teacher, and if I say something stupid or something that is really simple, I know people are looking at me. But if I'm in the back, they're gonna (*turning his body around*) turn back to me. In the front I'm just going to look at the teacher. And a couple times just in the middle of the class, I just turn around and I see lots of white people and me being the only Hispanic person there I'm like, "I made it this far I guess." And I think if I'm

here it's because of something. Maybe I am at their level, maybe not, but right now in this class I am.

If Carlos's statement was simply about fears of looking ignorant, then one might question the role of race in his experiences within STEM. Instead, Carlos pairs his concerns about looking "dumb" with his hyper awareness of his Hispanic identities. Sitting up front so a whole class won't turn around to look at a Hispanic student asking a stupid question, are paired with a Hispanic student turning around to see a class full of white people. Carlos's fears and his hyper-awareness were then paired with doubts about his own mathematics ability relative to that of his peers. Carlos never accused fellow students or college staff of mistreatment, but he still notices that something about his being Hispanic is considered less than his White counterparts. This recognition, and the tension Carlos experienced was similar to the experience reported by Jose.

Jose was a Latino student interested in pursuing mechanical engineering. In initial interviews, Jose reported no racialized experiences in college. It was only in subsequent interviews that Jose started opening up about his experiences with race and ethnicity in STEM classrooms. Jose was careful not to place blame on his classmates for his racialized experiences. He then noted that he was well aware of racial stereotypes, and how his appearance as a tattooed Guatemalan man was potentially threatening to fellow students. Unlike Carlos, who sat in the front of the room, Jose chose to engage proactively with his classmates in an effort to disprove their racist assumptions and to prove himself as non-threatening.

Around ethnicity, ah, kinda hard because I don't want to put people on the spot for whatever reason, if they think...me, I'm of color, so I know I'm going to be an elephant in the room at all times, so...I think I take all that tension off everybody else, you know....So, the way I do it instead of going up to them and being like hey man, how do

you feel about me? And my race? And my color? ... So instead of like trying to pull their thoughts out of it, I initially introduce myself like the true person that I am. Not what I resemble. And by doing that I think the way they feel is just kind of like 180. Right away. Cause even my brother has told me that the way I look, you know it can be intimidating at all times. And I understand that, but as soon as I start talking, people, they are not aware, because they do not know. I feel like I put myself in this position, you know... It's like a 50/50, yeah, me engaging first is where I start to take that tension away from everybody. Me being able to introduce myself and being able to say; Hi, how are you? What's your name? You know it's really nice to meet you guys. And I'm happy that we can work together, and I'm here to help anybody however I can.

Jose's impression that he needed to disprove racist assumptions of his peers was not in response to specific interactions like those Daniel, Asher, Sofia, Isabella, Dylan, or Mariana spoke of. Instead, Jose was engaged in a constant process of impression management. The need to manage the impressions of others is a clear byproduct of larger stereotypes about Latino men with tattoos. Jose then linked his efforts to put other students at ease to larger national discourses about his minoritized Latino identity.

I'm kind of making a statement that not everybody that comes from a third world country, a developing country, you know that's gone through a bunch of challenges, cause that's exactly what it was, twelve and a half when I immigrated here.... You know illegally cross the border and stuff and through all the BS that's going on in this country and how divided its getting, it's really easy to be influenced by everything that's going on in this country.

While Jose's actions speak to his experiences as a Latino man in STEM at a community college, the experience comes from the confluence of his minoritized identities, his situatedness within STEM, and larger national discourses about immigrant Latino men. Jose's awareness of this dynamic, and his efforts to manage the impression of others, serve to conclude this section, which clearly establishes that students with minoritized identities in STEM encounter discrimination both in college and outside of college. At the same time, Jose's attempts to manage the impressions of his peers serve as a poignant transition into the more substantial findings that follow. Simply finding that STEM academic pathways at a community college can be hostile to minoritized identities is not unexpected, but establishing this reality is essential for the subsequent findings. It was the ways that students like Jose dealt with those hostilities that was far more noteworthy.

While the next section will report how students dealt with hostilities, it is necessary to summarize the findings to this point. First, it was found that students utilized discourses about their personal success in science to support their STEM identities. Second, academic struggles appeared to be inadequate in explaining why students had decided to stop pursuing STEM. Finally, it was found that discourses exist that question whether women and men of color belong in STEM. Those discourses came from instructors, advisors, peers, and community members. Participants were aware of these discourses hostile to minoritized identities. It will now be seen that the way participants responded to those hostilities, as a man or woman of color in STEM, strongly influenced decisions regarding persistence.

Minoritized identities situated in STEM at the community college

The ways in which students dealt with their minoritized identities in STEM fell into three distinct categories. The first group recognized pervasive racism and sexism based upon their

minoritized identities, and took actions to reconcile their intersecting minoritized and STEM identities (the Salient group in Figure 3).

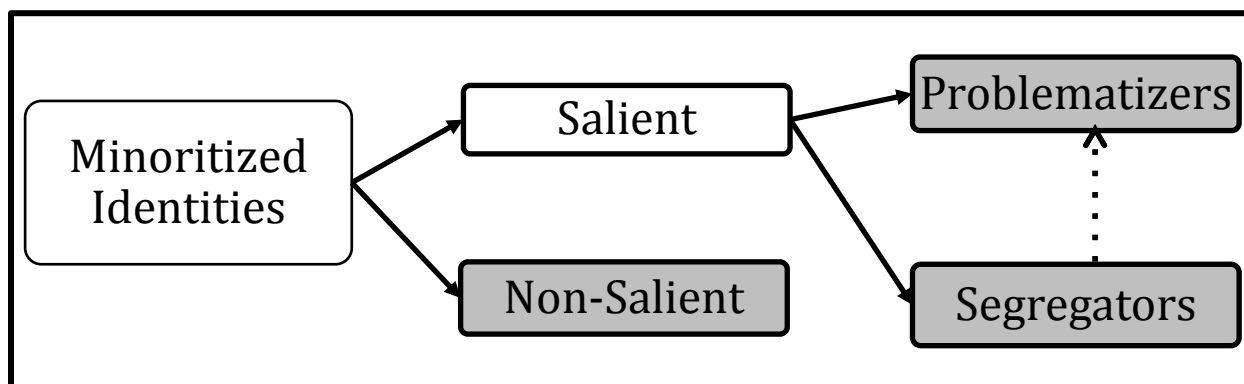


Figure 3: The salience of minoritized identities and responses to the marginalization of those identities

The first category, labeled *Problematizers*, demonstrated intersecting STEM and minoritized identities that were consistent with previous research on stereotype management and authoring identity in STEM. This meant that *Problematizers* felt the need to prove themselves, they needed to disregard racist or sexist assumptions, or that they amplified discourses supportive of their minoritized identities in STEM. A second group, labeled *Segregators*, included students who intended to pursue a STEM pathway, but who appeared to actively separate their STEM identity from their racial or gender identities. Race was still a salient identity for these students, but their minoritized identities were not perceived to influence their experiences as students in STEM or their developing STEM identities. A third group, identified as *Non-salient*, had racial identities with very low salience levels, such that minoritized identities were not seen as being a prominent identity in their student experience. *All of the students who decided to stop pursuing a STEM pathway fell into the Segregators group.* One student, Miguel, who did not progress beyond basic arithmetic, was excluded from these categorizations as his minoritized identities and intentions to pursue STEM were never situated within a STEM setting.

In the following section, I intend to begin by presenting *Problematizers* to illuminate how some community college students find that their minoritized identities and their STEM identities intersect and are in conflict. These *Problematizers* worked at the intersection of conflicting identities in an attempt to reconcile their intentions to pursue STEM with experiences that signal they don't belong. The second group, *Segregators*, will then be presented to demonstrate that there exists a second group of students with salient minoritized identities who do not attempt to work at the intersection of STEM identities and those minoritized identities. It will be seen that attempts to segregate minoritized identities from developing STEM identities appears to undermine those STEM identities. The third group of students, who did not find race to be salient in their community college experience, will then be shared to illuminate the range of student experiences found in this study.

Problematizers

Four of the twelve participants in this study shared experiences consistent describing STEM as a hostile place to author identity for women and persons of color. These participants reported discriminatory behavior that doubted their belonging in fields like engineering or mathematics. Discriminatory behaviors directed at these participants were rarely blatantly hostile. As was established earlier, students were not confronted with racist slurs or sexist tirades. Still, perceptions of microaggressions ranged from those who felt they were a great concern, to those who felt the marginalizing treatment was more of an annoyance. The meaning making by these four individuals will be shared in order from Daniel, who felt his minoritized identity played a central role in his student experience; to Asher, who perceived microaggressions to be less obtrusive. The perceived marginalization was often subtle, but

students were intentional in the ways they interpreted their STEM identities in light of those experiences.

These meaning making strategies, used to infer meaning from discourses, include those previously identified as authoring identity or stereotype management. Meaning making for these students was complex, and included the amplification of supportive messages from institutional agents, positive self-talk, or proving people wrong. For Daniel, long established discourses informing STEM identities were forged in childhood and in prior workplaces. The discourses included experiences learning math from his father as a child. Daniel noted he had been competent in mathematics, “all my life. Yeah, my dad taught me how to count with money. And then he taught me my five times tables with dominos.” Discourses of competence carried on into a career in tooling, where engineers who he worked alongside were asking, “Why don’t you get a degree?” “Why don’t you have a degree?” you know, cause the comprehension was there.” Daniel had taken up discourses of his competence in mathematics from a variety of sources, and combined those discourses with intentions to pursue a career in support of fellow veterans with disabilities.

I am looking at prosthetics, making a hand or a leg or whatever, umm, that you can operate with your brain and have feeling in again. If you can figure out a way to get those, the brain to connect back to this prosthesis that it could give feeling back to the hand so that it could move. Yeah, and feel and you can still pick up your kid again and you can feel yourself picking up your kid.

For Daniel, racist discourses from classmates established earlier in the findings were countered by strong connections to his family, to his African American culture, to his veteran’s status, and to his disabled status. In crafting a future in STEM that incorporated his diverse identities, Daniel

authored a STEM identity that acknowledged reduced the impact of hostile discourses found in the racist rubbernecking of peers. Daniel took this identity with him as he transferred from community college to a university where he intended to pursue engineering.

Sofia similarly employed the active construction of discourses supportive of minoritized identities in STEM. Sofia was not blind to the structural challenges she faced. She recognized that her family's employment as migrant farmworkers, and her experiences, "strawberry picking, blueberry picking with my family when I was a youngster," placed her at a disadvantage when compared to peers in STEM who grew up with college educated parents who were, "working with big companies that you would be like wow." Sofia recognized the impediments she faced as a first generation student.

No one ever came to me. I kind of had to look for it, and a lot of people are like well yeah this is a grown up world, and it's like yeah, but it's easier for someone who has someone like a parent a grandpa, you know, someone that they can ask questions to that, they can be like, Mom, I'm in college now, what's the next step. This is how you register. I feel like we don't have that because none of our parents had it.

While aware of the disadvantages associated with being a first generation student, Sofia was able to recognize marginalizing treatment by college employees. She shared, "when I came here to college, people were rude, desk people, some people in financial aid, just because I was a Latina trying to ask for financial aid. I did feel that rejection, and it made me feel bad." Sofia's complex meaning making acknowledged the disadvantages and the marginalization she faced as a first generation Latina in college.

This general marginalization is combined with the hostilities, established earlier in these findings, that questioned her belonging in STEM. Sofia was unique in her recognition of how

racist statements by her peers led to an understanding of her own racialized perspectives. Sofia was able to recognize her own racialized perceptions when she linked her noticing a black man in mathematics to how others perceived her as a Hispanic woman in those same classes.

This class that I took, it was only me and then there was a couple other girls and it was all guys. It was a limits and infinite series class that I took and I was the only Hispanic girl, and I was really surprised that there was the first black guy that I'd seen...I was very surprised cause he was also very smart, so then it made me think, That's how they see me. When I see a male black guy in class, you know and he's very smart, and he's handsome, cause you know you have that, and I think I'm like, you know...I think that's probably how they view me too.

With an ability to recognize how minoritized identities might factor into the perception of others, Sofia was able to envision how her Latina and female identities factored into how she was seen by others, and how that perception influenced how she was treated. Sofia did not try to ignore those hostile discourses. Instead, Sofia successfully constructed STEM identities that acknowledged and made space for her minoritized identities.

