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Interlocking Struggles, Interwoven Success: College and Career Pathways for Women of Color in STEM and Healthcare

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Interlocking Struggles, Interwoven Success:

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A dissertation submitted in partial satisfaction

of the requirements for the degree Doctor of Philosophy

in Education

by

Krystle Palma Cobian

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ABSTRACT OF THE DISSERTATION

Interlocking Struggles, Interwoven Success:

College and Career Pathways for Women of Color in STEM and Healthcare

by

Krystle Palma Cobian

Doctor of Philosophy in Education

University of California, Los Angeles, 2019

Professor Sylvia Hurtado, Chair

With more women of color (WOC) aspiring to study science, technology, engineering, mathematics, and healthcare (STEMH), colleges and universities serve as a critical environment for preparing and supporting successful transitions from earning a STEMH degree through participation in the STEMH workforce. I use a three-article format to examine the college and career pathways of WOC STEMH graduates (2006-2010), including those who were in graduate study or gainfully employed in the STEMH workforce. All three studies center WOC experiences and intersectionality. The first article uses longitudinal data to examine high school, college, and post-baccalaureate attitudes, opinions, and experiences of 427 WOC STEMH bachelor's degree holders to predict a three category outcome: whether a WOC entered a healthcare-related pathway, a STEM-specific pathway, or left STEMH. The second study aims to advance Quantitative Critical Methodology (QuantCrit) by using a mixed methods design to

examine how race, class, gender, and sociohistorical context of the 2008 economic recession shaped career outcomes for STEMH bachelor's degree holders who entered college in 2004. The third study involves interviews with seven Filipina American women working or attending graduate school in a STEMH field to show how sociohistorical context is key in capturing the full picture of how WOC in STEMH make career decisions. Together, these studies expand understandings of intersectionality as a theoretical lens to reveal individual and structural forms of oppression, advance QuantCrit methodology and the application of intersectionality in research methods, and provide new knowledge about the role of higher education institutions in facilitating or stalling WOC's STEMH career pathways. Findings of the three studies have implications for academic leaders and recommend changes that can reduce attrition of WOC as they navigate college and career decisions.

The dissertation of Krystle Palma Cobian is approved.

Mark Kevin Eagan

Jessica Christine Harris

Aradhna K. Tripati

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University of California, Los Angeles

2019

DEDICATION

Dedicated to my ancestors,
especially my abuela, Guadalupe, and my nanay, Marcela:
scientists, scholars, and healers in their own right.

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ACKNOWLEDGEMENTS

When I was young, my mother gave me the book, *7 Habits for Highly Effective Teens*. One of these habits was to "begin with the end in mind", which I have taken to heart by drafting my acknowledgments section long before starting any other chapter of this dissertation. I begin and end this project with deepest gratitude to the many individuals who have supported me throughout my PhD program at UCLA, as well as my educational and career path thus far.

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inspire me to think big, and to actively support the people and communities whom we theorize and research.

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VITA

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Cobian, K.P., Ramos, H., & Hurtado, S. (March, 2019). Institutional policies and practices that support undergraduate STEM talent development: Lessons from exemplar institutions. Presentation at the Understanding Interventions Conference in Baltimore, MD.

Cobian, K.P., Hurtado, S., & Gomez, A.K. (2018). How campuses do more with less:

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Gomez, A, Cobian, K., & Hurtado, S. (2018). Improving STEM degree attainment rates: Lessons from Hispanic Serving Institutions. Paper presented at the annual conference for the American Educational Research Association (AERA), New York, NY.

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Cobian, K.P., Hurtado, S., Eagan, M.K. (2018). Strategies for organizational transformation in STEM education. Presentation at the annual conference for Southern California Project Kaleidoscope (SoCal PKAL) Annual Meeting, UCLA.

Cobian, K.P, & Hurtado, S. (2017). Undergraduate science identity for women of color: Predicting STEM career persistence eleven years after college entry. Paper presented at the annual meeting for the Association for the Study of Higher Education (ASHE), Houston, TX.

Cobian, K.P. (2017). Why It's Important That UC Them: The Case for Improving Campus Climate for Women of Color Graduate Students in the Sciences. *University of California Graduate Student Association Policy Journal, 3*, 18-20.

Hurtado, S., & Cobian, K.P. (2017). Institutional transformation: A new framework informed by strategies utilized at highly productive institutions. Presentation at the STEM Institute for the Higher Education Research Institute at the University of California, Los Angeles.

Figueroa, T., & Hurtado, S., Cobian, K., Wilkins, A., & White-Lewis, D. (2016). Cultivating STEM talent: Lessons from STEM pioneers and exemplar institutions. Paper presented at the annual meeting for the Association for the Study of Higher Education (ASHE), Columbus, OH.

CHAPTER 1

INTRODUCTION

Woven into the Fabric of Society:

Patterns of Participation for Women of Color in STEM and Healthcare

When I was a growing up, my dad would often bring me with him to work on the weekends. I remember the early morning drives, cruising down the 10 West freeway to arrive at the heart of the garment district in downtown Los Angeles. As soon as my dad parked the car, I would open the car door, the distinct scent of metal, smoke, and chemicals wafting in the air. I would follow my dad around as he walked past the trucks where men were loading giant rolls of fabric—gigantic colorful cylinders, each carefully wrapped in layers of clear plastic. We would stroll through the factory, where steam was billowing and machines of all kinds were loudly cranking and buzzing. We would walk up the creaky staircase to la oficina, where I did homework and ate snacks while my dad would make phone calls, feed yards of fabric into the machines with the men downstairs, and review piles of paperwork printed on the old school perforated reams of paper with the hole-punched edges.

My favorite part of the day was spending time in the factory's lab room. Dimly lit, air thick with chemicals, my dad would pour out various liquid dyes into small cups, and hand me a pair of gloves and several swatches of different types of fabric. I would dip each swatch into each cup of dye, mesmerized at how small changes in my dipping technique made huge differences in my resulting fabric swatch. While I did not know it at the time, I was running experiments. Leaving a swatch in the cup for an extra five seconds to see how bright the colors would become, or dipping a slightly silkier type of fabric to see how texture affected color

absorption. I was curious. I was engaged. I was doing science—in a small room, in a textile manufacturing plant on a weekend morning, in the heart of the garment district in downtown LA.

My story is one narrative of many from women of color in the United States, particularly children of immigrants or children of parents with jobs that may not seem STEM-related at first glance. Doing science can be found in the ordinary and everyday, just as I did science while my dad was simply keeping his daughter entertained while he worked at his textile manufacturing plant. Many women of color discover their curiosity for understanding phenomena or an interest in a science topic as they go through school. They arrive at college and aspire to obtain scientific careers. They are passionate and they are capable. Yet, many women of color with scientific curiosity often do not end up in science careers.

Time and time again, I have wondered why so few women of color end up becoming scientists. Where did their curiosity for understanding phenomena go? When did it go? How did it go? My intuition told me that something must be stifling science identities and career aspirations of women of color. I have always wanted to find evidence to prove it. If you ask a woman of color why she lost her interest in science, her response might have you falsely conclude that she simply was not cut from the same cloth as people who do become scientists. It is only when we take a step back that we see the pattern in the fabric of U.S. society. Patterns of stubborn norms and practices that slowly push women of color out of science by convincing them that they do not belong—patterns so entrenched that they are woven into classroom practices, laboratory culture, and workplace power dynamics. Indeed, just as science is found in the ordinary and everyday, so too are messages of exclusion in science. And women of color do not have to turn far to see that science has been, and continues to be a white man's world.

This dissertation examines what happens to women of color interested in science and science careers. What are the patterns we see from the interlocking struggles of these women of color? What are the patterns that contribute to their success in obtaining a STEM career? Finally, what can we do to weave a new pattern in the rapidly-changing fabric of this nation's demographic makeup? We have an opportunity to pave more pathways for women of color interested in science careers and create new endings to childhood stories of doing science.

Introduction and Background

For years, scholars have sought to understand why and how the underrepresentation of Women of Color (WOC) is perpetuated within science, technology, engineering, mathematics, and healthcare (STEMH) fields. What adds to the urgency is that WOC are expected to become 53 percent of the female U.S. population, and the overall largest proportion (approximately 26.5%) of the U.S. population by the year 2050 (Ahmad & Iverson, 2013; U.S. Census Bureau, 2014) yet remain severely underrepresented in the STEMH workforce (Williams, Phillips, & Hall, 2014). WOC are almost invisible in fields such as computer science and engineering (CEOSE, 2013; Mack, Rankins, and Woodson, 2013) relative to their representation in the country. For example, in 2015 approximately one in 10 scientists and engineers were WOC, with 2% African American women, 2% Hispanic women, and 7% Asian women (National Science Foundation, 2017a).

A national need exists to increase the number of domestically-trained STEMH workers to ensure U.S. innovation and global competition (Olson & Riordan, 2012). Further, there are several calls to ensure inclusive research training practices and policy developments in the national effort to broaden and diversify the STEMH workforce (Johnson, 2011; NASEM, 2016; Ong, 2010). However, much of the research on diversifying STEMH continues to primarily

examine underrepresented groups in exclusive categories (e.g. studying students by race or by gender). This research does not fully capture the experiences of WOC in STEMH, who experience their educational and career trajectories differently from both Men of Color and white women. To ignore race/ethnicity in STEMH obscures a critical dimension of women's experiences and erases the effects of racial privilege that white women experience (Atwater, 2000; Collins, 1999; Hanson, 2004). Similarly, to ignore gender would miss critical gender-based stereotypes that affect women in science (Nassar-McMillan, Wyer, Oliver-Hoyo, & Schneider, 2011). Indeed, "WOC should not be further marginalized in a body of research that, in theory, is about transforming women's underrepresentation in male-dominated academic disciplines and career fields." (Johnson, 2011, p. 75). However, the current literature base can benefit from a more precise and nuanced understanding of why WOC remain severely underrepresented in the STEMH workforce. This dissertation is presented as a set of three studies on the experiences of WOC and aims to develop promising answers to the question of how to substantially increase the proportion of WOC in STEMH.