Whereas Daniel had parents and previous employment on which he could construct his STEM identity, Sofia's parents were farm workers without a formal education. Sofia crafted a STEM identity during her second year at the community college based upon success in her initial mathematics classes. While Sofia's, feeling like a "wizard" and having her parents place her math tests on the refrigerator were recounted earlier in these findings, it is necessary to recount how recognition from peers who sought Sofia's help in algebra, and the feeling of being a wizard pushed Sofia to identify with mathematics. Discourses from parents and siblings supported narratives about Sofia's academic strength in STEM. Sofia noted, "I guess when you have that,

that your parents are proud and everyone in your family agrees, I think that has a huge impact and it has a huge impact on me.” At the same time, she sought out discourses outside her family that valued her minoritized identities. Sofia revoiced supportive discourses from the computer industry that promoted the importance of collaborative work and innovative thinking, allowing her to reframe her minoritized identities as an asset. Sofia was able to look beyond her college career to a time when her diverse identities would become an asset to an employer, noting, “they have all kinds of people and it’s like the only thing they are looking for are people who are creative....And I was like, “I can be working there” and I’ve always been thrilled about working in group-work, you know doing things like that. I really like that, if I can just sit down with a group of really smart people and create something, a new app, a new device that helps people you know, translate words faster.” Sofia was looking to her strengths, to her ability to collaborate and her ability to be creative, in her efforts to justify her existence within a STEM field.

While Sofia relied on supportive discourses perpetuated within her family, Carlos did not have a supportive family to help perpetuate his STEM identity. Instead, Carlos was seen relying on supportive interactions with instructors in the construction of his STEM identity. These discourses arose from success in STEM classes and subsequent legitimization from college faculty. Carlos noted the importance of college staff in his decisions to persist as he noted, “when I returned to college my main goal was to just get my transfer degree and move on...instructors are pushing me saying good things about me, that I never thought I would hear from an instructor.” That support was not necessarily specific to STEM. It was an offer of employment as a teaching assistant in English that appeared to validate Carlos as a college student.

When she offered me an English job I was like, “Me? I don’t even speak English well” but she said that I had the qualities to be a good work study...she’s a tough teacher, and to for her to say that kind of thing to me, I was really amazed.

While the role of supportive discourses from faculty members are not specific to STEM, the discourses about his academic competence are specific to his Hispanic identity, as can be heard in a second exchange.

When you guys come and talk to me, you guys are always sincere and tell me things like “you can get it done,” “just move on,” “do what you got to do,” coming from you guys means a lot. I mean you guys are white and you’re telling that to a Hispanic person, and me being Hispanic, that really means a lot to me.

For Carlos, meaning-making relative to his identity in STEM appeared to hinge on validation of his strength as a student. Carlos did not have the supportive family that Sofia relied on, nor the long established STEM identity that While Carlos perceived the doubtful stares of his peers, and recognized that his Hispanic identity was not the norm in engineering, supportive discourses enabled the construction of a STEM identity that persisted through his transfer to an engineering program in engineering.

The importance of faculty members in supporting and validating emerging STEM identities was also visible with Asher. Asher decided to switch from a profession in a health career to one in engineering after encountering success in calculus. That STEM identity, born in calculus, was bolstered by a supportive family and supported by a relationship with one of his math professors. While Asher was aware of his minoritized racial identity in STEM, perceiving how classmates didn’t turn to him as a source for answers until he had proven himself, he was able to construct a STEM identity that persisted through his transfer to a university program in

engineering. Asher had a family who was involved in discourses of subject expertise as he texted test results to his mom. He also sought out a supportive relationship with a math and engineering faculty member who validated his efforts to pursue STEM. Recounting his relationship with this faculty member, Asher noted how he made efforts to engage with this professor through classroom interactions and efforts to interact during office hours.

It was more personal, more fun. I mean I don't know, maybe because I sat in the front of the class and we interacted a lot, but I was always in his office, and I guess a couple times where I just ran into him outside of school. It was just we had a conversation, and we, I don't know. I've been to the office a couple times, I looked at some of his 3D printing things, and it was just really cool. So him and I, we just gelled.

Much like Carlos, who relied on supportive discourses from faculty members to support discourses legitimizing his presence in STEM, Asher utilized a supportive relationship with a STEM faculty member to support the development of his STEM identity. Asher utilized agency in promoting narratives of his competence when texting grades to his mother. Similar agency in support of his STEM identity can be seen in his efforts to strengthen his relationship with his professor. Asher, like other *Problematizers*, were observed identifying the hostilities encountered because of their minoritized identities, and working to craft STEM identities in light of those hostilities.

This first group of participants included people who were aware of how their identities ran counter to those dominant within STEM fields. They recognized microaggressions that questioned the intellect of a woman or a student of color in STEM. To cope with this hostile environment, participants sought out supportive faculty members, relied on long held critical discourses of competence, and leaned on family members to legitimize STEM identities that

intersected minoritized racial and gender identities. Problematizers recognized and pushed back against the identity contingencies, situational cues, and microaggressions that questioned whether they belonged in STEM. The experiences of these students, and the strategies employed to persist in STEM run counter to the students who follow. Whereas *Problematizers* noted marginalization and worked to craft a STEM identity in spite of it, the second group of students attempted to reject any associations of their minoritized identities and marginalization in STEM.

Segregators

Six of the thirteen participants in this study, four of whom decided to stop pursuing STEM pathways, held salient minoritized identities, but didn't appear to construct STEM identities that connected to those minoritized identities. These students' STEM identities ranged from well-established, constructed over years in a variety of settings, to very embryonic, one of a variety of career paths available coming out of high school. For each of the segregators, there existed a disconnect between students' STEM and minoritized identities. The first case is Jose, who presents the most complex case from the *Segregators*. During the course of this study, Jose was progressing through his STEM coursework. He had worked his way from basic math to engineering and calculus classes. Jose appeared to be able to author both his racial identity and his STEM identity. Jose's case begins with exchanges intending to portray how he expressed the salience of his ethnic identity, to paint a picture of the complex identities he held, and the agency he was exerting to shape his STEM identity.

When initially asked if he was aware of the racial composition of students in his higher-level math classes, Jose replied, "No, I don't." While his racial salience appeared to be low, discourses regarding his racial identity were constructed around a teenage experience in which he immigrated from Guatemala to the United States. His enculturation process included

integrating his former identity as a strong student in his former country with some new identity in his new home. Jose noted how he adopted a style of dress and a physical appearance associated with stereotypes that led others to doubt his academic strengths. This included tattoos and apparel endemic of a Hispanic community that ran counter to the norms of a community that was predominately white, “cause when I came here, you know I was all into the swag, saggy pants, you know, handkerchiefs...I was just trying to fit in.” Jose had a strong awareness of his identities related to race and immigration status. At the same time, Jose appeared to be able to actively construct a STEM identity for himself. Authoring a STEM identity included a visit to a local four-year university to introduce himself to the engineering program leadership. “Yeah. I visited State University a couple of times. I seen the people, talked to some of the instructors and stuff, and so I spoke with Mary the coordinator, and broke down my program. She said, ‘I love it.’” By initiating opportunities to construct a STEM identity, Jose was observed actively constructing a future for himself in STEM.

Later, Jose would take up an offer from an English teacher to visit an engineering firm. This English teacher, who’s husband worked for a local engineering firm, offered to set up a visit to the facility for Jose. While he could have passed on this offer, Jose chose to accept and to exploit the opportunity to strengthen his STEM identity.

I told her what I was doing, and she really enjoyed what she heard so she suggested I go where her husband works, which is at an engineering firm. I got to go and visit the facility and talk to Bob, that’s his name, he’s some sort of manager there so he’s kind of a top dog, so I was really impressed. Yeah, she just told me, you know, “My husband, he did this, he did what you’re trying to do and now he’s where he’s at, so you should go check it out.

In visiting a university engineering program and an engineering firm, Jose was actively making meaning around his emerging identity as an engineer. Creating and taking advantage of opportunities to experience his future profession and to build a network of supportive people was paralleled by his mathematics course taking. Jose had worked his way through two basic math classes, three algebra classes, two pre-calculus classes and was enrolled in calculus. When he failed a class, he reenrolled and framed the failure as an opportunity to learn.

This strengthening STEM identity was then probed for linkage to his ethnic identity. In a line of questioning intended to explore Jose's experience as a Latin American in STEM, Jose was adamant that his presence on campus and his backpack, the things that identified him as a student, negated negative contingencies associated with his ethnic identity.

Well, as far as at school, no. I don't see any prejudice. Nothing, there's none of that, from the teachers to the people I walk past, just this school in general is so broad. And there's so many people in here. And even though I know I strike a resemblance something that I'm totally backwards from...I'm talking about my tattoos, you know, the way I look. If you see me in the streets, you're probably going to walk to the other side of the street if you see me if we're walking towards the same direction on the same street, some people might cross the street just to avoid anything. But, then at the same time, if you have to talk to me, as soon as I start talking, then it strikes you in a different way.

While Jose was well aware of how his appearance might subject him to racist treatment off campus, he was adamant that his presence on campus and protected him from racist assumptions.

No, because I'm in here. It's because I'm in here, I'm in classes, I'm wearing the backpack. They know I'm in here, they know I'm not causing trouble, as I would be. Like

they are not going to see me with my backpack while going to school, working on this...they're going to see me with school stuff...

The dynamics that Jose recognized when people crossed the streets to avoid him off campus weren't perceived as a part of his experience on campus. Jose had an established ethnic identity and an emerging STEM identity, but those identities were not seen to be in conversation with one another. Further compounding the intersection of these identities was Jose's status as an older student. Jose perceived his age to be an identity that was outside the norm for STEM classes at a community college. His statements also conveyed that he had internalized stereotypes regarding age that made him think being thirty years old made him less capable of learning than someone in their late teens or early twenties. When asked about whether or not he felt he belonged in his STEM classes, Jose shared,

Yeah (*sigh*), I feel like I got to just get in there and flex on them young-ins cause I'm not 18 anymore. I'm not in my early 20's anymore, I gotta just make sure that I can at least jog along with them, you know? And if that means staying up extra late at night, I'm still gonna get in there and at least know what the teacher's talking about.

It became apparent that Jose's identities relative to ethnicity, immigration status, age, and his intentions to pursue STEM were all salient, yet Jose felt only his age intersected with his decision to pursue STEM. In a subsequent interview probing the intersection of Jose's racial identity in STEM classes, Jose shared a more nuanced intersection of his race in STEM. The strategy, established earlier in these findings, in which he tries to disprove the racist assumptions of his classmates, established his awareness of the hostilities in STEM for his minoritized identities. In this exchange, it became apparent that Jose was actively attempting to eliminate the role of race in his experiences in STEM.

Two weeks after this interview, Jose dropped out of college near the conclusion of the quarter. He was passing both his calculus course and his engineering class when he dropped out. Explanations for stopping his pursuit of a STEM centered on financial distress, yet questioning indicated that his actions did nothing to ameliorate financial strain. Loans that were in deferment would need to be repaid, and tuition dollars were not refunded when dropping so late in the quarter. He wasn't going to be working any additional hours at his employer and he was not seeking additional employment. In fact, his decision to drop out was made just after he learned he had been awarded one of a dozen \$7,000 scholarship intended to support students pursuing STEM degrees. His reasons for dropping, and the relationship between his minoritized identities and his STEM identity became more complex during a final interview.

You know, in life, my age has a big factor in it. I know you can relate (*I had just shared that I'd turned 40*), but as far as like age goes, that was a big factor in it too. And I keep going back to it, I feel at this point I should be further in life. That's what I feel like, period. I should be further, I'm not happy where I live, I'm not happy with what I have. That's exactly where I'm at right now. And I feel like if I continue this school, it's going to get me there, but I'm not going to enjoy it the way I would like to. You know, coming from a developing country, I feel like I should be grateful for what I have, but I feel like there's something in me, there's something in me that wants more....I came from Guatemala, I crossed the border, I went to school, I went to technical college, I got degrees, I'm the first one in my family to accomplish anything like that,

Within this exchange, it became apparent that the tensions of Jose's immigrant identity, and his identity as an older student were conflicting with his efforts to construct a STEM identity. His statement, "You know, coming from a developing country, I feel like I should be grateful for

what I have,” reflect discourses about expectations immigrants should have for their futures and the careers meant for people like Jose.

While Jose was not feeling socially threatened, it is important to note that none of the students in this study reported feeling threatened. Instead, the dynamics underlying authoring an identity in STEM appear to rely, in some capacity, on minoritized students ability to connect salient minoritized identities to developing STEM identities. It became apparent that Jose held on to his ethnic identity, and had worked hard to curate a STEM identity, but those two identities had never been in conversation with one another. In fact, Jose had actively worked to reduce his perceptions of the role of his racial identity in his experience as a student, and as a student in STEM. While he does not identify discord between his identities as a reason for dropping his pursuit, his case was part of a theme that emerged from the data and held across all cases in which students stopped pursuing STEM.

Similar to Jose, who worked to segregate his ethnic identity from his STEM identity, Juan never appeared to relate the two. In an initial interview, Juan indicated that his second quarter of college enrollment found him with a modest interest in STEM that was paralleled by an interest in Law. “When I first started thinking about actually going into, the first thought was actually law. Like being a, like working with law to change to benefit a lot of other people that are underrepresented, something like that?” Exploring where Juan’s intentions to pursue a STEM pathway started, it became apparent that discourses in high school accounted for early intentions to pursue STEM. Juan noted discourses that linked his success in math to a future in engineering. While his career interests were competing, Juan enrolled in courses that were oriented specifically towards computer science and engineering. He enrolled in a mathematics course that wasn’t required for law, and a computer systems course that was also disconnected

from any law program. It was in these STEM oriented courses that Juan noted he decided to drop his pursuit of STEM, sharing, “at first it was interesting...kind of. But then after like a few classes, I realized no, this isn’t for me.” The vague reasons Juan gave for departure from STEM based on shifting interests was common among Segregators. It is important to note that decisions to depart STEM are likely influenced by his racial identity.

Juan reported that his Hispanic identity did not play a role in his student experience. While it appeared that the salience of Juan’s racial identity was low, Juan later shared that he was an undocumented immigrant who’s family had been directly impacted by that identity when his mother was detained by Customs and Border Patrol (CBP).

My mom was taken to the local detention center because she was stopped by a police because I guess a road was closed, but since she couldn’t speak English they called immigration, and then they took her, and then I had to take care of my siblings and go to school and balance homework, classes, sports in high school

With an undocumented student status and a mother detained by CBP, race was clearly a salient identity for Juan. Juan constantly had to worry about how his immigration status impacted his ability to find viable employment after school. Juan was regularly fearful of his immigration status as law enforcement regularly utilized the campus as a training location for K-9 units.

While Juan never reported STEM courses to be hostile towards his ethnic identity, none of the Segregators claimed that their minoritized identities influenced their student experience in STEM. Juan chose to pursue law instead, with the intention of supporting fellow immigrants in the future. Juan, a talented student who had traditionally succeeded in mathematics and who pursued a future in STEM for two quarters, abandoned the pursuit of STEM because his minoritized identities did not intersect with his attempts at constructing a STEM identity.

Similar to Juan, who's marginalized identity seemed to be isolated from his intentions to pursue STEM, Dylan seemed unable to incorporate intentions to pursue STEM with his minoritized racial and sexual identities. Dylan was a veteran who had worked on aviation electronics in the military, and felt that he was prepared to pursue a career in electrical engineering. Upon starting at the community college, Dylan joined the engineering club. He encountered success in his initial STEM coursework, only to struggle in his second year. Dylan quit the engineering club after failing to connect socially to other club members. At the end of his second year, Dylan opted out of his intentions to pursue STEM. In probing the relationship between his minoritized identities and a decision to give up on his pursuit of a future in STEM, Dylan felt strongly that the two shouldn't be connected. When asked if his racial identity factored into his experiences as a student, Dylan replied:

I would hope not. No, I would hope not because I wouldn't want that to be a factor....And I would hope that it doesn't play a role. Because I would hate to think that because I'm male or a minority that I would be offered a certain position. Or like, "Oh, we need more STEM people"....I wouldn't want to be judged on my race. I wouldn't want to be, and because I don't identify as a race and I know it does happen, it totally does, everyday it happens, but I wouldn't want that to be something that affects my academic career, you know?

This reluctance to associate his experiences in pursuit of STEM at the community college with his racial identities were influenced by a complex racial identification that he claimed to renounce.

So for me in particular for race, I feel like I don't really identify with anything, and the reason why I say that is because...so my dad is Vietnamese and my mom is Mexican. I

was raised in a very, how should I put this, a very rich upper class very white neighborhood. So I was the only brown kid in elementary school and growing up. I don't know Spanish or Vietnamese. So and we've all gone to these family reunions on both sides and we're called the city folk or people. So I never felt like I identified with being Mexican or Vietnamese. And if anything probably a little bit more Vietnamese at some points and a little bit more Mexican so I'm not sure, as far as race goes, I kind of just identify as mixed race. Cause I really don't. I don't...it's weird, for me it's such an amalgamous thing, it doesn't, I don't, for me I have no value of my race.

Dylan's struggles to reconcile the role of race in his experiences with peers was conflicted, with statements both denying and acknowledging the role of race in his student experience within the same thought. At the same time, his identity as an openly gay veteran was a salient minoritized identity that appeared to influence his decisions. Dylan noted how his decision to switch from electrical engineering to a career in graphic design fulfilled stereotypes about gay men.

There's a stigma there that exists, so like I totally get it, and for me too, there's also the stereotype of being gay and an art student and that's definitely a thing, and like I'm kind of one that doesn't like being stereotyped in anything cause, I don't know, I come from a lot of different backgrounds so it's weird to get stereotyped in anything, but I think in this particular case, just having peers around me and knowing that that stereotype exists, it's kind of weird, but at the same time it really shouldn't influence me, but at the same time it kind of does.

The role of stereotypes was difficult for Dylan to resolve in decision making relative to his future career. At the same time, Dylan's minoritized identities were never framed relative to his STEM identity. His experience working on computers as a child was never paired with his experience as

the only impoverished student of color in his high school. Similarly, his experiences in pursuit of STEM were never linked to his mixed race, gay, veteran, or impoverished identities. Decisions about what careers to pursue were largely constrained to discourses arising from stereotypes and to discourses arising from academic successes and failures.

I knew I struggled with math, and it was more of an indicator for me, not just with the arithmetic, but um, it was just more of an indicator, because I know I can do the work, I know I can do it, it just, the grades for me, I don't look at them as how I'm graded, like on my intellect with what field. I see it as where my interests are. And everything on my transcripts, like humanities, political science English, writing, and like even the tutoring work that I do, mentorship, all those other things, they spell a different code than a STEM field or electrical engineering. So like I look at my grades and I see, well, what am I good at? I can do something that I'm good at or just do something that I'll end up hating. So grades for me it was more of an indicator of like where my interests were than like what I'm good at.

Much like Juan and Jose, who claimed that their racial identities played no role in their experiences as students in STEM, Dylan was adamant that his mixed race identity wasn't a factor. Dylan's assertions came in spite of his reporting his misidentification as an Indonesian student. Microaggressions were written off as meaningless, academic difficulties in STEM classes were attributed to shifting interests, and decisions to opt out of STEM were never connected to minoritized identities. It is the pattern of discounting or disregarding the experiences associated with being a student with minoritized identities that appeared common among Segregators.

Like Dylan, Pedro was a military veteran who, “connected satellites to radios, radios to ships, and everything in between. And I would actually go out and train people on systems.” This strong technological background was paired with discourses about his STEM identity as a child that framed him as, “inclined mechanically.” While Pedro was able to speak about discourses surrounding his STEM identity, Pedro could be heard discounting the role of race in his experience.

I tend to identify, even though it’s not necessarily a race, as an American, cause I tend not to associate with the Latin blood in me...to me the Latin community is really antiquated in their perceptions of what is right and what is wrong.

Pedro’s disidentification with his Latin heritage was paired with perceptions that his ethnicity had no influence on his experiences in STEM. Pedro’s academic trajectory within STEM was similar to the trajectories of other *Segregators*. He encountered success in his initial STEM coursework and attended engineering club meetings. While he worked to establish relationship with academic peers within that club, he became increasingly isolated over the course of his college career, and his grades shifted from A’s to failing grades. Pedro shared that he felt his race had no role in opting out of his pursuit of an electrical engineering career for a two-year technical degree.

Jose, Juan, Dylan, and Pedro clearly possessed STEM and minoritized identities that were segregated from each other. At the same time, these four students were socially isolated and unable to find communities to take up and perpetuate the discourses surround their futures in STEM. Jose had significant experiences relative to a future in engineering, but those stories were largely isolated. Juan had academic record that indicated his abilities to succeed in STEM. Dylan, and Pedro held similar military and pre-adult discourses about their competence in STEM

affiliated fields. Yet all four individuals held these identities in isolation. It is worth noting that these isolated STEM identities, when segregated from racial or ethnic identities that call into question an individual's belonging within STEM, appear to be associated with decisions to opt out of STEM academic pathways. The findings regarding the isolation of STEM identities and minoritized identities is further illuminated by Mariana.

Similar to the rest of students in the *Segregators* group, the minoritized identities Mariana held were highly salient. Earlier in the findings, Mariana's community members were heard making assumptions about her belonging in beauty school. She started her first interview by responding to a question about her interest in computers by referring to migrant parents, their citizenship status, and their misogynistic beliefs.

So growing up I had two migrant worker parents, they're both like citizens and everything, just...yeah, but um, so they were accustomed to their culture over there and that's mostly like belittling women and women should do this, women should do that. The marginalization of identities including gender, ethnicity, and citizenship was echoed at a later point in the interview when she shared insulting insinuations her father made about her abilities. "I haven't talked to him in such a long time, I remember he was like, "oh you're"...I don't think he ever expected much from me." With an unsupportive father piled onto assumptions about her roles as a Hispanic woman and the daughter of migrant workers, Mariana echoed reduced expectations for herself based on her background as the child of migrant farmworkers. Mariana worked hard to construct a STEM identity despite racist and sexist discourses arising from both stereotypes and her family members.

I did have a lot of like problems growing up. And it just hit me, and like finally I'm starting to find my groove, cause I did okay in high school, I wasn't ever, I never failed anything. I always did well coming from my circumstances, I always did well enough.

The tempered expectations Mariana held for herself based upon "my circumstances" reflected a consistent discourse of marginalization. These marginalized ethnic and gender identities were paired with STEM identities that emerged from early success in elementary school mathematics.

Math I really liked growing up. I was really good at it, until like, my mom only went to sixth grade, so she taught me everything that she knew when I was little. So I was always ahead of everybody, cause she taught me really early on, but then like once that hit where she couldn't teach me any more, I was at the same level as everybody else. But I could still catch on pretty quickly

Mariana's emergent STEM identity, starting with discourses established with early success in mathematics, were enabled by a mother who taught her all she knew at an early age. This success became focused on computer science during a series of projects as an upperclassman in high school, where Mariana taught herself HTML and CSS coding. "I really liked it and it was really easy for me to pick up... And so then I kept looking into it...so I started looking into schools that had computer related degrees."

Mariana's STEM identity in math and computer science existed despite a lack of support on multiple fronts. Mariana's community was asking if she was going to beauty school. Her father held low expectations for her future. Her high school adviser wasn't invested in her pursuit of computer science. From Mariana's perspective, her STEM identity paralleled but rarely intersected her gender and ethnic identities, save instances when people outside of school questioned her place in computer science. Mariana's gender and racial identities were salient, as

was her STEM identity. Yet unlike those individuals who managed to interweave their minoritized identities with developing STEM identities, Mariana seemed to keep these identities separate. There was little talk of proving herself, no opportunities to receive mentorship from other women or Hispanic students, and little opportunity to seek out discourses from family or faculty that were supportive of her pursuits.

Mariana's discourses appeared largely constrained to stereotypes, which question her place in computer science while equivocating male gamers as somehow innately proficient in computer science. Citing what little support she received from instructors, Mariana recalled how a single supportive instructor interacted with her.

I think that's why Bill kind of approached me more...I think they are trying to get more females in the field...I kind of got that vibe from him...Like when I was in his class, he would be like, "oh hey, everything okay Mariana?" and I'd be like yeah, or I'd be like oh no...I felt comfortable asking him questions. I didn't really care.

For Mariana, the institutional agents who legitimized Carlos as a student, or the supportive family and instructors who supported Sofia and Asher weren't there. The most Mariana got in support of constructing her identities as a woman of color in computer science was, "Oh hey, everything okay Mariana?" While subtle, it is when Mariana notes that she gets a "vibe" regarding Bill's intentions and the college's efforts to, "get more females in the field." In that single exchange, Mariana could be heard acknowledging the intersection of her female identity and the realities of that identity in a computer science field dominated by men. In inferring the intentions of a male instructor, Mariana brought her STEM and her minoritized identities together. When asked about the role her Mexican identity played in her experiences in computer science, Mariana noted, "I think it's more based on gender honestly." While Mariana seen

beginning to problematize the marginalization of her gender identity within STEM, she never appeared to problematize her ethnic identity, or the intersecting minoritized identities she held, within STEM.