Encouragingly, research trends show that the responsibility for counterbalancing the legacy of exclusion of WOC in STEMH is shifting toward higher education institutions to provide effective campus contexts to improve retention (Holdren, Cora, & Suresh, 2013; NASEM, 2016a; Olson & Riordan, 2012). More recently, a report from the National Academy of Sciences, Engineering and Medicine (NASEM) concluded that "better alignment of science, technology, engineering, and mathematics (STEMH) programs, instructional practices, and student supports is needed in institutions to meet the needs of the populations they serve" (NASEM, 2016a, p. 4), suggesting that coordinated undergraduate efforts are needed in institutions of higher education to advance excellence and equity in the scientific workforce. In

addition, “educators, policy makers, industry leaders, and others recognize the importance of strong college-university-industry collaboration in preparing the STEMH workforce of the future” (NASEM, 2016b, p.2).

Yet, coordinated institutional efforts alone may not be enough to address the underrepresentation of WOC in STEMH. Race and gender play a significant role in shaping experiences of WOC, ultimately creating unique challenges, needs, and opportunities (Collins & Bilge, 2016; Crenshaw, 1989; Johnson, 2007). Some wonder whether WOC are simply not interested in STEMH. However, evidence show trends that indicate more WOC are interested in STEMH degrees than previous decades compared to their White female counterparts (Daily & Eugene, 2013; Higher Education Research Institute [HERI], 2010). Placing race aside, others claim that biological differences in gender affect women’s ability to do STEM (Halpern, Benbow, Geary, Gur, Hyde, & Gernsbacher, 2007; Summers, 2005). Yet, WOC earn proportionally more science and engineering baccalaureate degrees compared to Men of Color at all degree levels (National Science Foundation, 2017b). Consequently, the notion that WOC are not interested nor capable of persisting on a pathway toward gainful employment in a STEMH occupation is highly questionable given the rising number of WOC who are interested, and/or equipped with the degree, training, and knowledge to perform science. To better understand the connections between the current status of WOC on STEMH career pathways and the severe underrepresentation of WOC in the STEMH workforce, it is important to discuss the larger history of research on WOC in science, and the role of racism and sexism within the sciences.

Women of Color and the Significance of Race and Gender in STEMH

In 1976, Malcom, Hall, and Brown described the experiences of women of color in STEMH using the term “*double bind”* to convey the notion that WOC in STEMH experience

oppression and discrimination based on their race or ethnicity and gender, resulting in less recognition, less perceived value, less visibility, and increased marginalization compared to other underrepresented groups in STEMH (Malcom, Hall, and Brown, 1976). While this influential work laid a foundation for literature on WOC in STEMH, advances in feminist theory and research on the topic of WOC in STEMH have shifted toward thinking of oppression of WOC in STEMH as intersectional (Bowleg, 2008; Crenshaw, 1991), not additive as the double-bind suggests. In other words, being a WOC in STEMH is an integrated identity, rather than a summation of racial/ethnic and gender identities.

Efforts to increase representation of underrepresented minorities in science acknowledge that the experiences of WOC in STEMH are rooted in structural inequalities based on the intersections of gender and race (Espinosa, 2011; Wilkins, 2017). Extensive research has documented the negative impacts of racism and sexism for WOC in STEMH that contribute to their underrepresentation (Espinosa, 2011; Foor, Walden, & Trytten, 2007; Hurtado & Figueroa, 2013; Johnson, 2007; Malcom, Hall, & Brown, 1976; Malone & Barabino, 2009; Ong, 2005; Ong, Wright, Espinosa, & Orfield, 2011; Wilkins 2017).

Despite the challenges of oppression for WOC in STEMH as evidenced by research, not all is grim. While it must be acknowledged that many continue to be pushed out of their STEMH career aspirations, other WOC have found support and resilience in spite of the racial and gender oppression (Brown, 2008; Johnson, 2006; Ong, 2005; Tate & Linn, 2005). Studies have found that the development of a strong sense of racial or ethnic identity gave WOC the agency and resilience to cope with the stereotypes and marginalization they experienced in STEMH (Brown, 2008; Malone & Barabino, 2009; Tate & Linn, 2005). Additionally, goals such as a desire to give back to one's marginalized community or wanting to make a difference in society can be

beneficial in motivating persistence in STEMH (Espinosa, 2011; Trenor, Yu, Waight, Zerda, & Sha, 2008). These society-minded, altruistic goals can also contribute to the development of a science identity (Carlone and Johnson, 2007).

STEMH Career Pathways

Recent research on diversifying STEMH is beginning to explore the unique experiences and interventions that better serve WOC throughout various points in their educational and career pathways (Borum & Walker, 2012; Carlone & Johnson, 2007; Espinosa, 2011; Xu, 2013). This suggests that attrition for WOC at different points in time (i.e. college entry, major selection, STEMH graduate school study, employment) can possibly be solved by looking to certain college experiences and contexts that might increase their persistence. It is also crucial that research continues to simultaneously acknowledge systems of domination that are at play during critical points along the trajectory.

Decades of evidence indicate that, rather than following a linear "pipeline" into the STEMH workforce, individuals with STEMH degrees follow numerous pathways leading to careers in and out of their STEMH field of study (National Science Board, 2015). Carlone and Johnson (2007) examined how "women of color experience, negotiate, and persist in science" (p.1188) and developed a sense of science identity in the process of their educational training for a STEMH career. This set of studies seeks to expand upon Carlone and Johnson's efforts to explore career trajectories of WOC in three main ways, by 1) centering race and racism, as well as sexism and gender stereotypes in analyses, 2) pushing the boundaries of research on WOC in STEMH by examining how socioeconomic class and sociohistorical context also shape career development, and 3) focusing on undergraduate and graduate school as sites for hindering or helping WOC along their trajectory. There is still much to understand about higher education's

influence on long-term STEMH career persistence for WOC while intentionally centering the history of intersecting oppressions of race, class, and gender in STEMH.

Definition of Terms

This research aims to deepen understandings of STEMH career trajectories for WOC in the U.S. Considering the centrality of social identities in this dissertation, I will define several terms that are used throughout this work to clarify their meanings. I will also describe the scope of the academic and workforce disciplines that are included in STEMH and introduce key concepts found in all three studies.

STEM: Science, Technology, Engineering and Mathematics. The National Science Foundation (NSF) uses the term interchangeably with "*science and engineering"* to include the following disciplines: agricultural, biological, and computer sciences; atmospheric, earth, and ocean sciences; mathematics and statistics; astronomy; chemistry; physics; aerospace, chemical, civil, electrical, industrial, materials, and mechanical engineering; social sciences, and psychology. For the purposes of this study, I do not include the social sciences and psychology in my definition of STEM (see scope of study).

STEMH: Science, Technology, Engineering, Mathematics, and Healthcare. To capture individuals who were initially interested in healthcare-related fields or shifted their STEMH interest to healthcare during the course of their college and career paths, which include healthcare fields such as medicine, optometry, pharmacy, physical therapy, nursing, and all other health or medical-related fields.

Women of Color (WOC abbreviation): Asian American, Pacific Islander, African/American (Black), Latinx, and American Indian/Alaska Native (Native

American) women are defined as women of color by the National Science Foundation (NSF). The phrase *underrepresented women in STEMH* refers to Black, Latinx, and Native American women because they are represented in STEMH occupations and in academia at lower percentages than the entire population (Towns, 2010). I include Asian women when I refer to WOC, unless explicitly stated otherwise.

URM: Underrepresented Racial/Ethnic Minority. The term *underrepresented* describes populations that have lower representation than the population as a whole. In scholarship on science education and broadening the scientific workforce, Black, Latinx, and Native Americans are considered URM students.

Intersectionality: The theory that an individual's position within society and resulting experiences are uniquely shaped as a result of their multiple, intersecting identities (Crenshaw, 1991). Intersectionality considers both the micro-level and the macro-level systems of social domination and inequality (Collins, 2009; Crenshaw, 1991). For example, WOC may personally experience such forms of oppression as classism, racism, and sexism and simultaneously gendered, classed, and raced while in college and/or working in STEMH at the micro, or individual level. On a macro, or structural level, WOC in STEMH have historically experienced structural forms of oppression in higher education, the workforce, and STEMH disciplines in general. The lingering effects of the historical denial of access to STEMH, along with current structural practices and policies continue to further marginalize and diminish career opportunities for WOC.

Purpose and Scope of the Set of Studies

The purpose of this work is to understand how higher education contexts facilitate or stall STEMH career trajectories of WOC. To accomplish this goal, three studies examine different

aspects WOC in STEMH careers and address current gaps in the literature. I employ quantitative, mixed methods, and qualitative approaches to examine the lingering influence of higher education contexts on career decisions, and make visible the often underestimated impacts of racism and sexism that WOC encounter along their STEMH career trajectory. A variety of research methods are used in a series of linked studies that vary in scope in order to 1) address national prospective and longitudinal correlates of achieving a STEMH workplace goal, 2) employ mixed methods to better address the limitations of large scale studies with complimentary experience narratives that can ground the research findings, and 3) employ qualitative techniques to retrospectively document the experiences of one of the most underrepresented WOC groups now in the STEMH workplace, Filipina American women. Often the experiences of such groups are lost in large scale data and are underreported even when these women are present in national databases. The smaller scope of this work (limited to interviews obtained from Filipina women in the STEMH workplace) will allow more depth in exploring their science identity, academic, and social experience.