Mariana did not possess the narratives from previous careers that Daniel utilized, nor did she have anyone to mentor her. In this setting, it is tough to see how Mariana would counter discourses questioning whether she was not as smart as her gaming peers. While Daniel, Sofia, Carlos, and Asher were able to focus on coping with micro-aggressions that influenced their student experience, Mariana seemed to be grappling with far more hostile discourses. At the conclusion of this study, Mariana was still enrolled in the community college, but she was on academic probation, her credit load had been reduced to half time, she had failed every computer science course she had enrolled in (four courses) and her GPA was 0.89 out of 4.0. Mariana's academic trajectory appeared dire at the conclusion of this study, with no community member perpetuating discourses about her belonging in STEM, and no work on her part to reconcile minoritized identities with the discourses that questioned the belonging of those identities within STEM.

From Segregator to Problematizer

Mariana's inability to integrate her minoritized identities with her STEM identity can be compared to Isabella, who intended to pursue a career in structural engineering. Much like the rest of the students in the *Segregators* group, Isabella appeared to have maintained a separation between her minoritized identities and her STEM identity. Having decided to pursue engineering after abandoning prior intentions to become a veterinarian, Isabella found structural engineering to blend together her family's connection to the construction trade and her proficiency in mathematics. When asked if her racial or gender identities influenced her experience as a

student, Isabella remarked, “Um, no. Not really.” At the same time, Isabella was subjected to the familiar microaggressions surrounding her ethnic identity, but did not feel that questions about her ethnicity were related to intentions to pursue a career in engineering. Isabella encountered peers who assumed that she was of Indian descent. Yet for Isabella, minoritized and STEM identities did not appear consciously linked, although those identities appeared to be a part of her student experience.

In another example of this disconnect, Isabella did not find salient the fact that the only person she was studying with, who she had forged a working relationship with through chemistry and calculus classes, was another Mexican woman. Isabella did not perceive the microaggressions from her peers, or her co-enrolling in class and studying with a fellow Mexican woman as connected to experience as a woman of color in STEM. It was not until she encountered a skeptical discourse from an aunt regarding her plans to pursue engineering that she started to acknowledge the intersection of these identities as potentially troublesome. When questioned about who was skeptical of her intentions to pursue structural engineering, Isabella noted,

Well I have an aunt who doesn't want me to go into this...I don't really want to say it's because we're Mexican, but there's a lot of machismo in my family, so it's like, “Why are you doing to do this?” like my aunt, she'll always ask me, “What do you want to do?” and I'm like, “I'm going to study for structural engineer.” She's like “What's that?” and she's like “Oh, why are you doing that.”

Months later, Isabella shared that her mother had taken up her aunt's discourses skeptical of her intentions to pursue an engineering degree.

Well right now, I'm having issues with my mom, and she's sort of like not wanting me to go all the way in now. And so it's like, it affects, but it's not like, very influential now. It's like. I don't need... well I do need them, but it's like just like, their ideas won't change where I'm gonna go. And then she was saying that I don't really need to go into such a male dominant, math degree area...she was saying more like, "Just go to the technical college, like don't get a degree, just get something that will get you a job."

At the same time, Isabella reported that the Mexican classmate, who'd intended to become a surgeon, had dropped out of college altogether. "The girl that I was telling you about last time, she dropped these two classes that we had together...because of the chemistry class being so hard...now she just has two psychology classes." The hostile discourses directed at the intersection of her minoritized and STEM identities coming from Isabella's mother appeared to initiate dissonance. Isabella could be heard reducing the volume of her mother's discourses while not actively arguing with her mom. Instead of listening to her aunt's and mother's discourses which were skeptical of a future in engineering, Isabella relied instead on her father who was identified as still extremely supportive of her intentions to become an engineer. By shifting the significance of discourses from her family members, Isabella was able to maintain a future for herself in STEM despite skepticism from her mother.

It is in this response, which increasingly problematized her gender identities within STEM, that Isabella can be seen beginning to shift from a *Segregator* to a *Problematizer*. Isabella had initially felt as if her Mexican and her female identities played little role in her student experience. Yet, as her mother became increasingly doubtful of her STEM intentions, and as a Hispanic peer opted out of intentions to pursue a career in surgery, Isabella was forced to start addressing the intersection of her STEM and her minoritized identities. Isabella could be

heard reducing the attention given to corrosive discourses propagated by her mother. In this shift, Isabella was seen beginning to problematize discourses that did not align with her intentions to pursue STEM. Isabella's adaptations were unique, but indicate a process by which students shift from someone with segregated minoritized and STEM identities towards someone for whom those identities are problematized. At the end of this study, Isabella was successfully pursuing structural engineering, having passed integral calculus and a second chemistry course.

While Isabella offers insight into how *Segregators* might shift towards *Problematizers*, it is important to look back at the *Segregators* as a whole. Four of six *Segregators* decided to opt out of STEM, and a fifth was failing academically. All of those who opted out of STEM fell into this group. When they did opt out, most participants typically noted shifting interests. Jose cited vague financial considerations and intimated that graduation would take too long. Decisions to opt out were typically reported as a long time coming, with no students citing a passion for an alternative academic pathway as a reason for departing. While Jose dropped out of college altogether, Juan, Dylan, Pedro chose to pursue alternative academic pathways.

Minoritized racial, ethnic, and gender identities were salient for each of these individuals, yet they *resisted acknowledging salience for experiences in STEM*. These were students who knew their appearance was associated with negative stereotypes; students who's appearance would intimidate; students who had to fear their registering as an undocumented student would out them and their families to immigration officials; students who were misidentified as East Asian because of their academic success; students who were told their academic efforts were not appropriate for their female identities. *Segregators* held identities that impacted their experience in STEM. At the same time, they claimed those minoritized identities were not salient in their experiences as a STEM student.

While the mechanisms underlying the outcomes for *Segregators* will be hypothesized in the discussion that follows, I want to close this section with an exchange with Mariana in a final interview from this study. Recounting an experience during group work within computer science classes, Mariana noted a particular instance in which her academic peers talk over her, led her to an incorrect answer, and failed to apologize for their mistake. In this instance, Mariana's peers can be heard treating her poorly, but Mariana can also be heard internalizing discourses about her academic inferiority.

I think it was just because I didn't have as much experience or that I wasn't as familiar with the material... That's why I felt really uncomfortable asking them questions, because they would talk over me. We would be in a group and they would be, "do this, this, and this." It was really funny, we had to do a lab one time, where we would have to try to bring down a website the quickest, there's three groups, and they (*her peers*) were like "you need to HTTP and then put like 20,000" but originally what I had put was UDP and I think I did like 100, and they were like, "no you need to change that" and I just listened because, "You're probably right. I'm probably wrong." And in the end you should have used UDP to make the website go down... I didn't say anything, they didn't say anything.

Mariana's lab group did not even find it necessary to acknowledge that she had been right, or that they had misled her. There were no apologies or acknowledgements of Mariana's competence; no asking Mariana to explain why they would UDP as opposed to HTTP. At the same time Mariana did not take the opportunity to amplify the discourse that she did have understanding in computers. Instead, in that moment, Mariana defaulted to discourses that made white, largely male, academic peers "probably right" while her female Hispanic identity was "probably wrong." The expressed inferiority that led Mariana to "probably wrong" or Jose to

note, “*coming from a developing country, I feel like I should be grateful for what I have,*” appear to hint at mechanisms responsible for decisions to opt out of STEM.

It is important to note that none of the *Segregators* reported perceiving marginalization in STEM the way *Problematizers* did. Both groups attended the same college, at the same time, with the same student population, and the same faculty. It was impossible to ascertain whether *Segregators* were subjected to the doubtful glances or the need to prove themselves that the *Problematizers* experienced.

Non-Salience

In addition to the *Problematizers* and *Segregators* who found their minoritized identities to be salient, there existed students for whom the salience of race in their STEM pursuits was extremely low. These two individuals, both male, felt as if their race didn’t factor into their student experience. The first was Ken, a mixed race man interested in aeronautical engineering. Ken was consistent in reporting that his race did not play a role in his student experience. When explaining how his race wasn’t a factor in his experiences in STEM, Ken noted the community college “is very, very accepting,” noting that he thought his race might be a factor in his experience, “maybe if you were somewhere in the Deep South where they have some small community college.” Ken did not perceive the subtle micro-aggressions reported by other participants.

In a subsequent interview, the intersection of Ken’s racial identity and his STEM identity was probed further. It became apparent that Ken’s high school experience was overtly racist.

Yes, people did talk about that kind of thing (*race*). There were like, four black people in the entire school...I wouldn’t necessarily say they are like racist things, but there are definitely attempting to be funny, and I think if they said that here (*the community*

college) you could probably get in trouble...you know, they would joke around about that crap, all the time. So, yes, I would say it was more prevalent there. Much more.

With a high school experience that included hyper-visibility and constant racist “joking” from academic peers, the shift in social norms Ken experienced moving from high school to the community college, it made sense that the salience of Ken’s racial identity was significantly reduced once he matriculated to college. This reduction can be heard when he noted, “I would feel uncomfortable making a black joke or something, just because no one around here has any kind of tolerance for that.” For Ken, perceptions of hostilities regarding his race were calibrated by a disturbing reality in which his mixed race was subjected to direct verbal assault. Given the reduced salience of race in Ken’s student experience, it was not surprising to find that he found the community college to be open and completely welcoming to his minoritized identities.

Similar to Ken, Martin reported that his Hispanic identity had no impact on his experience as a student pursuing engineering. He noted that he was never aware of the ethnic composition of his STEM classrooms, and felt as if both students and staff at the community college were very accepting of all people. Similar to Ken, Martin came to the community college after serving in the Navy. He shared that race and ethnicity were overtly dealt with in the military and that his experience at the community college was free of ethnic discrimination.

For Ken, and Martin, minoritized racial and ethnic identities did not appear to factor into their experiences as students in STEM pathways. Both referred to racist treatment as something that happened elsewhere, but not at this school. This does not mean that these individuals weren’t subjected to treatment similar to those who reported racist peers and advisers, or that subsequent racialized environments won’t increase the salience of race. What it does mean is at the time of this interview racial salience was extremely low for these individuals. Such findings

are not unexpected based upon previous research. At the conclusion of this study, both Ken and Martin were still enrolled in college level STEM classes and pursuing degrees in engineering.

DISCUSSION

The findings for this study fell into three different themes. The first concerned the construction of discourse-based identities for latecomers to STEM. These participants were seen encountering initial success, and then utilizing self-narratives regarding academic competence arising from that success in social interactions with friends, family, academic peers, and faculty members, to create a sense they belonged in STEM. The second theme was that the student experience within STEM at community colleges for those holding non-white and non-male racial and gender identities are hostile. Finding that these hostilities exist were not unexpected. Research indicates four-year colleges and universities are unwelcoming places for women and students of color (Johnson et al., 2011; McGee & Martin, 2011; McGee, 2016), and finding that similar realities face community college students is not surprising. The third theme regards how students come to cope with the hostilities they encounter. I found that those who recognized their marginalization in STEM as problematic were more likely to persist. These students recognized mistreatment, attributed the mistreatment to the bias of other people, judged that bias as wrong, and implemented strategies to cope with the mistreatment. A second group of students encountered that same marginalization, but failed to attribute that mistreatment to other people. These students appeared to assume their experiences in STEM were indicative of not belonging in STEM or of shifting interests, and were most likely to drop out of STEM. Because this third theme appears to be so influential in decisions to persist, the discussion begins with problematizing the hostilities minoritized identities encounter within STEM before discussing discourse based identity construction.

Problematizing intersecting STEM and minoritized identities

In the post-secondary context, research on identity construction for minoritized students in STEM has largely centered on students' agency within a university context. Students filter discourses, identify and selectively listen to supportive mentors, fight to quiet or disprove discriminatory discourses, and elect to participate in experiences that afford opportunities to strengthen STEM identities (Johnson et al, 2011). These studies have largely relied on students who have persisted to upper level or graduate courses and possess nuanced understandings of the intersections of their STEM identities and their minoritized identities. At the same time, research at the K-12 level indicates students' STEM identity construction is heavily influenced by teachers in the classroom and peer interactions (Brickhouse and Porter 2001; Calabrese Barton et al. 2013; Calabrese Barton et al., 2013; Carlone et al. 2014; Kurth, Anderson, & Palincsar, 2002).

Where graduate students in STEM are able to exert some influence over feelings of belonging in STEM, K-12 students' feelings are more dependent on others. These younger students construct meaning around their identities in STEM utilizing discourses available from stereotypes and influential individuals. Younger students' STEM identities are largely the product of what influential people and stereotypes suggest they should be. With different influences governing STEM identity construction, there exists an under-theorized middle ground at the transition between these two descriptions of identity construction. This study focused on students who have matriculated to a community college, intend to pursue a future in STEM, but have yet to enter into a major at a Bachelor's granting institution. These students were found to vary in the ways that they constructed meaning at the intersection of their minoritized and STEM identities, and those methods appear to influence students' ability to persist.

At the outset this study, I had assumed that students who encountered racist or sexist treatment as they pursued STEM would be the most likely to quit. I thought that issues of persistence would depend on students' capacity to endure sexism and racism. I envisioned "Racial Battle Fatigue" (McGee 2016) as the gradual wearing down of students until they decided to opt out of STEM. In my initial thinking, the salience of students' racial or gender identities would help determine how fast they became exhausted, with the relative salience of minoritized identities serving to magnify the impact of discriminatory treatment. I thought students who found their racial, ethnic and gender identities to be highly salient would be worn down relatively quicker than those whose minoritized identities lacked salience. Social support might stave off exhaustion, but my thinking about the role of community lacked nuance. It wasn't until participants started dropping out of STEM that my initial hypotheses proved inadequate. Students didn't report dropping out of STEM because of hostilities towards their being a person of color. These participants were saying, in fact, that their minoritized identities were not a factor in their decisions to stop pursuing STEM.

The assertions that race and ethnicity didn't matter in students' decision making ran counter to the very experiences that these students reported. Students who were opting out were reporting microaggressions around their minoritized identities in STEM, but were reluctant to attribute those aggressions to racism or sexism. Jose, for example, reported the need to allay the racist concerns of his peers in the first days of class, but didn't want to attribute that need to racist assumptions of others. Dylan and Pedro, reported being mistaken for Indian or East-Asian, but insisted that racialized questioning by peers, and subsequent misidentification, was not problematic. It was possible that these individuals did not want to offend a white male interviewer who worked at the college they attended. At the same time, students were willing to

share sensitive details about discrimination outside of STEM, their sexuality, immigration status, and sensitive family details. These students appeared to be actively avoiding associating their marginalization with their minoritized racial, ethnic, and gender identities; they appeared to be segregating their STEM identities from their minoritized identities. While *Segregators* were reluctant to attribute opting out of STEM to minoritized identities, those who persisted appeared to be those most troubled by marginalization. *Problematizers*, on the other hand, were troubled by the marginalization on the basis of minoritized identities and appeared to associate that treatment to the intersection of their minoritized and STEM identities. Patterns of persistence were running counter to what I'd expected.

While coping strategies consistent with stereotype management (McGee & Martin, 2011; McGee, 2016) or authoring identity (Johnson et al. 2011) were evident in those who persisted, those same strategies weren't being seen among those deciding to quit. Coping strategies seemed to be a mechanism necessary for those with salient minoritized identities, but what about those who opted out? Students who quit STEM still had salient minoritized identities. What was it about the students with coping strategies that allowed them to persist while similar students dropped out of STEM? Discussions with participants who decided to persist, and a body of research on sense-making from student development theory, offered a mechanism to explain why such similar students were exhibiting such dissimilar outcomes.

Attempts to conceptualize the process responsible for the results of this study relied upon differences in students' ability to make meaning of the experiences they had in STEM (see Abes et al., 2007, Evans et al., 2010, Johnson et al., 2011). Within this conceptualization, depicted in Figure 4, the focus is on participants' racial, ethnic, or gender identities, and a co-occurring STEM identity. The left side of the figure utilizes two parallel waves to depict STEM and

minoritized identities that are held by an individual. These co-occurring identities become out of phase, or discordant, when they encounter hostilities. These hostilities include Mariana being disregarded during group work, Sofia being questioned about intentions to take yet another math class by an advisor, or Daniel noticing other students are staring his way for awkwardly long durations in STEM contexts. This discordance is represented in waves that have shifted from parallel and complementary to opposed and contradictory. How students then handle that discordance influences feelings of belonging and decisions to persist.

For those with formulaic meaning making ability (represented by the lower set of opposing waves, the discordance is seen as indicating something about STEM isn't a good fit. These students frame marginalizing experiences as indicative of personally held traits, academic inferiority or disinterest. *Segregators* do not perceive hostilities coming from others as being the product of their minoritized identity in STEM. *Segregators* possessed foundational meaning making, and the discordance arising from hostilities is not attributed to the racist or sexist bias of others. These *Segregators* resist seeing their mistreatment by others as influenced by their race, ethnicity, or gender in STEM.

On the other hand, *Problematizers* (represented by the upper set of waves emanating from Hostilities) recognize that their minoritized identities are subject to marginalization, and have similar discordance after encountering messages that convey messages that their minoritized and STEM identities are not compatible. These students are troubled by that reality, and problematize the discordance. It is that problematization that allows students to attribute the discordance to others and to rely on coping strategies in response. It is clear that *Problematizers* are troubled by their marginalization in STEM, and burdened in ways unknown to members of

dominant groups. Yet *Problematizers* have a means of pulling their STEM and minoritized identities into phase again.

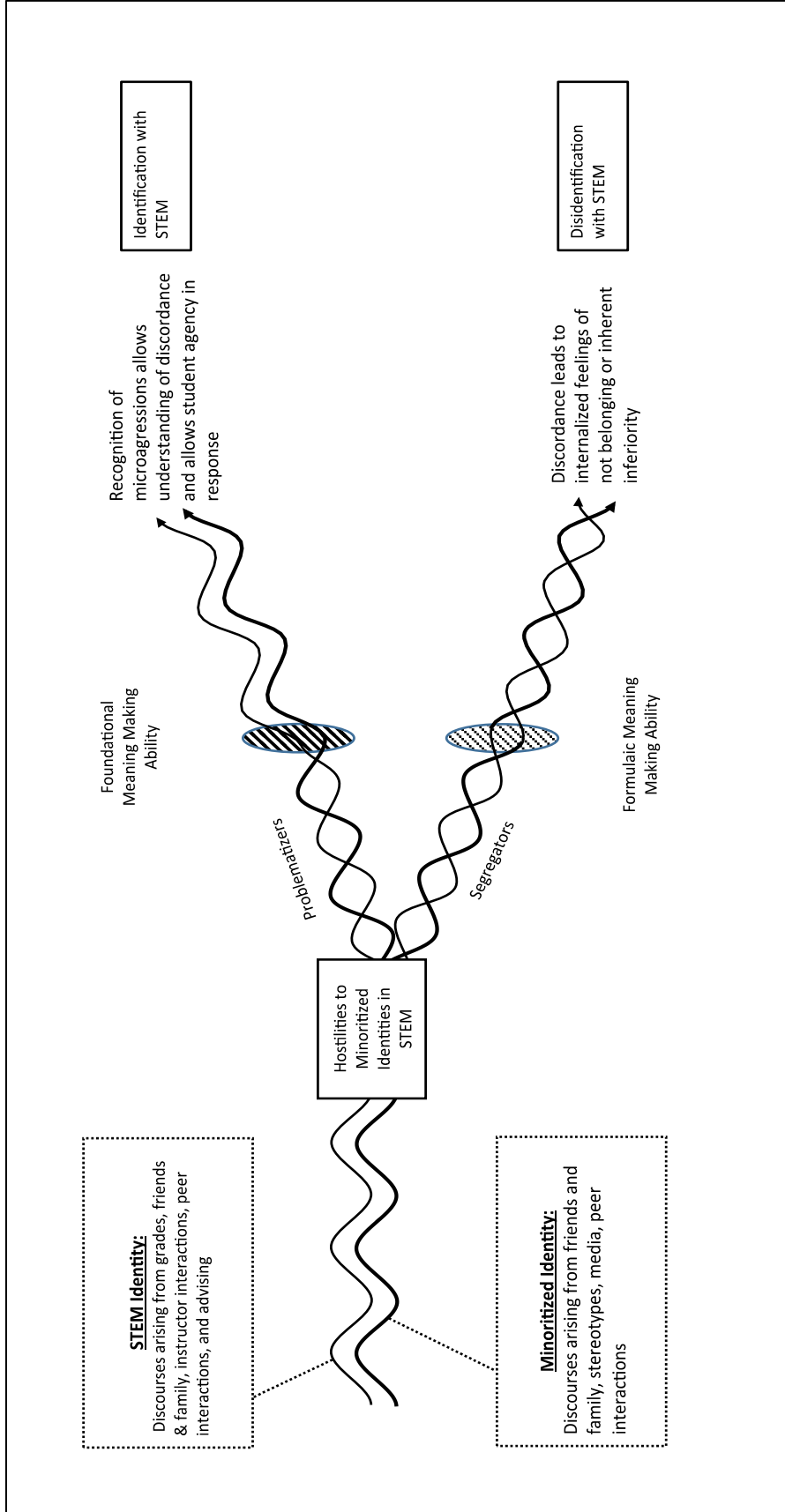


Figure 4: The role of problematization and sense-making in decisions of persistence by students with salient minoritized identities in hostile STEM settings

To summarize the logic undergirding this first theme, for students who choose to abandon intentions to pursue STEM, it may be a result of hostilities from students, staff, and peers. But this is not the whole picture. Those hostilities are not attributed to students, staff, and peers, but assumed to be reflective of something intrinsic. Students respond by feeling as if they do not belong in STEM. They may feel academically inferior, that interests have shifted, or that STEM is somehow the “wrong path” for them. For students who persist in STEM, hostilities are similarly encountered from students, staff, and peers. This second group however, is more likely to attribute these hostilities to the bias of other individuals. That attribution of hostilities to extrinsic sources allows the mistreatment to become productively problematic. Problematization allows the adoption of coping strategies that allows STEM identities to be maintained.

Without problematizing the treatment by others, there is no means of initiating coping strategies. There is no need to cope; a student’s experience is the product of their own doing. In the section that follows, the differences between meaning making utilized by Problematizers and Segregators will be further unpacked, with references to findings from this study and previous literature on minoritized identities in STEM. Doing so builds a case for the consideration of meaning making as a lens to interpret student identification with STEM.

Meaning Making

The importance of meaning making in student decisions to persist in STEM is not to be overlooked. Meaning making provides the mechanism by which some students persist, while so many others opt out of the very same STEM settings. The way that students make meaning of the day-to-day experiences in STEM determine whether or not they feel as if they belong in the discipline. To help understand the process of meaning making, it helps to return to Holland (1998) who described the process of meaning making.

In the making of meaning, we “author” the world. But the “I” is by no means a freewheeling agent, authoring worlds from creative springs within. Rather, the “I” is more like Lévi-Strauss’s (1966) bricoleur, who builds with preexisting materials. In authoring the world, in putting words to the world that addresses her, the “I” draws upon the languages, the dialects, the words of others to which she has been exposed.

The preexisting materials that Holland refers to are the experiences, the stories that students pick up from their community, their peers, and from instructors. The way that those experiences and stories are taken in and incorporated into existing identities differs from person to person.

Returning to Holland’s (1998) summary of Bakhtin, there are “neophytes,” whose identity is “given over to a voice of authority,” and then there are, “persons of greater experience” who “begin to rearrange, reword, rephrase, reorchestrate different voices and, by this process, develops her own ‘authorial stance’” (p. 181). The differences in meaning making abilities provide an explanation for the very different trajectories of students in this study.

For students with formulaic meaning making abilities, who rely on stereotypes and on what they have been told about race, gender, and their own identities, the discordance is explained using a lens that focuses inward. Students feel that discordant identities reflect academic inadequacies or shifting interests, and gradually disidentify with STEM over time. These students do not see their shifting interests as reflective of their interactions within social structures, instead assuming their interests are independent of the experiences and interactions they have within communities of practice. These students with formulaic meaning making abilities were *Segregators* within this study. They were students who encountered discriminatory treatment on the basis of their minoritized identities, but who were unable to link those experiences to larger societal assumptions about who belongs in STEM.

Students who did not problematize the intersection of their minoritized and STEM identities still encountered hostile discourses. They were socially isolated, talked over, questioned, and feared. By not attributing their experiences to the bias of others, *Segregators* were left feeling as if their experiences were the result of something core to their being. The discordance between STEM and minoritized identities implies that these two identities are not meant to be together. There is a poor fit, a general discontent, which might lead to shifting one's interest away from STEM. The disidentification with STEM seen among *Segregators* harkens back to previous research looking at classroom experiences for students of color in STEM. The stories of these *Segregators* mirrored the young students of color with names like *Crystal* (Brickhouse and Porter, 2001), *William* (Carlone et al., 2014), or *Carla* (Kurth et al., 2002). In recounting the experiences of *Carla*, echoes of Mariana's experiences (current study) in computer science classes can be heard.