Chapter 2 uses a quantitative methodology to look at how undergraduate and post-baccalaureate experiences and perspectives matter for WOC STEMH bachelor's degree earners. The study, *Predicting Career Outcomes of Women of Color STEM/Health Bachelor's Degree Holders: Cultivating Asset Bundles and Intersectionality* was presented at a national peer-reviewed conference in November, 2017 and co-authored with Sylvia Hurtado (Professor, UCLA). I used national longitudinal survey data from an NIH project in the Higher Educational Research Institute (HERI) to identify factors that predict whether WOC STEMH bachelor's degree earners left STEMH, went into a STEM field, or went into a healthcare field 12 years after they began college.

Chapter 3, *Examining STEM Career Pathways for Women of Color: A QuantCrit Mixed Methods Approach*, is a mixed methods study that examines how race, gender, socioeconomic status, and the context of the Great Recession of 2008 impact career outcomes for STEMH bachelor's degree holders.). I used the national longitudinal survey dataset in Chapter II. However, this study included all men and women in the quantitative analysis, and predicted whether individuals went into STEMH or left STEMH, thus combining STEM and Healthcare careers. I also interviewed WOC who either work or are enrolled in STEMH graduate study to provide nuanced explanations of the findings from the quantitative analysis.

Chapter 4, entitled *Multiple Pathways, Shared Struggles: Understanding STEMH Career Development for Filipina American Women*, is an analysis of interviews with seven Filipina American women in STEMH to understand their career pathways into STEMH, how college played a role in supporting or stalling their trajectory, and how the unique history of the Philippines and the United States impacts current career decisions of Filipina American women.

Collectively, the work contributes to the literature base by expanding theory about career development specifically for WOC in STEMH. It is vital that stakeholders who wish to broaden and diversify the STEMH workforce understand the gender and racial climates within STEMH career pathways, and remove systemic barriers to the persistence of WOC by employing evidence-based practices that work for this unique demographic.

Rationale for Three Studies

The three studies that compose this dissertation begin to fill the gaps in the bodies of literature on WOC in STEMH. In order to find better solutions to increase the proportion of WOC in the STEMH workforce, an understanding of what contributes to STEMH career persistence for WOC is needed. While all three studies focus on WOC in STEMH, applying

quantitative, mixed methods, and qualitative approaches using an intersectional lens allows for greater depth of understanding of the topic of this volume. Additionally, I sought to employ three different methodologies using a dataset and new data collections (a longitudinal, national survey and qualitative interviews) so that each study's methodology addresses limitations and constraints of the other approaches taken in the other studies.

The quantitative study is a longitudinal analysis of a national cohort of STEMH baccalaureate degree holders who entered college in 2004, and is unique to the literature base on WOC in STEMH because of its use of a national longitudinal survey with three time points, its focus on undergraduate and post-baccalaureate experiences, and the ability to control for several factors that the literature shows are correlated with STEMH career attainment. The variables chosen for the statistical model also empirically test the Asset Bundle Model, a framework of key types of capital to support and advance underrepresented students' careers in STEMH. Thus, this quantitative study is a useful first exploration that takes a prospective approach to determine what contributes to STEMH career persistence for WOC.

The quantitative study can be helpful to employers and campus administrators working with underrepresented students in general, and WOC in particular, in developing approaches to improve career development and career retention efforts. A quantitative longitudinal analysis can provide evidence for the importance of the college context in shaping STEMH career trajectories. In doing so, the study expands upon interventions that uniquely support WOC, both while WOC are engaged in STEMH undergraduate study and beyond obtaining a STEMH undergraduate degree.

In consideration of this dissertation's focus on WOC and the importance of exploring the intersections of multiple social identities that shape educational and career trajectories, one

significant limitation of the first study is the reductionist nature of quantitative analysis. While studies have used intersectionality as an analytic tool (Collins & Bilge, 2016) to qualitatively understand the unique experiences and struggles of individuals with intersectional identities as they navigate higher education, the field is only beginning to employ critical quantitative methodologies to answer research questions that center intersectional identities. For example, Metcalf (2014) examined STEMH degree-occupation relatedness using logistic regression and interaction models to account for race and gender while also examining data from a critical lens. The mixed methods study presented here expands upon Metcalf's approach to studying STEMH through the use of Quantitative Critical Methodology, or "QuantCrit." As a subset of inquiry stemming from Critical Race theory (CRT), QuantCrit urges researchers to use statistics for racial justice and begin the long project of 'deracializing statistics' (Zuberi &Bonilla-Silva, 2008). This study builds on the first analysis by adding another layer of depth, critical inquiry, and situates race primarily, followed by gender and SES, using explanatory narratives offered by WOC.

A mixed methods examination with a critical approach can challenge opinions that race and gender are the primary identities that impact STEMH career persistence. Introducing socioeconomic class as a third social identity of interest and historical context of the 2008 economic recession pushes the boundaries of research on this topic. The study expands upon intersectionality work as applied to women of color in STEMH by calling attention to the need to focus on additional identities that play a significant role in impacting a woman of color's STEMH career trajectory. The study also provides researchers with an additional example of how to apply QuantCrit to intersectionality research that historically has valued qualitative inquiry. Quantitative research has been criticized for its reductionist approach to answering

questions. Further, quantitative studies that examine underrepresented groups often look at race, class, and gender as separate groups, rather than creating statistical analyses that models the simultaneity of racial/ethnic identity, gender, and SES status. This study provides important implications and analysis techniques to begin to study intersectionality in using intersectional and critical methods.

While the mixed methods study has strengths in its anti-essentialist approach to studying the phenomena of interest, the resulting limitation is its lack of focus and depth on any particular racial/ethnic group of women in STEMH. Thus, a purely qualitative study addresses these limitations by focusing on a subset of Filipina-American women from the interviews collected for the mixed methods study. The study is unique in both its focus on Filipina American women, who are understudied in higher education literature, and its incorporation of the history of U.S.-Philippine migration and colonialism. I argue that the impact of U.S. occupation in the Philippines and resulting immigration patterns to the U.S. impacts STEMH degree and career patterns for Filipina Americans.

The use of qualitative analysis to better understand how Filipina American women in STEMH careers perceive and experience racism and sexism in college and in their career pathway contributes to the theoretical and empirical work examining racism, sexism, and career development. This study also questions constructions of what is considered important to study in the STEMH education literature, considering the common strategy of combining Asian American students with White students in STEMH education research.

In sum, the strategic use of three studies that build upon each other advances our knowledge of STEMH career pathways in three main ways. First, the quantitative study can advance our understanding of national undergraduate and post-baccalaureate experiences unique

to WOC so that institutions can divert resources to programs and strategies that were shown to support persistence in STEMH several years after obtaining a STEMH bachelor's degree. Second, the mixed methods study builds upon the first study with the addition of interviews to provide a richer understanding of the bridge between social identities and career outcomes. Additionally, the study aims to advance QuantCrit methodology (Garcia, Lopez, & Velez, 2018) with a re-analysis of my first study through a QuantCrit frame to better answer the question of Women of Color in STEMH. Third, the qualitative study allows a focus on an extremely underrepresented group of Filipina Americans that cannot be captured in national quantitative data. Together, the studies present a prospective (longitudinal data) and retrospective approach to expand the career development literature on WOC in STEMH.

Restricting the Scope

Unfortunately, focusing on important fields of science such as the social sciences (i.e. psychology, sociology, education) is beyond the scope of the present study. Additionally, all three studies, "attempt to satisfy the demand for complexity and, as a result, face the need to manage complexity" (McCall, 2005, p. 1773). Although the concept of a "STEM workforce" is widely used and has been referenced in law, there is no consensus on how it is defined. Various reports use different definitions, leading to divergent and sometimes conflicting conclusions about the size and other characteristics of the STEM workforce. Furthermore, the STEM workforce is heterogeneous. In other words, while this study achieves its goal of examining critical experiences that lie at the intersections of multiple identities, when discussions of experiences become so fragmented there can be no easy implication or practical solution for policy and practice. Thus, I am aware of this tension throughout the studies and attempt where

possible to, “join inquiry and praxis as distinctive, yet interdependent dimensions” (Collins & Bilge, 2016. p. 192).

Perspective of the Researcher

I position myself as a scholar who engages in research that examines power dynamics, broadly. I am currently a research analyst and doctoral student in the Higher Education an Organizational Change Ph.D program at UCLA. I grew up in Southern California, and attended public education from kindergarten until I graduated with a bachelor’s degree from UCLA and a Master’s degree in student affairs from Seattle University. I self-identify as a Filipina and Mexican woman and come from a working class, immigrant household situated in a socio-economic and racial/ethnically diverse community 40 miles east of Los Angeles.

My research interests are partially rooted in my experiences as an undergraduate student STEMH career aspirant at a large, public research university where many students are pushed out of STEMH majors due to environments in introductory courses. I entered college the same year as the cohort of survey participants for the dataset used in two of the three studies presented here so I identify with the cohort that is the focus of this analysis. I also chose to interview Filipina women due to my background knowledge of the complexities that contribute to Filipina STEMH career pathways, and the need to contribute to the dearth of literature on this topic. As a scholar who is committed to social justice, I engage in research that holds the inherent tension between positivist and constructivist paradigms, and aim to utilize the benefits of both paradigms to advance knowledge of phenomena by contextualizing data sources through a transformative approach, using the lens of intersectionality and employment of QuantCrit methodology.