The four students had entered the class as strangers to one another, and they were not overtly prejudiced in their speech and action. Yet the expectations they brought with them about how and when people should talk, how work should be done, and what standards of quality they should aspire to led them to reconstruct among themselves some of the most troubling inequities of our society as a whole. These inequalities affected Carla's perception of herself as a science learner and her opportunities to practice scientific genres in speech and writing. (p. 311)

This summary from Kurth et al. provides insight into the processes responsible for the outcomes of *Segregators* in this study. Carla was a young woman of color, and her peers were not overtly racist. Yet her experiences in interactions with others conveyed messages to Carla about her not belonging in STEM.

It was clear that most students experienced hostilities to their minoritized identities in STEM. It is also clear that most of those hostilities were not overt. When hostilities are not overt, it appears that attribution for the basis of those hostilities is difficult. This inability to attribute the experience of marginalization to the racist and sexist beliefs of others was perhaps most evident in the exchange between Mariana and her classmates that closed out the findings section.

That's why I felt really uncomfortable asking them questions, because they would talk over me. We would be in a group and they would be, "do this, this, and this." ...and they were like, "no you need to change that"...and I just listened because, "You're probably right. I'm probably wrong."

It was apparent that Mariana's peers not only assumed her incompetence regarding information technology; it was apparent that they were compounding her marginalization when they failed to acknowledge that they should have listened to her suggestions. Discourses arising from Mariana's peer group insinuated her inferiority, and without coping strategies, Mariana, like other *Segregators*, was taking up discourses implying that she didn't belong in STEM.

If Asher noticed a classmate turns to ask a clarifying question of their white neighbor, instead of the black or brown student on the other side, is it because that classmate is racist? When Mariana has lab group members talking over her, are they sexist and racist, or does she not have the knowledge needed to contribute to group work? How students attribute the hostilities they encounter seems essential in framing how students make sense of their experience, and that attribution seems tied to how students construct meaning.

Students who problematized their intersecting identities were more aligned with foundational meaning making abilities (Baxter Magdola's *Phase 3: Becoming the Author of One's Life* or Kagan's *Order 4: Self-Authoring Mind* (cited in Evans et al., 2010)). They were

able to acknowledge the source of the dissonance as coming from discriminatory treatment based on their minoritized identities. These students were able to utilize coping strategies to reduce the discordance and to make STEM and minoritized identities compatible again. Students with foundational meaning making abilities were able to acknowledge that they were subject to racism or sexism because of their decision to pursue STEM. They were able to then amplify discourses supportive of their future in STEM while diminishing the impact of discourses that questioned the belonging of their minoritized identities in STEM. This amplification of some messages, and the dampening of others, appears to be the mechanism that allows individuals with minoritized identities to persist in the very settings where those identities are minoritized.

Abes et al. (2010) noted that students with foundational meaning making ability had the, “capacity to richly analyze the relationships between discrimination and identity perceptions” and then used that analysis to, “maintain some ownership over the dynamic saliency of these dimensions” (p. 12). In this study, students with more foundational meaning making abilities were able to recognize discrimination, and to push back against that marginalization utilizing discourses that validated their belonging in STEM.

The support for this relationship between students’ meaning making ability, their ability to problematize hostile treatment from others, and decisions to persist in STEM are exemplified by Isabella’s shifting meaning making ability over the course of this study. Isabella initially reported that her gender and race had no perceptible influence in her experiences pursuing a future in engineering. It wasn’t until her second and third quarters at college that she started running into discourses that questioned her decisions to pursue STEM. Those discourses, originating from her aunts, were taken up by her mother and threatened to erode her sense of belonging in STEM. To counter the corrosive discourses from her aunts and mother, Isabella

dampened their discourses while simultaneously amplifying the supportive discourses coming from her father. It is in this response to a problematic discourse that we can see how students come to problematize the intersection of their minoritized identities in STEM. Isabella shows how problematization involves the recognition of the problematic discourses, attribution of racist or sexist assumptions to the biases other people hold, and the initiation of stereotype management strategies that filter incoming discourses. It is easy to imagine a scenario in which Isabella ignored statements from her family that doubted her future in engineering. She could have avoided coping with those iterations that questioned women's role in STEM. If Isabella were to try to ignore the messages that women don't belong in engineering, it is possible she would have never grappled with the discordant messages from her family, but would incorporate those harmful discourses into the intersecting identities she held.

Where this research stands to fill a gap in the research is in understanding the dynamic between the existence of hostilities towards minoritized identities in STEM, and how understanding of the racialized basis of those hostilities allows students to utilize coping strategies to counter them. It was how students responded to these hostilities that was important. Students who could attribute marginalization to the biases of other people were able to cope with discourses that questioned their belonging in STEM. These students were able to understand that the intersection of their minoritized identity and their STEM identity, and biases people had about those minoritized identities in STEM, were troublesome. Problematizing those negative discourses allowed students to persist despite the hostilities they encountered. It is important to note that this problematization was sophisticated. Students were not attributing all of their failures to the racist or sexist perspectives of others. In fact, failing a test or a course were often seen as reflections of inadequate preparation. Instead, problematization was specific to the

racialized or gendered messaging coming from students and staff. The importance of this distinction, between students' academic struggles and their encounters with mistreatment on the basis of minoritized identities cannot be overstated. Students who persisted took responsibility for their own academic failures, but were able to place responsibility for marginalization within their college experience squarely on other people.

The construction of discourse based STEM identities

While a focus on the role of problematization is important to understand decisions regarding persistence, it is also important to consider insight into the development of STEM identities provided by this study. Four individuals opted into STEM academic pathways after matriculating to community college. For these students, early success in mathematics provided opportunities to consider themselves as having a future in STEM. These STEM identities were not simply reinforced by grades. Instead, participants utilized discourses about their academic competence to craft a STEM future within social settings. Academic successes became stories that were shared with friends and family. Sofia's family posted test results on the refrigerator. Carlos slammed his transcripts on the table in an argument to establish his achievements. Asher texted a picture of his Calculus test to his mother. Students who decided to pursue STEM after starting college earned good grades, but then took discourses about those grades and put them into public spaces as a means of crafting a STEM identity for themselves.

Surprisingly, the latecomers to STEM in this study seem to contradict the findings of Jackson & Seiler (2013), who noted that similar students in their study were consistently successful with regards to academic achievement. Three of the four latecomers to STEM in this study (Carlos, Sofia, and Mo) failed classes necessary for their intended major. The latecomers appeared to have robust STEM identities that were able to cope with academic failure in ways that allowed persistence. In contrast to Jackson & Seiler, who postulated that academic struggles

for latecomers quickly eroded newly formed identities, the results of findings in this study suggest that the ability of students to proliferate discourses about belonging in STEM helps to influence their ability to persist. Students who affiliate with STEM disciplines, and who manage to establish that affiliation among friends and family members within their communities, are able to persist despite encountering academic failures early in their academic career. The process by which these contextual discourses are utilized by students to construct STEM identities is difficult to conceptualize. This difficulty is compounded when also considering the role of minoritized identities, identity salience, meaning making. Given the complexity and nuance associated with discourse based STEM identity, it becomes useful to consider the following analogy.

Painting as an analogy for identity construction

To more adequately capture the salience of identities, the intersection of identities, the histories of those identities, and students' ability to author identity, it became helpful to utilize an analogy to think about identity construction. The research has a rich body of literature describing the processes by which identity develops, but no comprehensive model to pull those mechanisms together. Some models tend to focus on individuals, as opposed to participants within communities of practice (see Carlone & Johnson, 2007; Abes et al., 2010). Other models for thinking about identity tended to focus on experiences an individual encounters but fail to take into account the agency individuals have in encouraging their own sense of belonging in STEM. In this analogy, identity is thought of as a painting on a large transparent sheet of glass. On one side is an individual, and on the other is the rest of the world. Discourses serve as paint. The painters are the student on one side, and the community they interact with on the other, both sides having their own palettes.

Initially, other people use their brushes to render the identities of a student through the discourses about things like academic ability, social identities, stereotypical narratives, and socio-cultural norms. Students, standing on the other side of the glass, with formulaic meaning making abilities largely let others do the painting, assuming that their identity is what others compose. As students grow discontent with the ascribed identities, they shift from formulaic meaning making towards a more foundational meaning making. Students begin to take up the brush, claiming agency over what that identity looks like. Paint covers paint, as students begin contributing to their side of the mural. Discourses, be they supportive or corrosive, shape the ways that identities like race, disability, gender, sexuality, citizenship, or STEM affiliation are integrated into the mural. Who does the painting shifts over time.

As students grow, they are able to integrate disparate identities into a more cohesive whole. Identities with more salience are more prominent and central, while others identities lose prominence or are painted over. This identity mural is in effect an ever-changing entity, co-constructed by students and the communities in which they are embedded. There is history in that layered paint, and different sides have different perspectives, one never quite knowing what the other sees. While this vision of a two-sided Jackson Pollock creation seems daunting, the framing is powerful in its simplicity.

The painters are both individuals and their communities. Identity is the painting itself, never static, and individuals never know exactly what their identity looks like from the community's perspective. With painting as a conceptual framing, important questions quickly rise to the surface. Who is doing the painting? Which components of the painting are salient and has that salience shifted? Where do emerging STEM identities exist, and how do other identities threaten or bolster these STEM identities? How do students learn to pick up the brush and start

painting, and do they learn to paint different portions of their identities at different times in their lives? Who attends to which portions of the mural, and who averts their gaze from other portions?

Using painting as a means of framing identity construction affords opportunities to allow for multiple identities that are related and constructed by individuals and the communities they are in. Painting allows for differing abilities to shape one's own identity and opportunities for growth in that ability. The analogy also maintains history while accounting for student agency; the social and the individual with room to account for complexity.

Reviewing the cases of this study using the metaphor of painting, it becomes apparent that the discourses of race and gender overlapped emerging STEM identities for *Problematizers* and that these students were able to take up brushes to respond to discourses that were skeptical of their identities. Their ability to perceive tensions, and their ability to make meaning at the intersection of those identities allowed them to persist. Sofia was able to appropriate discourses about the value of creative thinking and diversity in technology companies to paint a future for herself at Microsoft or Google. Carlos latched onto discourses about his strength as a student from an English teacher who chose him to be the TA for her class, and used that discourse to validate his existence as a student in upper level STEM classes. Students with salient minoritized identities who persisted to transfer were able to use discourses to paint in ways that countered racist or sexist discourses from the other side. These students were marginalized on the basis of their identity, yet it was the recognition that mistreatment was attributable to the racist or sexist assumptions of others, and the ability to paint an identity that countered those unsupportive discourses that allowed them to persist.

For *Segregators*, STEM identities were largely composed separate from minoritized identities. For students like Jose and Dylan, this segregated composition was intentional. They worked to separate their racial identities from STEM settings. Jose was unable to incorporate STEM identities with his own tattooed Latino immigrant identities, and tried to cover that identity within STEM by acting to allay the concerns of his white classmates. Dylan actively sought to deny his racial identity influenced his experience, yet acknowledged that discourses regarding his identification as a gay man influenced his decision to pursue graphic design instead of engineering. Meaning making related to minoritized identities situated in STEM was largely formulaic for *Segregators*, with participants' perceptions and actions constrained by stereotypical discourses or the discourses of others.

This painting metaphor is also helpful in conceptualizing decisions to stop pursuing STEM pathways. When students like Dylan or Jose decide to give up on portions of the mural they have spent years composing, there must be some level of dissatisfaction with what they are seeing. When Jose, talking about his decision to drop out of his classes says,

Essentially I'm not happy where I'm at. You know, in life, my age has a big factor in it. I know you can relate, but as far as like age goes, that was a big factor in it too. And I keep going back to it, I feel at this point I should be further in life. That's what I feel like, period. I should be further, I'm not happy where I live, I'm not happy with what I have. That's exactly where I'm at right now. And I feel like if I continue this school, it's going to get me there, but I'm not going to enjoy it the way I would like to. You know, coming from a developing country, I feel like I should be grateful for what I have, but I feel like there's something in me, there's something in me that wants more.

He is, in effect, standing back and disapproving of the mural he's created. Dropping out of his classes and deciding to give up on his pursuit of engineering is like taking a big paint roller to the STEM portion of his identity. His experiences visiting universities and engineering programs, his three years of course taking, his plans for the future, they were all covered up in that one moment. Jose's inability to compose something that incorporated his age, ethnicity, immigration status, and engineering can be compared to Isabella. Isabella manages to compose a STEM identity that is initially quite separate her gender and ethnicity. It is only when her mother attempts to introduce conflict into the composition that Isabella is forced to respond. When Isabella's mother used discourse that brings STEM and minoritized identities in opposition, Isabella averts her attention from that harmful discourse to focusing instead on her own desired identities and the supportive discourses of her father.