Significance of the Work

Findings from these studies have several implications for educational policy, practice, and research on broadening and diversifying the STEMH workforce at a time when the significance of a strong STEMH labor force continues to be an urgent national need. An examination of the national undergraduate and post-baccalaureate experiences that contribute to persistence in STEMH-related employment produces generalizable findings can inform senior administrators, faculty, and program directors across institutions who are responsible for building initiatives and allocating resources to improve career development opportunities for WOC. The mixed methods inquiry begins to paint a picture of the quality of these critical undergraduate and post-baccalaureate experiences, using powerful narratives that affirm how race, class, and gender have shaped experiences in STEMH. The final study sheds light on unique challenges that Filipina American women face, which begins to fill a gap of research knowledge on this understudied group. Collectively, these three articles provide policy makers, researchers, and practitioners with new knowledge as well as analytical and practical tools to proactively investigate and improve pathways into STEMH careers and retention.

In closing, research on how to broaden and diversify the STEMH workforce must consider the complexity of career pathways for Women of Color, as they are located within and between White, male-dominated communities in academia and in the workplace. In light of the history of a White, male-dominated STEMH workforce in the U.S., we must take the complexities of intersectionality into thoughtful consideration to critically examine how multiple domains of oppression function for WOC in higher education and beyond, considering that understanding how to support WOC interested in STEMH is critical for the development of the

diverse STEMH workforce needed to address national and global issues (Johnson, 2011; Ong et al., 2011).

Conclusion

While renowned poet Maya Angelou did not have any daughters of her own, she penned the book, *A Letter to my Daughter* for women of color. The book is a poignant letter from Angelou that serves as an ode to the next generation of "daughters" in order to share her wisdom, courage, and life lessons. Near the beginning of the letter, Maya Angelou states, "You may not control all the events that happen to you, but you can decide not to be reduced by them" (Angelou, 2008, p.2). This work is, in many ways, a way to honor the WOC who took Maya Angelou's advice. This work centers the stories of numerous daughters—WOC who refused to be "reduced". They made their way into the fabric of STEMH despite the odds being stacked against them. I am humbled to be able to share the stories of these women of color in the hopes that the lessons from their experiences make actual, sizeable change to the status quo.

When it comes to creative solutions and innovative thinking needed to improve our world through STEMH, we need to include everybody at the table. It is not the deficits of WOC that keep them out. It is their strengths that keep them in. Having more WOC involved in this effort is not practical and moral, but inevitable considering the future direction of our nation's population and the future need for STEMH talent. My hope is that we not only produce knowledge about WOC in STEMH, but that we act and begin to weave new patterns of justice, equity, and celebration of WOC scientists.

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CHAPTER 2

Predicting Career Outcomes of Women of Color STEM/Health Bachelor's Degree Holders: Cultivating Asset Bundles and Intersectionality

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Introduction

Women of color (WOC) constitute 39% of the U.S. population and are expected to become 53% of the female U.S. population by the year 2050 (Ahmad & Iverson, 2013; McAlear, Scott, Scott, & Weiss, 2018; U.S. Census Bureau, 2014), yet remain severely underrepresented in the science, technology, engineering, mathematics, and medical/healthcare (STEMH) workforce, and almost invisible in fields such as computer science and engineering (CEOSE, 2013; Mack, Rankins & Woodson, 2013; Williams, Phillips, & Erika, 2014). For example, less than one in 10 scientists and engineers are WOC, with 2% African American women, 2% Hispanic women, and 5% Asian women (National Science Foundation, 2015). Even in medical fields, which attract a larger proportion of WOC professionals, they made up only 11.7% of all active medical physicians in 2013 (Galace & Calimlin, 2017). Although WOC have the highest level of interest in STEMH degrees compared to their White female counterparts (Daily & Eugene, 2013; Higher Education Research Institute, 2010), and earn proportionally more science and engineering baccalaureate degrees compared to Men of Color (National Science Foundation, 2015), myths that WOC are not interested nor capable in science continue to persist. Further, WOC who enter STEMH fields encounter structural inequalities based on the intersections of sexism and racism that place additional barriers in their pathways toward gainful employment in the STEMH workforce (Butter, Carpenter, Kay & Simmons, 1987; Espinosa, 2011; Wilkins, 2017).

Considering the myriad of challenges that WOC STEMH professionals overcome to remain on a STEMH career pathway, it is important to understand who these WOC are, and how higher education can support their career aspirations. Research has begun to explore the influential college experiences that contribute to STEMH bachelor's degree persistence for WOC compared to White women (Espinosa, 2011; Huang, Taddese, & Walter, 2000) and underrepresented racial minority (URM) persistence into STEMH post-baccalaureate study and work (Estrada, Hernandez & Schultz, 2018; Hurtado, Hughes, Eagan & Paul, 2018). Studies have also examined career outcomes for STEMH and non-STEMH major graduates (Cannady, Moore, Votruba-Drzal, Greenwald, Stites, & Schunn, 2017; Xu, 2013). However, research that focuses on the college context and post-baccalaureate experiences influencing STEMH career retention is lacking in the field, especially for WOC who exist at the intersection of multiple underrepresented identities. In a meta-analysis of empirical papers between 1970 and 2009 examining WOC in STEMH, researchers emphasized the dearth of longitudinal and comparative analyses using robust, national data in the past 40 years of literature as one of the limitations in original research on this topic (Ong, Wright, Espinosa, & Orfield, 2011). Additionally, research on the status of WOC in STEMH varies depending on how "STEM" is defined. For example, a study on STEMH career decision-making by Mau, Perkins, & Mau (2016) included health fields such as nursing and physician assistants, which the authors admit may have overclassified women participants in their sample. Still, if these are the fields that WOC graduates enter, a longitudinal analysis of WOC engaged in both STEM-specific research careers and healthcare fields can shed light on the unique experiences that contribute to retention into the total STEMH workforce.

Thus, the purpose of this study is to shift the lens from previous work on STEMH undergraduate degree completion to focus on how higher education and post-baccalaureate experiences continue to shape early career outcomes for WOC. Specifically, this study examines the pre-college, undergraduate, and post-baccalaureate experiences of WOC STEMH bachelor's degree holders to determine who remains in STEM, a medical or health care field, or left STEMH 12 years after college entry. The following questions guide this research:

1. What are the post-baccalaureate pathways by race/ethnicity, gender, STEMH baccalaureate degree holders?
2. What are the characteristics of WOC STEMH baccalaureate degree holders who remained on a STEM and/or Healthcare career pathway?
3. What are key predictors of remaining on a STEMH career pathway?

This study builds on the literature base using an intersectionality research lens applied to better understand the undergraduate and post-baccalaureate experiences that uniquely shape STEMH career pathways, with specific focus on identifying the factors that contribute to the persistence of WOC STEMH baccalaureate degree holders after they began their undergraduate education. Findings will be of interest to institutional leadership, faculty, and STEMH employers in national efforts to stop the continued loss of STEMH talent and broaden and diversify the STEMH workforce.

Framing the Study of WOC in STEMH

In an influential paper written in 1976, a group of women scientists of color argued that interventions aimed at supporting underrepresented groups in STEM have often addressed the needs and experiences of students of color and women as separate categories of people (Malcom, Hall, and Brown, 1976), leaving WOC in an unsafe space widened by the continued lack of role

models who share their unique positions and backgrounds (Espinosa, 2008). Thus, the concept of intersectionality is useful for this study, as it denotes various ways that social identities shape multiple dimensions of WOC's lived experience (Crenshaw, 1991). Compared to White women and Men of Color, WOC are situated differently with respect to economic status, social class, and political worlds (Crenshaw, 1991). Indeed, the interlocking effects of gender, race, and ethnicity lead to WOC experiencing racial and gender discrimination differently from both White women and Men of Color while seeking opportunities and pursuing professional goals (Jean-Marie, Williams, & Sherman, 2009; Tran, 2014). With respect to the STEMH fields, racial and gender identity become even more salient considering the historical exclusion of women in the U.S. from participating in higher education and/or the workforce, as well as overall obstacles regarding racial and gender discrimination that white men do not face. For example, Cheryan, Ziegler, Montoya, & Jiang (2017) posit that the masculine culture of computer science, engineering, and physics majors compared to other STEM fields like the biological sciences, chemistry, and math can cause women to feel a lower sense of belonging in those fields. Thus, the extent to which WOC experience a masculine and/or a predominately White culture likely impacts perceptions of belonging in STEMH fields, and ultimately whether a WOC makes the decision to continue on a STEMH career pathway.

Intersectionality scholars urge researchers to conceptualize social categories as "differentially experienced, fluid, and mutually constituted" (Hunting, 2014, p. 8). It allows the researcher to think *beyond* categories as additive or isolated, create space for the complexities of identity and life experiences, and potentially reveal which intersections and processes are most salient in a given context (Hankivsky & Grace, 2014). Intersectionality helps us see how WOC will experience education and the workplace differently than white women, men, or Men of

Color. Applied to this study, certain college contexts or experiences may contribute to a WOC's decision to move forward applying to graduate school in a STEMH program, or to seeking employment in a STEM or medical/health career.

Previous Research on Women of Color in STEM/Healthcare (STEMH)

The underrepresentation of WOC in the STEMH workforce has most recently focused on the college environment's role in promoting or detracting underrepresented women from a STEMH career pathway (Espinosa, 2011). With respect to college experiences that contribute to STEMH career persistence, undergraduate research programs (Bauer & Bennett, 2003; Yauch, 2007), participation in major-related clubs (Herrera, Hurtado, & Chang, 2011), and receipt of mentorship from faculty (Byars-Winston et al., 2015; Cole & Espinoza, 2011; Estrada et al., 2018) are likely to positively influence students' intentions to pursue a STEMH career. Most of these studies, however, focus only on persistence in general STEMH areas, or biological sciences in particular, and are not explicit about health-care fields or majors.