Conceptualizing identity construction through the analogy of painting affords opportunities to account for the complexities inherent in considering intersecting and consistently evolving identities. While it is worth noting that this analogy is parallel to Bakhtin's "authoring self" (see Holland, 1998), the analogy more clearly illuminates positioning, meaning making ability, historicity, intersectionality, and salience.

Alternative explanations

Existing research provides a partial explanation for the underrepresentation of men and women of color in STEM fields. Stereotype threat (Steele, 2010), for instance, offers a mechanism to explain reduced performance in tests or performances. As McGee & Martin (2011) point out, stereotype threat only addresses tests and performances, and not the day-to-day existence in a context. McGee & Martin offer stereotype management as a day-to-day coping strategy to complement stereotype threat. While these frameworks provide a mechanism for reduced test scores and understanding coping strategies, they fail to adequately address how

students come to stereotype management. The concepts of *Problematization* and *Segregation* offered by this research provide a mechanism to explain how students learn stereotype management, and an explanation for why so many chose to stop pursuing STEM.

While it is also worth considering the possibility that different outcomes for students in this study encountered very different experiences, students were attending the same campus, during the same time period, in similar classes, taught by the same faculty. It is more likely that the perceptions of those experiences were different for participants. It is noteworthy in the findings that those who managed to recognize discriminatory microaggressions targeted at their minoritized identities were able to persist, while those who felt their minoritized identities had little influence on their student experience did not.

It is also possible that those who drop out of STEM never managed to construct very substantial STEM identities. Such an explanation seems fragile, however, and fails to take into account the time and energy spent by students like Dylan, Jose, and Mariana. These were students who had years of experience working in technology similar to their intended majors. They had joined engineering clubs and taught themselves computer coding. These students were able to refer to a rich set stories about their experiences in STEM that led to intentions to pursue STEM. Only Juan and Miguel appeared to have relatively few discourses to rely on to construct a STEM identity.

At the same time, it is worth considering the strength of students' STEM identities, and the possibility that alternative non-STEM academic pathways supersede student intentions to pursue STEM. It is fair to assume that students like Dylan, Jose, Juan, or Pedro simply shifted their interests, the work of Bonous-Hammarth (2000) must be kept in mind. If 44% of students of color switch out of STEM majors while only 25-26% of Asian and White students switch out of

STEM, there must be something underlying the disproportionate attrition of students of color. At some level, it seems as if there are dynamics at play that account for the racial disparities in decisions to opt out of STEM. This research suggests that the hostilities students with minoritized identities encounter, and how they respond to those hostilities, is influential in explaining this discrepancy.

Why is this important?

Situating this research in a community college targets a different population of students than previous research on K-12 or four-year institutions. This study serves as a bridge between research on students in K-12 settings and those who have managed to successfully navigate post-secondary academic pathways. This study is unique in incorporating understandings of student sense-making as a conceptual tool to provide an understanding of how students holding minoritized identities make decisions regarding persistence. Students at this juncture, early in their post-secondary experiences, appear to be at the transition between formulaic and foundational meaning making. Meaning-making introduces a mechanism that explains *how* negative stereotypes associated with minoritized identities manifest themselves in decisions regarding persistence in STEM, and *why* some students with minoritized identities decide STEM isn't a good fit for them, while others persist to transfer. This study speaks to a student need for discourses supportive of their belonging in STEM, and caring individuals to perpetuate those discourses. Isolation allows marginalizing discourses to dominate. This study also speaks to the importance of programming/curriculum that explicitly supports minoritized identities in STEM and acknowledges the racist and sexist culture that pervades STEM.

Implications

For people who don't possess the white male identities typically over-represented in STEM fields, the ability to construct meaning around marginalization within STEM is important in decisions to persist. Coping with that marginalization might be attributing mistreatment to the racist or sexist bias of others. Alternatively, coping might mean seeking out supportive mentors who can provide discourses that validate a student's belonging in STEM. Without the ability to cope with the hostilities that come with occupying a place in a discipline that is unwelcoming, students are susceptible to assuming that feelings of not belonging reflect a general disinterest in STEM or personal inadequacies. The need to problematize the intersection identities speaks to the need for students holding minoritized identities in STEM to have opportunities to gain an awareness of the racism and sexism endemic to STEM fields, and strategies to cope. This awareness and coping strategies might come from a mentor. Additionally, explicitly addressing the racist and sexist histories in STEM fields, and the demographic realities that exist because of those histories, would offer a means of facilitating problematization. Students with minoritized identities might be offered access to affinity groups, where peers with similar backgrounds and similar academic intentions can talk about their experiences as persons of color in STEM and how they respond. The opportunity exists at community college, and beyond, to address the realities men and women of color will face as they pursue STEM with intentionally designed programs and instruction designed to provide support.

Guided Pathways at Community Colleges

While this research draws attention to a need for explicitly addressing the hostilities students with minoritized identities encounter, it also speaks to the need for careful policy considerations around course taking. At community colleges across the country, there is a push to refine the way students are offered courses. This refinement, labeled a "guided pathways"

approach (Bailey, Jaggars, & Jenkins, 2015), consists of directing students into academic pathways aligned with career interests early in their student experience. This effort aims to focus course taking and to provide structure for first generation students who may not be as proficient at navigating post secondary education. As community colleges work to design meta-majors (academic pathways which encompass similar disciplines-e.g. STEM, Business, Health Sciences, Humanities), it will be essential for community colleges to be conscious of the varying abilities of students to construct meaning when their social identities do not align with the hegemonic norms of a discipline. To simply offer minoritized populations the opportunity to opt into STEM without an opportunity to acknowledge and cope with harmful discourses would threaten their opportunities for success.

It is also important to note the number of individuals in this study who decided to opt into STEM after encountering success in preliminary STEM courses. Sofia, Carlos, Asher, and Martin all started at the community college in pursuit of academic pathways other than STEM. These four students serve as examples of the 49% of community college students who enter STEM after their first year at college (Van Noy & Zeidenberg, 2014). If guided pathways are put in place, there will need to be well thought out mechanisms to allow students to easily pursue interests that deviate from their initial pathway. Without such mechanisms minoritized students who rely on community colleges for post-secondary access, might face yet another barrier to a future in STEM.

At the same time, minoritized students who decide to switch into STEM oriented meta-majors will need to be offered the same opportunity to learn to make meaning at the intersection of their identities as those who begin in STEM. Teaching students how to problematize the marginalization on the basis of minoritized identities needs to be an ongoing element of post-

secondary STEM education, woven into the student experience at multiple points. As this research demonstrates, affording opportunities for students with minoritized identities to acknowledge and then cope with mistreatment they encounter, and planning for students who gain an interest in STEM after matriculating to the community college will be essential if we are to promote more equitable participation in STEM arising from the guided pathways movement.

CONCLUSION

Men and women of color in STEM face demographic realities that call into question their belonging within disciplines of science, engineering, and mathematics. If students hold minoritized identities as central to who they are, then entering into STEM academic pathways will force those minoritized identities to intersect with emerging STEM identities. How students handle those intersections is important. If students acknowledge the racist and sexist stereotypes, and the poor treatment from others that arises from those stereotypes, then they are more likely to initiate coping strategies that help students persist. If students resist acknowledging stereotypes that question their identities in STEM, and resist attributing marginalization within STEM courses to other people, then the marginalization leads to doubts about their belonging in STEM. Students who doubt their belonging in STEM because of marginalization by others are more likely to opt out of STEM. The alternative is to acknowledge the marginalization by others. By attributing that marginalization to the bias of others, and judging that treatment as unfair, students are then able to seeking out alternative discourses that are supportive of their belonging in STEM. This acknowledgement, attribution, judgment, and coping are encompassed in the concept of Problematization.

The idea that problematization is a means of initiating coping strategies is powerful for understanding decisions regarding persistence in STEM. Problematization stands to serve as a

bridge between the research on K-12 students and research examining those successful in post-secondary STEM. The concept of problematization also stands to explain the dynamics underlying students holding minoritized identities more broadly. If we acknowledge that many students have identities in conflict, how do we help them integrate those identities in ways that facilitate academic success? How do we help students who are athletes or non-traditionally aged students work to reconcile the biased assumptions of others with the questions of belonging they pick up from academic settings? By problematizing the intersection of identities traditionally not associated with one another, we can provide a means of addressing students' perceptions that they don't belong; we can begin to provide alternative discourses that say they do belong.

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APPENDIX A: INTERVIEW PROTOCOL

General Theme Being Explored	Sub-theme	Initial question	Potential follow up questions
Influences on Discourses Prior to Post-Secondary Education	Precollege Educational Experiences	How long have you known you wanted to pursue a career in STEM?	Were there middle or high school experiences or influences that helped inform that decision? Do you have friends or family in STEM related careers that helped make that decision?
	Financial & Altruistic Ambitions	Why a career in STEM?	What are you hoping to do/get with this degree?
Contributors to Contextual Discourses	<p>Card Sort-Explain I'm trying to figure out messages and perceptions you're getting from different experiences and peers, both positive and negative. Ask students to rank the following elements, from most to least influential in your pursuit of a major and career in a STEM discipline. (<i>prompt participant for explanations of why certain elements were ranked as they were...be sure to ask for connections</i>)</p> <p>Can you tell me whether this ranking was influential? Was it positive or negative? Be open to the construction of another sub theme</p>		
	Support and/or advice from Advising & Financial Aid	Did/Do you regularly meet with an Advisor?	What did you discuss related to career/transfer plans
		How frequently are college costs and financial aid a concern over the course of a quarter? How frequently do you have to think about it?	Did you feel supported? How or how not? Are you working while you go to school? Are you supporting a family?
	Your Early College Course Experiences in Mathematics and the Sciences	Remedial math <i>if appropriate</i> : How was/were our experiences in Math 97,98, 99?	How would you describe your relationship with your instructor?
			How would you describe your grades and level of success in those classes? Did you ever retake a math class? How did you decide to retake it instead of quitting?
		STEM coursework	How have your math classes changed as you move to higher levels? (Teachers, Peers, Work expected)

			Can you describe what your experiences have been like with your Physics/Bio/Chem coursework?
	Either Grades earned for a whole course or grades on single tests/quizzes	How much do you feel grades are an indicator of what you can and can't major in with respect to STEM?	How would you describe your STEM grades?
		Can you remember a test you got back that either built up or broke down your plans to major in STEM?	What was it about that grade/test? Did you share it with people? Who?
	The advice and comments from Friends & Family	Who have you told about your interest in a STEM major/career?	Who has been most supportive of these ambitions?
			Who has been most skeptical or negative of these ambitions?
	Your interactions with other students from your classes and degree programs	Do you typically work with peers in your STEM classes?	What does that work typically require you to do?
			Who do you normally work with? Who chooses that?
		Do you interact with your peers outside of class?	Do you work with people from your classes outside of the classroom? Studying? Would you consider anyone from your class a friend? Someone you'd hang out with outside of classwork?
	Your interactions with instructors	How would you describe your typical interaction with STEM instructors?	Do you feel like they know who you are?
			Do you think they know of your college and career plans?
			Are they supportive of your plan? How?
			Are any skeptical or unsupportive of your college and career plans? How?
Mediators of Contextual Discourses	Academic Community of Practice	Do you interact with your classmates very often?	Who do you work on STEM coursework with? What does that look like (i.e. study sessions, homework, tutoring, etc.)?

			Do you talk to your peers about your transfer plans or career plans?
			Do you share your grades with your peers? Which ones? Why?
		Are there instructors you go to work with regularly?	What was it about the instructors you worked with that was different than the ones you didn't work with?
			Did you share your major/career plans with them?
			Did you get any mentoring from them? What did they do that was helpful?
		Are there other places on campus you go to spend time? (Tutoring center, veteran's center, multicultural center, etc.)	What is it about this location that makes it an attractive place to spend time? Do you discuss classes and student experiences?
	Friends & Family	Away from school, do you hang out with other college students or do you have a separate group of friends who are not taking the same classes? <i>This might include coworkers</i>	Do you talk about your college and career ambitions with those friends?
			Are your friends supportive of your plans? How or how not? What do they do/say to support you?
			How much of your college experience do you share with your friends? Grades? Instructor interactions? Peer interactions?
		Outside of school, do you spend time with your family	Do you talk about your college and career ambitions with your family?
			Is your family supportive of your plans? How or how not? What do they do/say to support you?
			How much of your college experience do you share with your family? Grades? Instructor interactions? Peer interactions?
	Racial & Gender Identities	Do you think that race or gender influence	How aware of your race & gender do you think your peers are? Do they say/do anything because of this awareness?

		your college experience?	How aware of your race & gender do you think your instructors are? Do they say/do anything because of this awareness?
			Do you act and talk in class in ways similar to the way you act and talk outside of class (with friends/family)? If no, Why not?
		How aware of your race and gender are you when you are in STEM classes?	Is this experience different than what you experience in non-STEM/humanities classes
			How does your awareness influence how you participate in those classes? Are you singled out, ignored, or does it not factor in at all?
		Can I ask how you identify in terms of race & gender?	Do you think your classmates are aware of how you identify?