Fewer studies also explore the various pathways and predictors of STEMH career persistence *beyond* obtaining a bachelor's degree, and how college experiences and institutional contexts influence decisions to continue in a STEMH pathway. An individual's confidence in their ability to successfully fulfill the roles, competencies, and identity features of a profession were more likely to persist in their engineering career (Cech, Rubineau, Silbey & Seron, 2011), suggesting that this finding may also hold true for other STEMH professions and for WOC. Further, women's self-confidence and confidence in pursuing a STEMH career is impacted by the mixed messages they receive about career and life choices (Kubanek and Waller, 1995), suggesting that self-perceptions, based on such messages, also influence decisions to enter or remain in the STEMH pathway.

Although women tend to complete in STEMH fields at similar rates or do better than men (Huang, et al., 2000), career attrition typically takes place after graduation from college as they choose a career path inconsistent with their college major (Joy, 2000), further suggesting that a myriad of factors can pull WOC away from, or propel them toward continuing in a STEMH pathway. In a longitudinal study conducted by Xu (2013) on STEM graduates and non-STEM graduates, several findings indicated possible factors that motivate STEM major graduates to enter an occupation closely related to their major. For example, individuals who graduated with a STEM-related bachelor's degree are more likely to be employed in a major-related job, immediately after and 10 years later compared with non-STEM majors. However, no differences were evident by gender or racial group in assessing long term occupation employment that differed from their college major, although findings were not disaggregated by race and gender to see if they hold true for WOC specifically.

This pattern of career persistence has yet to be tested for WOC, but is likely to be consistent, considering that most STEMH degrees tend to be prescriptive with occupations compared to non-STEM degrees where it is normal for a them to end up in a field different from one's undergraduate major (Xu, 2013). The author also found that the association between high pay rate and zero net costs (i.e. actual college costs minus financial aid) of attending college increased the likelihood of having a job closely related to their major is much more evident for STEM than it appears for non- STEM graduates, suggesting the importance of factors such as aid, income, and job security contributing to WOC STEMH career persistence.

However, monetary factors are not the only thing that influence STEMH majors, as the study also looked into other factors that may push or pull individuals away from a major-related occupation. One such nonmonetary factor to consider from the literature about women in

STEMH is family planning. Contrary to widely-held beliefs about the pull of children impacting STEMH persistence, one study found that family plans do not contribute to women's attrition in engineering careers (Cech et al., 2011), although it is still worth examining what role family planning and other nonmonetary factors play in contributing to STEMH workforce persistence.

Considering intersectionality, women of color used culturally relevant and humanistic goals for pursuing a career in science (e.g., giving back to their community, being a role model for girls of color, helping their family, wanting to make a difference in society) as tools for persisting in STEMH (Espinosa, 2011; Trenor, Yu, Waight, Zerda, & Sha, 2008) and creating an altruistic science identity (Carlone and Johnson, 2007). Carlone and Johnson's (2007) science identity model is a useful frame for understanding how intersections of identity continue to influence behaviors and decisions that affect STEMH career trajectories. Developed from a six-year ethnographic study on WOC who persisted in STEMH fields at a large, predominantly White research university, the model focuses on the development of gender, racial/ethnic, and academic identities while pursuing a STEMH major and STEMH career aspiration. Carlone and Johnson (2007) define science identity as displaying competence, having the ability to perform science, and recognizing oneself as part of the scientific community. Of these three components, recognition-- defined as being recognized as legitimate scientists by established members of the scientific community-- is the most salient to developing a science identity, suggesting that WOC must recognize themselves and receive recognition from others as part of the scientific organization before deciding whether to continue to pursue a STEMH career after graduation. Estrada et al. (2018) found that among URMs (Blacks, Hispanics, and Native Americans) science identity and values continue to be predictive of STEM pathways four years after college graduation, with the exception of those in medical/clinical career pathways.

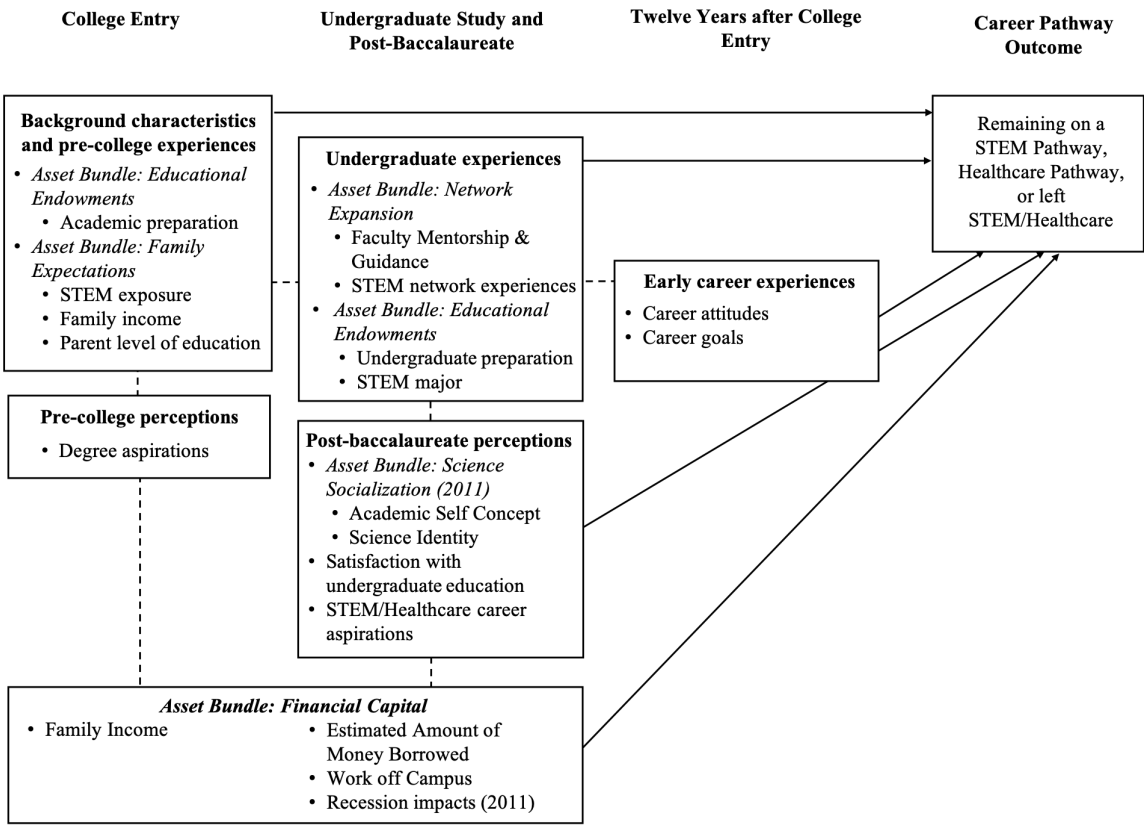
Asset Bundle Model to Mitigate Barriers to Persistence

To address the needs of underrepresented students with STEMH and academic medicine career aspirations, Johnson & Bozeman (2012) propose an Asset Bundle Model that conjoins the scientific and technical human capital model (Bozeman, Dietz, & Gaughan, 2001) with social identity contingencies theory (Purdie-Vaughns, Steele, Davies, Ditlmann, & Crosby, 2008). The authors define asset bundles as the specific sets of abilities and resources that students develop to succeed in STEMH-related educational and professional tasks (Johnson & Bozeman, 2012). As the students' asset bundles develop, their insecurities and disadvantages stemming from social inequities can be mitigated. Johnson & Bozeman propose five asset bundles in three key categories that may lead to improved and sustained diversity in career pathways: scientific human capital includes *educational endowments* and *science socialization*; social capital suggests information and messages that come from *network development* and *family expectations*; and financial capital involves *material resources*. Scientific human capital includes educational endowments that address such issues as the quality of high school science and math preparation. Relatedly, science socialization involves curricula that incorporate societal relevance, socializing experiences, and developing a science identity that is compatible with a STEM/Healthcare career. Social capital is comprised of network expansion that may include mentoring relationships, involvement in science-related activities and experiences, and peer support and influence, whereas family expectations involve interpersonal family dynamics that can either encourage or discourage one from pursuing a STEM/Healthcare career. Lastly, financial capital are the material resources to afford scientific training (e.g., family income, scholarships, grants, working during college, amount of loans borrowed to fund education). This study begins to provide empirical evidence to see how elements of this model and other

experiences along the educational and career trajectory impact the persistence of WOC into STEMH and Healthcare fields.

Given the intersecting effects of race and gender that create unique spaces in which WOC inhabit as they are socialized prior to college, during college, and beyond obtaining a baccalaureate degree, the current study's conceptual approach considers exposure to experiences and opportunities as a foundation from which to understand STEMH career persistence. In consideration of the frameworks presented, this study tests the extent to which the asset bundle model influences WOC career persistence into STEMH and/or medical/Health careers. Specifically, educational endowments (pre-college characteristics and preparation), family expectations, science socialization, network expansion, financial capital, and attitudes and goals about careers likely predict career decisions to pursue STEMH graduate study and/or enter the STEMH workforce (see Figure 1).

Figure 1. Conceptual Model of Women of Color STEM/Healthcare Career Pathways



Although recent studies have found that STEMH-related opportunities and environments likely influence educational and career trajectories in STEMH for WOC (Carlone & Johnson, 2007; Eagan & Newman, 2010), less is known about how undergraduate opportunities and contexts influence post-baccalaureate career decisions to enter science and engineering versus healthcare. While Espinosa (2011) examined factors that predicted persistence in a STEMH major for WOC in college, this study shifts the focus on WOC who earned a STEMH degree to understand who persists into the STEMH or Healthcare workforce after college. Thus, this study uses longitudinal data to examine factors, with particular focus on the college and post-baccalaureate experiences and attitudes, to determine how race and gender uniquely shape factors that matter to remaining in STEM and/or medical/health career pathways.

Methodology

Data Source and Sample

This longitudinal study used merged data from three national surveys conducted by the Higher Education Research Institute (HERI) at the University of California, Los Angeles. The merged data include the 2004 Cooperative Institutional Research Program's (CIRP) Freshman Survey (TFS), 2011 Post-Baccalaureate Survey (2011 PBS), and the 2016 12-Year Follow-Up Survey (2016 PBS) to examine the factors that predict STEMH bachelor's degree recipients' likelihood of persistence in a STEMH pathway (defined as current employment in the STEMH workforce or current enrollment in a STEMH graduate program).

The baseline sample came from the Cooperative Institutional Research Program's (CIRP) 2004 Freshman Survey (TFS). The TFS asked students at the beginning of college about their demographic characteristics and academic backgrounds, their high school activities, their educational and career ambitions, and expectations for college. The purpose of using the dataset for students who entered college in 2004 is because it was the year with the highest number of four-year institutions (over 700) participating in the survey, which is partially due to the fact that the National Institutes of Health (NIH) provided funds to target minority-serving institutions and institutions with NIH-sponsored undergraduate research programs to expand the traditional sample of colleges and universities that participate in the TFS. These funds provided an opportunity to administer the TFS to campuses that typically did not collect such data on their students and follow these students longitudinally. Institutions were selected accordingly: For every URM student who indicated intentions to major in STEMH, White and Asian students were proportionally selected indicating a similar STEMH interest, as well as comparison group of non-STEMH URM students in each college. This resulted in 634 initial institutions with a comparative sample of STEMH aspirants and representation of URM groups.

A sample of students were followed up in 2005 and 2008, and a website was developed to maintain contact with students longitudinally. In 2011, we collected follow-up survey data to learn more about educational and career pathways using the Post-Baccalaureate Survey (2011 PBS), verifying completion using the National Student Clearinghouse data. The 2011 PBS collected data about participants' undergraduate experiences, perceptions, graduate school experiences, and several attitudinal and behavioral items. We then created a longitudinal survey to extend the PBS and administered the 2016 11-Year Follow-up Survey (2016 PBS). For the 2016 PBS, invitations to participate were sent to individuals who completed the 2011 PBS. Of the 13,671 reachable participants from the 2011 PBS, a total of 3,771 participants located across 338 undergraduate institutions responded to the survey, which resulted in a response rate of 27.6%. Of the 3,771 participants, 2,333 indicated on the 2016 PBS that they had completed a STEMH bachelor's degree. After removing cases that had not participated in all three surveys (2004 TFS, 2011 PBS, and 2016 PBS), the sample was further reduced to 2,120 students across 337 institutions. Of this group, 427 were identified as WOC graduates with STEMH degrees.

The study examined the individual-level factors that predict WOC STEMH bachelor's degree recipients' likelihood of remaining in a STEMH pathway, health sciences pathway, or departure from a STEMH pathway by matriculation into a non-STEMH graduate program or working in a non-STEMH occupation. To answer research questions, we used a combination of descriptive statistics and multinomial logistic regression to determine key predictors of persisting in a STEMH pathway in a longitudinal sample of WOC. Multinomial logistic regression is a categorical statistical analysis that is appropriate to use when there are three or more categories to the dependent or outcome variable (Hosmer & Lemeshow, 2000). Given the categorical nature of the dependent variable, multinomial logistic regression uses odds ratios as estimators for the

predictor variables. Further, both categorical and continuous independent variables can be used as predictors in a statistical model (Petrucci, 2009).

Study Sample. The sample for multinomial logistic regression is comprised of 427 WOC STEMH bachelor's degree holders who responded to all three surveys, including 26% Latina, 23.6% Black, 42.5% Asian American/Native Hawaiian/Pacific Islander (AA/PI), and 7.9% American Indian early career professionals who had attended 169 institutions. The data are unweighted.

Variables

Dependent variables. The primary dependent variable is 2016 Career Pathway type. WOC in the sample fell into one of three pathways: 1) a STEMH pathway (defined as gainful employment in a STEMH occupation or STEMH graduate study at the time the participant responded to the survey), 2) A medical or health field pathway (defined as gainful employment in a health field occupation or graduate study at the time the participant responded to the survey), and 3) neither STEM nor medical/healthcare, with non-persisters as the referent group. Gainful employment in a STEMH field occupation includes part-time employment by choice and full-time employment. Individuals who switched job occupations or graduate study within a STEMH field are still considered as remaining on a STEMH pathway. For example, a student who earned a bachelor's degree in chemistry, but reported working in a technology occupation at the time of the survey was administered is considered to have persisted in a STEM pathway. For a complete list of all STEM and health-related graduate programs and occupations included in the study as part of each dependent variable, see Appendix Tables A-1 and A-2.

Independent Variables. The analyses account for several independent variables, including demographic characteristics, high school academic preparation, and pre-college

experiences (see Table A-3 for a complete description of the variables and their coding schemes used in the analyses) following the model in Figure 1. We accounted for parental income at college entry,[1] with four levels, using those estimates for developing low-income as the lowest quartile (less than $39,999) with the highest quartile as the referent group as a form of parental financial capital. We also included whether or not mother or father had at least a college degree, and if the student has a parent who is employed in a STEMH field as a form of family expectations.

Educational endowments were measured using prior academic preparation with high school GPA, standardized test scores (SAT composite with ACT equivalent conversions), years of high school mathematics courses, and whether a student participated in a summer research program or health science research program sponsored by a university. The latter as well as degree aspirations before college entry was captured as form of early science socialization. Given Carlone and Johnson's (2007) science identity framework, we created the science identity construct using principal axis factoring with promax rotation (see Appendix A-4). The items comprising this factor included the following from the 2011 PBS: goals of wanting to make a theoretical contribution to science, finding a cure to a major health problem, recognition as an authority in the field, and recognition for theoretical contributions to their specific field (see Hurtado et al., 2011 for information about the creation of the Science Identity factor). This also represents a measure of scientific socialization that is included among various undergraduate experiences based on the Assets Bundle Model (Johnson & Bozeman, 2012). The model also

[1] Although many population and economic studies have also used twice the rate of current year poverty levels to define low-income (Population Reference Bureau, 2013), the U.S. Department of Education (2019) currently defines low-income as an individual whose family's taxable income for the preceding year did not exceed 150 percent of the poverty level. In 2004 (the time participants entered college) the poverty level for a four-person family was $18,850 and $25,210 for a family of six (https://aspe.hhs.gov/2004-hhs-poverty-guidelines), making $28,275 and the low-income level for a family of four and $37,815 for a family of six, the closest survey category is $30,000 to $39,999 or less for identifying students from families in the lowest-income quartile.

includes 2011 PBS measures for academic self-concept assuming that how one feels about their own competence at college completion or early career will determine further persistence in STEMH jobs. For more information about factor loading for academic self-concept, see Appendix A-5.

In order to assess the link between college major and retention in a pathway, we grouped a student's undergraduate major into six categories: engineering, physical science, health professional field, math/statistics, or computer/technological sciences, with biological sciences serving as the referent group. We also accounted for overall undergraduate GPA as an educational endowment. The model accounted for social capital or network expansion by examining experiences such as participating in an internship or cooperative educational program, working with faculty on research, participation in an academic club/professional association, or in an ethnic/cultural club or organization, and receiving mentoring and guidance from a faculty member. The survey questions for the faculty mentorship and guidance factor were on the 2016 PBS, and thus are measures of participants' reflections upon their undergraduate experience. For more information on the factor loading, see Appendix A-6.

Additionally, financial capital was examined by asking whether a student worked off campus during the academic year in college, and the amount of money borrowed to pay for undergraduate education. To further expand on scientific human capital in later years, we examined the extent to which their undergraduate program contributed to the ability to understand the role of science and technology, as well as the extent to which they felt their undergraduate program prepared them for graduate or professional school. Post-baccalaureate variables were examined according to the literature on post-baccalaureate goals of women in STEMH (Cole & Espinosa, 2011; Diekman, Brown, Johnston, and Clark., 2010), and outcomes

of STEMH degree holders (Xu, 2013). The following variables examined values/goals: When thinking about long-term career choices participants reported the importance of social recognition or status, advancing knowledge, job security, improving the health of minority communities, the importance of raising a family when thinking about long-term career choices. Finally, because this cohort attended college during the Great Recession, we included one item from 2011 that asked the extent to which WOC agreed that the economy affected their career decisions.

Institutional selectivity, control, institutional type. Several institutional variables were selected based on research that indicates where students go to college matters in terms of college experiences in STEMH, with more selective institutions having a depressing effect on faculty interaction and persistence (Chang, Cerna, Han, & Sáenz, 2008; Hurtado et al., 2011). Selectivity is measured using Barron's college admissions competitiveness ratings, which are based on such measures as percent of applicants admitted, average students' high school class rank, and average students' college entrance exam scores. Selectivity rankings include "most competitive," "highly competitive," "very competitive," "competitive," and "less competitive." These rankings have a high level of consistency across the years (Bastedo & Jacquette, 2011). Other measures include institutional control (private or publicly funded), and type (university or four-year comprehensive institution).