Additional Questions for Participants Working Towards Transfer

I noticed that your ranking in the card sort has changed since we last met, and that _____ moved up. What was it about _____ that changed?	
How is college going for you?	What are 1-2 things that are going really well for you?
	What are the biggest challenges?
	Can you describe how you work through the challenging portions of your college career?
Are you doing anything outside of coursework to pursue your degree?	Are you looking at where to transfer?
	Have you joined any clubs?
	Are you networking with people or businesses?

Additional Questions for Part 2 Participants exiting STEM pathways

What do you think is the most important factor in your deciding to stop pursuing a STEM degree?	Who knows about your decisions to stop?
	What are your new academic goals?
	Do you have any regrets from your past few quarters? What are they?
	When did you start thinking that a STEM degree might not work out for you?
Did you think about continuing on in STEM?	What would you have needed/wanted to keep going? (Financial support, peer support, faculty encouragement, etc.)
	Do you think you'll come back to a STEM career later in life?
You're an intelligent individual who is/was interested in STEM,	Anything stand out about your peers who were successful?
	Do you feel as if they received different treatment from each other or from staff relative to you? How?

<p>what do you think it is that prevented you from continuing on that academic pathway while others persist?</p>	<p>Were there other students of color in your classes? Do you think people noticed you were a minority in the classroom? Do you have evidence or examples that let you know they noticed?</p>
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APPENDIX B: RECRUITMENT POSTER/HANDBILLS

Do you identify as a Student of Color? Are you interested in a career in a STEM field?

S TUDENTS SCIENCE	T ECHNOLOGY	E NGINEERING	M ATHEMATICS
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Students of color interested in STEM fields are needed to take part in a research project involving interviews exploring the community college experience.

Share the experiences that help and hinder your pursuit of a STEM degree, and help build more solid pathways into STEM careers for students of the future.

If you think you may be interested in taking part and would like to more information about the project, please contact me, Jason Babcock
Details below:

For more information contact Jason Babcock at jbabcock@uw.edu or [REDACTED]

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UNIVERSITY of
WASHINGTON

APPENDIX C: CODING SCHEME

Code Family	Code	Code Definitions (References to)
Influential People	Friends not in college	Friends who are not enrolled in post-secondary education
	Friends in college	Friends who are enrolled in post-secondary education
	Family	Parents, siblings, children, aunts, uncles, cousins, grandparents
	Institutional Agents	Employees of the college who are influential in decisions to persist or stop out of STEM pathways (advisors, classified staff, instructors, facilities, administrators)
Academic Community of Practice	Isolation	Being excluded from academic peers, working alone, studying alone, choosing to work by oneself
	Active Participation	Participating in classroom discussions, study groups, academic support centers, intercultural centers
	Expert Status	Being recognized as an academic expert by instructor or peers, recognizing others as experts
	Peers	Classmates enrolled in the same class or students who are on similar academic pathways
	Instructors	Current or past instructors, instructors with a reputation
	Division of Labor	The roles that students have in the classroom, in lab settings, the expectations of work by instructors, expectations instructors have for students and themselves, expectations students have of instructors and of each other, the nature of assessments and assignments
Institutional Structures	Advising	Advisors, the advice received from advisors
	Financial Aid	Financial aid, financial resources, grants, scholarships, loans
	Centers and Spaces	Intercultural Center, Learning Center, Library, Veterans Center
Institutional Norms	Rigged System	Talk of an unfair system with little connection between one's merit and the ability to succeed
	Fair System/meritocracy	The idea that schooling is a meritocracy and outcomes are directly linked to the effort and skill of a student
	Advantaged and disadvantaged	Talk of what other students have or have experienced relative to their own, access to money, transportation, native language instruction, prior coursework, high school education, stable housing

	Proving oneself	The idea that you need to prove yourself to peers before you are accepted, specifically because of minoritized identities
STEM Identity	Earnings	Equating a future in STEM with earning potential
	Future career/work	The work that one wants to engage in after obtaining the necessary credentials
	Student in STEM classes	Being a student of physics or chemistry or math, can be as an individual or as a member of the larger community of practice
	Clubs	Membership in a STEM oriented (math, engineering, or pre-med) club on campus
	Past STEM experiences	Experiences in summer camps, internships, high school, middle school, weekend events, museums, science centers
	Grades in STEM classes	Grades earned in STEM classes, framing of grades as a positive or negative influence on future STEM careers
	Non-STEM classes	Experiences in classes that are not typically aligned with STEM, interactions with peers in those classes, interactions with instructors
	Self-Doubt	
	Strengthening Stem Identity	Talk about how an individual is getting more excited about future careers, future courses, experiences that bolster an individual's sense that they are going to be successful in the pursuit of a STEM career
	Eroding STEM Identity	Talk about how an individual is getting doubtful of a future career, future course, experiences that erode an individual's sense that they are going to be successful in the pursuit of a STEM career, talk of failure, talk of alternative majors or careers
	Confidence in Abilities	Talk about being confident (or not confident) in their academic abilities
	Critical Event	A specific event that changed STEM interest or academic trajectories
	Strengthening alternative career identity	Talk of a non-STEM field of study as more interesting or attractive than STEM
Minoritized Identity	Race & Ethnicity	Talk of experience as a minoritized racial or ethnic identity, talk of races & ethnicities aligned with hegemonic norms,
	Gender	Talk of being a man or woman
	Unspoken	Ideas about minoritized identities that exist and are held by people, but which are not explicitly talked about by peers or instructors

	Marginalized	Talk of marginalization of one self (or others) based upon a personally held identity
	Non-issue	The idea that race, ethnicity, or gender have little or no impact upon the student experience
	Noticing	Student talk about being aware of the ways in which their social identities might deviate from their peers or from disciplinary norms
	Not at this campus/town	Talk about the campus location being special or sheltered from non-campus environs
	Other minoritized identity	Sexuality, religion, social class, citizenship, native language, etc.
	Racial Salience	The perception that race or gender was salient in a particular instance/setting
	Discrimination from Ingroup	Participant perceived discrimination from people with similar minoritized identities
	Discrimination from outgroup	Participant perceived discrimination from people with dominant identities
	Proving oneself	The idea that you need to prove yourself to peers before you are accepted, specifically because of minoritized identities
	Previous Racialized Experiences	References to racialized experiences prior to community college
	Expectations of others	The idea that other people have expectations within STEM based on race or gender
Unrelated Constraints	Unrelated employment	Having to work, having to raise siblings or children,
	Disability/illness	Having a disability, having medical conditions, constraints and accommodations for disability or illness
Tools	Resources	Unique resources (financial or mentoring)
	Conceptual tools	Ways of thinking that helped explain experiences, <i>noticeably different than others</i>
Other	Agency	Talk of having control over their own outcomes. A sense of power/influence

Curriculum Vitae

Michael Jason Babcock

Education

- Graduate Degree: The University of Washington, *anticipated December 2017* (GPA 3.9/4.0)
 - PhD in Curriculum and Instruction
 - Thesis work investigating the dynamics underlying disparities in STEM for students with underrepresented racial, ethnic, & gender identities
 - Studies included Teacher Education, Model Based Science Inquiry Instruction, Educational Technology, and Multicultural & Bilingual Instruction
- Graduate Degree: The Pennsylvania State University, May 2005 (GPA 3.88/4.0)
 - M.S. in Curriculum and Instruction-Science Education
 - Thesis work investigating influences on student understanding of the nature of science
 - Additional coursework in Parasitology, Soil Sciences, Hydrology, and Mammology
- Undergraduate Degree: The Pennsylvania State University, December 2000 (GPA 3.4/4.0)
 - Bachelor of Science, Secondary Science Education (Major GPA 3.5/4.0)
 - Additional coursework, including Entrepreneurship, Creativity Innovation and Change, African and African American Studies, Native American Anthropology, and Oriental Philosophy

Professional Experience

Director: Whatcom Community College • Bellingham, WA • Learning Center

- Managed a staff of eighty five and a budget of over \$300,000 to deliver over 5,000 tutoring sessions/quarter to undergraduate students in multiple disciplines
- Created unique academic supports tailored to the unique needs of Adult Basic Education, Academic ESL students, Medical Assisting, and Veteran Students
- Developed and delivered professional development workshops for faculty members on Team-Based Learning, Active Learning frameworks, and building supportive learning environments for students with disabilities
- Consistent collaboration with the campus Intercultural Center, including regular service as chaperone to the annual Students of Color Conference in Yakima, WA
- Co-PI on NSF S-STEM grant to support institutional support for students pursuing STEM academic pathways

Coordinator: Whatcom Community College • Bellingham, WA • Math Center

- Staffed and managed 30+ tutors in a drop in math center delivering over 3000 tutoring sessions/quarter
- Developed and implemented professional development framework to improve tutoring services delivered
- Taught mathematics using Team-Based Learning framework
- Developed and delivered professional development workshop on Team Based learning to 20 faculty and staff

Graduate Student Assistant: University of Washington • Seattle, WA • Academic Support

Programs

- Taught and refined a series of courses that paired underachieving students admitted to the University of Washington with volunteer upperclassmen and graduate students who served as tutor/mentors.
- Developer and teacher of academic skills course for underperforming undergraduates within the context of ethical issues surrounding genetic engineering. Skills embedded within the science content included reading, writing, organization, test taking, classroom discussion, and scientific literacy.
- Developer and instructor for weekly course that prepared tutor/mentors to work with underperforming undergraduates in ways that maximized the effectiveness of tutor/mentor relationships for mentors and mentees.

Science Teacher & Homeschool Consultant: Mount Baker School District • Deming, WA •

MBAcademy

- Developed and taught chemistry course to homeschooled children enrolled in a district supported Alternative Learning Environment (ALE) program.
- Directed program actions to ensure compliance with WA state ALE law
- Served as an educational consultant to over thirty families developing learning plans for their homeschooled children.

Teaching Experience

Whatcom Community College • Bellingham, WA

- Math 97 & 98-Elementary Algebra I & II
- English 174-Academic Knowledge and Power
- EDPL 100 & 299-Educational Planning
- HUMDV 135-Mentorship in Higher Education

University of Washington • Seattle, WA • Academic Support Programs

- GENST 101-Genetic Engineering: Ethical and Moral Issues
- EDUC 401-Mentorship in Higher Education

Bellingham Public Schools • Bellingham, WA • Squalicum High School

- Taught, Environmental Science, Biology, Segmented Math, and PASS Math in 9th through 12th grades
- Developed and refined inquiry based student led scientific investigations using primary data sources such that students engaged in cognitive practices consistent with authentic scientific inquiry
- Developed and taught first Segmented Math course in school to twenty seven high school seniors not passing the math WASL and in need of additional math credits
- Developed and taught PASS math course to seniors needing additional coursework to graduate

Mount Baker School District • Deming, WA • Mount Baker Jr/Sr High

- Taught Geophysics to high school students through an inquiry based approach
- Implemented cooperative scientific investigations for students in Geophysics that incorporated content knowledge from Chemistry, Biology, and Physics.
- Taught Physical Science to eighth graders including inquiry units in Physics and Chemistry that included simple machines and electricity and magnetism instructional units.

State College Area School District • State College, PA • State College High School-South

- Taught integrated Earth Science- Astronomy, Meteorology, Oceanography, and Geology.
- Developed and implemented inquiry based Meteorology, Geology, and Astronomy units including field based inquiry experiences at a local Environmental Center and computer-based secondary data investigations.

Central Bucks School District • Buckingham, PA • Holicong Middle School

- Taught integrated Earth Science- Astronomy, Meteorology, Oceanography, and Geology in a team setting while collaborating within the science department to standardize instruction.
- Developed and implemented 8th grade honors science course including field trips and Intel Science Fair competition.

Pennsbury School District • Yardley, PA • William Penn Middle School

- Hired mid-year to replace a teacher removed from the classroom for inappropriate behavior with a mandate from the principal to renew interest in science for my students
- Taught integrated Chemistry and Biology in a team setting while working collaboratively within department to standardize eighth grade core assessments