Data Analysis

Missing Data. Accounting for incomplete observations is important for conducting analyses with several predictors (Horton & Kleinman, 2007). In the sample, no predictor was missing more than 15.5% of cases, and thus decided to address missing data to avoid dropping additional cases. When some of the predictors are missing, information can be recouped by

estimating the distribution of the covariates (Ibrahim, 1990). Providing a single imputation for a missing value does not account for the possible variance of missing data (Sinharay, Stern, & Russell, 2001). Multiple imputation of missing data may provide a more precise estimate of standard errors of parameter estimates (Little & Rubin, 2002). We used multiple imputation to address the cases with missing values for continuous variables only. We first determined whether there was monotonicity within the data that would require the use of the monotone method. We executed the multiple imputation procedure for 50 iterations, generating the mean and variance for each iteration. After addressing issues with missing data, we examined the variables with univariate descriptive statistics to determine whether there was a reduction in standard errors and confidence intervals for the final pooled dataset generated by the multiple imputation process. We also viewed the iteration history after each iteration to ensure that there was very little difference in the variation of means from iteration to iteration. We also analyzed the dataset using multinomial logistic regression with the original dataset and data generated by the multiple imputation process. For descriptive statistics for the sample used in this study, see Appendix Table A-7.

Limitations

There are several limitations of this study. First, nonresponse bias, or the potential difference between women who responded to the 2016 PBS and those who did not, may limit generalizability of the study's findings. Nonresponse in surveys can be thought of as a pre-study attrition, making nonresponse error akin to selection bias in studies since both are concerned with research participant recruitment prior to the start of a study (Sivo, Saunders, Chang, & Jiang, 2006). Second, the use of an aggregate variable for racial/ethnic groups in the sample including all women is problematic since use of one overarching group for analysis inherently

assumes that women from varying racial/ethnic backgrounds experience college in similar enough ways. For example, we were unable to disaggregate AA/PI women for separate analysis due to a small number of PI women, which limits our understanding of STEMH pathways for Asian American women compared to Pacific Islander women. Similar problems exist for Black, Latina, and American Indian women when conducting quantitative analysis with smaller sample sizes and limitations to survey items for racial/ethnic identification. The number of Native American women was also small in the final sample. We chose to retain cases for both Native American and PI women as there have been numerous studies in academic fields that drop cases for marginalized groups to achieve greater statistical significance at the cost and erasure of experiences of marginalized racial/ethnic groups (Zuberi, 2001; Zuberi & Bonilla-Silva, 2008). Another limitation is the use of survey items asking participants to reflect upon their college experience (2011 survey data) versus a measure of responses while students were in college.

While one of the benefits of longitudinal data is typically the ability to analyze responses from critical time periods, this study had to rely on responses from the 2016 PBS and 2011 PBS and asked students to reflect on their experiences given the small selected samples of interim surveys in 2005 and 2008. Third, institutional contexts are accounted for in this study, however we did not employ hierarchical general linear modeling (HGLM). The point of this study is to focus on WOC, and unfortunately, we had many campuses where they were the only WOC in STEMH and so could not produce the minimum number of cases (five per institution) that would support an HGLM analysis. Additionally, women in this study do not represent part-time or transfer students (only first-time, full-time students who began college in 2004), which is a common profile of underrepresented undergraduates in public institutions.

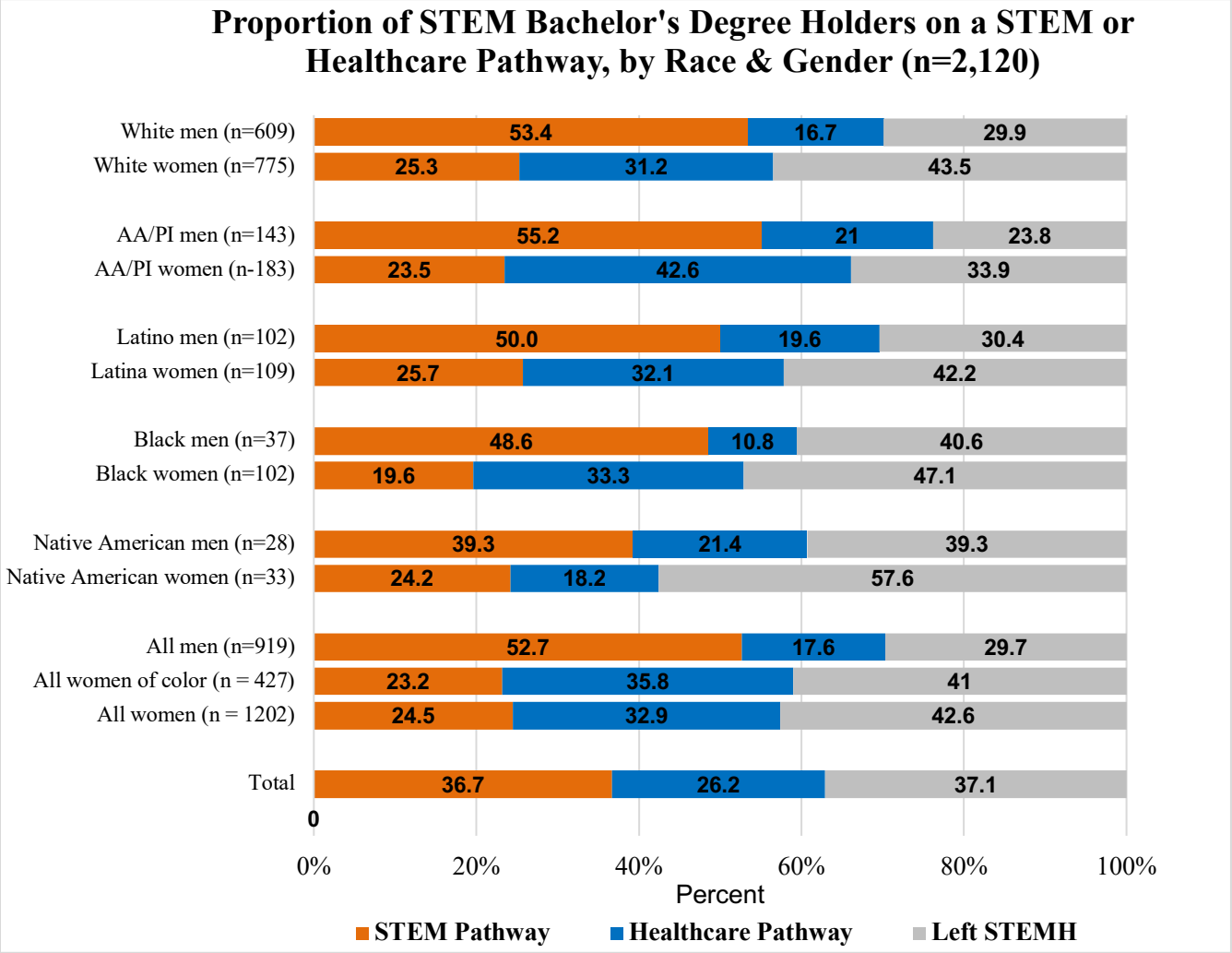
One final point is related to the faculty guidance and support construct. Five of the eight items for the faculty guidance and support construct refer to experiences directly provided by faculty. Unfortunately, the survey does not distinguish whether WOC are receiving faculty support from the professors in their major or from other faculty across the institution.

Findings

Comparing Post-Baccalaureate Pathways of STEMH Baccalaureate Degree Holders

From the entire sample of women and men who entered college in 2004 and earned STEMH bachelor's degrees (*n*=2,120), 62.9% were on a STEMH pathway 12 years later (i.e. in 2016), with 36.7% on a STEM-only career pathway and 26.2% on a healthcare career pathway (see Figure 2 or Appendix Table A-8). However, a breakdown by race, gender, and STEMH field reveals critical differences in career pathways.

Figure 2. Percent of STEMH Bachelor's Degree Holders on a STEM and/or Health Pathway 12 Years after College Entry, By Race and Gender.



Note: **STEM/Healthcare Pathway =indicated gainful employment in a STEMH -related occupation and/or enrolled in STEMH graduate study in 2016. Source: 2016 Post-baccalaureate Survey, Higher Education Research Institute, UCLA. See Appendix for further breakdowns by race and gender.

Overall, a greater proportion of men of all racial/ethnic groups were on STEM-only pathways compared to their women counterparts, whereas a greater proportion of women (except for Native Americans whose attrition was highest) were in healthcare in 2016 compared to their men counterparts (see Figure 2.). Gender disparity between men and women of all racial/ethnic groups is largest when considering who ends up in STEM-only fields in 2016. For example, only 19.6% of Black women with STEMH bachelor's degrees ended up on a STEM-only career

pathway compared to 48.6% of Black men ($p > .001$). With respect to healthcare pathways, a greater proportion of women with STEMH bachelor's degrees end up in healthcare occupations compared to men. Most striking is that 41% of WOC with bachelor's degrees in science reported they left a STEMHH pathway, as did 42.6% of all women. Less than a quarter of women remained in a STEM-only pathway, and only 23.2% of WOC, which remains the pathway where they are severely underrepresented.

When we disaggregate WOC by race/ethnicity, there are several significant differences by each career path and racial/ethnic group. For example, Native American women were significantly less likely to be in a healthcare-related occupation in 2016 compared to AAPI women (18.2% compared to 42.6%, $p < .05$). This finding is confirmed in the multivariate analyses that follow. A better understanding of the experiences of Native American students in STEMH fields is needed to understand the gap in healthcare workforce retention for these women, especially since there is a high need for health care professionals in Native American communities.

Graduate study. Approximately half of all men and women reported having earned a STEMH graduate degree in the past, with a slightly higher proportion of women compared to men who earned a STEMH graduate degree (See Table 1). For example, 50.4% of WOC earned a STEMH graduate degree prior to 2016 compared to 45% of all men, although there was not a statistically significant difference between the two groups. Approximately 6.7% of all STEMH bachelor's degree holders reported being enrolled in a STEM-only graduate program, and 5.4% reported being enrolled in a healthcare graduate program in 2016. For healthcare graduate study in 2016, a greater proportion of WOC (8.2%) compared to men (3.6%) were enrolled ($p < .05$).

Table 1

STEM/Healthcare Graduate Study and Employment of STEM Bachelor's Degree Holders in 2016 (N=2,120)

	Percent who earned a STEMH Graduate before 2016	Percent in STEM Graduate Study in 2016	Percent in Healthcare Graduate Study in 2016	Percent with Gainful Employment in STEM 2016*	Percent with Gainful Employment in Healthcare in 2016*
Total	47.7%	6.7%	5.4%	34.4%	24.0%
All women	49.7%	6.3%	6.8%	21.9%	30.1%
All men	45.3%	7.3%	3.6%	50.7%	16.0%
All women of color	50.4%	6.8%	8.2%	19.9%	32.8%

*Employment in a STEMH career includes those who working either full-time or part-time by choice.
Note: Percentages for graduate study in 2016 and gainful employment in 2016 do not add up to 100% because some employed are also pursuing graduate study, and those who left STEMH are not shown in this table.

STEMH Employment. From the entire sample of women and men STEM bachelor's degree holders, 34.4% were gainfully employed in a STEM field and 24% were gainfully employed in a Healthcare field. Interestingly, a greater proportion of women reported working in Healthcare (30.1%) compared to STEM (21.9%) in 2016. Almost one-third of WOC STEM Bachelor's degree holders were working in healthcare (31.8%) compared to one out of six men (16.0%), ($p < .01$). For STEM employment, the gap between WOC and men is even larger, with 19.9% of WOC employed in a STEM-only occupation compared to 50.7% of men ($p < .001$).

Characteristics of WOC STEMH Bachelor's Degree Holders

To understand differences between WOC who remained in STEMH compared to WOC who left, we examined the characteristics prior to college entry, undergraduate experiences, and post-baccalaureate opinions. Table 2 shows the selected statistics of WOC STEMH Bachelor's degree holders, descriptives for all variables in the model are in Table A-2. There are several similarities between those who continued and those who abandoned a STEMH career pathway in terms of degree aspirations and low-income status but other differences are evident.

Table 2

Characteristics of WOC Who Leave or Persist in a STEMH Pathway

	Left STEMH (n=180)	In STEMH 2016 (n=247)
Pre-College STEMH Exposure and Interest		
Mother with a college degree or higher	56.7	62.8
Father with a college degree or higher	51.7	63.6
At least one parent in STEMH	36.1	46.1
Aspired to earn an MD in 2004	32.0	36.0
Aspired to earn a doctorate in 2004	27.0	24.0
Undergraduate Experiences		
Worked with faculty on research	43.0	55.0
Participated in an academic club or organization	62.0	72.0
Participated in an ethnic/cultural club or organization	61.0	52.0
Participated in an internship or cooperative ed program	45.0	47.0
Major was in Biology	47.0	55.0
Major was in Engineering	16.0	18.0
Major was in Physical science, Math, or Computer Science	13.3	10.0
Major was in the Health Sciences	24.0	17.0
Financial Assets		
Family Income is $39,000 or less (low-income)	23.3	23.1
Estimated amount of money borrowed is less than $10,000 (reported in 2011)	44.4	55.1
Aid which need not be repaid greater than $10,000 (reported in 2011)	36.0	38.0
Post-Baccalaureate Opinions		
Opinion: Agree or strongly agree that economy affected career decision (2011)	55.9	42.8
Long-term career considerations: Importance of social status is very important or essential	19.6	30.6

Note: Percentages in each cell based total on number of WOC in each column.

Precollege STEMH Exposure and Interest. Overall, a slightly higher proportion of WOC who stayed in STEMH had parents with college degrees or higher compared to WOC who left STEMH. Among WOC who remained on a STEMH career pathway, 62.8% had a mother

with a college degree or higher and 63.6% had a father who earned a college degree or higher, compared to 56.7% and 51.7% for women who were no longer in STEMH. In considering family expectations, exposure from having at least one parent in STEMH also appears to be an important, though not a statistically significant difference. Among WOC who remained in STEMH, 46.1% had at least one parent with a STEMH career compared to 36.1% of WOC who left STEMH. Interestingly, 76% of WOC who stayed in STEMH entered college with similar STEMH career aspirations compared to those who left STEMH.

Undergraduate Experiences. Of the original sample of WOC STEMH bachelor's degree earners, 51.5% majored in the biological sciences, 20.1% majored in the health sciences, 16.9% majored in engineering, , and 11% majored in the physical sciences, math and computer science (See Appendix descriptives Table A-2). Among the WOC who remained in STEMH in 2016, 55% majored in the biological sciences, 18% were engineering majors in college, 17% were health sciences majors, and 10% majored in the physical sciences, math and computer science. Among WOC who remained in STEMH, 55.1% reported working with faculty on research during their undergraduate education compared to only 43.3% of WOC who left STEMH. The majority of WOC (72%) who were in STEMH in 2016 participated in an academic club/organization in college compared to 62% of WOC who left STEMH.

Financial Assets. Overall, WOC who stayed in STEMH appear to have similar financial assets compared to WOC who left STEMH. However, a slightly higher proportion of WOC who remained in STEMH reported borrowing less than $10,000 in loans (55.1% compared to 44.4%) and receiving more aid which did not need to be repaid (38% compared to 36%).

Post-Baccalaureate Opinions. When thinking about long-term career choice, 30.6% of WOC in STEM/Healthcare believed social recognition and status was "very important" or

"essential" compared to only 19.6% of WOC who were not in STEMH. This cohort was also asked questions to understand the impact of the 2008 Great Recession. In 2011, 42.8% of WOC who were still in STEMH agreed or strongly agreed that the economy affected their career decisions compared to 55.9% of WOC who were not in STEMH in 2016. However, these significant differences were not apparent in multivariate tests of the model.

Multinomial Logistic Regression Results

We employed multinomial logistic regression to identify key predictors of remaining on a STEM-only career pathway or healthcare career pathway with a non-STEMH pathway as the referent group. Multinomial logistic regression estimates *k-1* models, where *k* is the number of levels of the outcome variable. Results in Table 3 are shown in odds ratios for the predictors, which are the exponentiation of the regression coefficients. In examining the model fit, the final models are significant ($p>.001$). When employing logistic regression, the model estimates from a logistic regression are maximum likelihood estimates that are derived through an iterative process. Thus, they are not calculated to minimize variance. Additionally, the OLS regression approach to goodness-of-fit using R-squared does not apply as there is no R-squared measure for logistic regression. Instead, a "pseudo" R-squared value is used and different pseudo R-squared types can arrive at different values. For the multinomial logistic regression model, the McFadden pseudo R-squared average was 0.328, whereas the Nagelkerke pseudo R-squared average was 0.572, and the Cox & Snell average was 0.505 across the 50 imputed models. The fit indices suggest an overall good fit with the variables in the models predicting the dependent variables.

Table 3

Results of Multinomial Logistic Regression Predicting Career Pathway Type Compared to a Non-STEM/Healthcare Pathway for WOC STEMH Bachelor's Degree Holders

	Healthcare Pathway vs. Non-STEMH Pathway *(n=427)*						**STEMH Pathway vs. Non-STEM Pathway *(n=427)***					
Variables	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**
Demographic Characteristics												
Asian American/Pacific Islander (ref.)	0.12						0.01					
Latina/o	-0.05	0.66		0.42	0.29	1.50	0.04	1.24		0.44	0.52	2.97
Black	-0.03	0.46	~	0.45	0.19	1.11	-0.05	1.11		0.51	0.41	3.00
Native American	-0.11	0.18	*	0.67	0.05	0.68	0.01	1.05		0.63	0.31	3.59
Pre-College Preparation and Experiences												
Educational Endowments												
SAT score												
Quintile 5: 1330-1600 (ref.)	0.09						0.01					
Quintile 4: 1190-1320	-0.06	1.34		0.40	0.61	2.94	0.10	1.12		0.41	0.51	2.49
Quintile 3: 1040-1180	0.01	1.28		0.45	0.52	3.12	-0.10	0.44		0.51	0.16	1.20
Quintile 2: 900-1030	-0.02	1.22		0.61	0.37	4.01	-0.07	0.67		0.73	0.16	2.77
Quintile 1: < 890	-0.03	1.15		1.06	0.14	9.15	0.02	1.22		1.14	0.13	11.36
High school GPA	0.01	0.78		0.18	0.55	1.10	0.06	1.21		0.19	0.84	1.75
Years of HS Math	0.03	1.68	*	0.28	0.97	2.91	0.07	1.50		0.34	0.77	2.94
Participated in a summer research program or health science research program sponsored by a university	0.01	0.90		0.41	0.40	2.01	0.05	2.59	*	0.44	1.10	6.10

Table 3 (Continued)

Results of Multinomial Logistic Regression Predicting Career Pathway Type Compared to a Non-STEM/Healthcare Pathway for WOC STEMH Bachelor's Degree Holders

Variables	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**
Family Expectations												
Mother: College degree or higher	0.05	0.76		0.37	0.37	1.56	0.02	1.51		0.41	0.68	3.34
Father: College degree or higher	0.10	1.19		0.37	0.57	2.48	0.05	1.50		0.41	0.68	3.33
At least one parent in STEMH	0.10	1.75		0.35	0.88	3.47	-0.01	0.66		0.40	0.30	1.45
Science Socialization												
Degree Aspirations (2004)												
Bachelor's Degree (ref.)	-0.07						0.10					
Doctorate Degree	-0.14	0.77		0.52	0.28	2.13	0.12	0.33	*	0.50	0.12	0.89
Master's Degree	-0.06	0.71		0.50	0.27	1.87	0.001	0.35	*	0.52	0.13	0.98
MD Degree	0.22	1.22		0.35	0.88	3.47	-0.21	0.12	***	0.56	0.04	0.35
Financial Capital: Family Income (2004)												
Quartile 4- $100,000+ (Ref.)	0.01						-0.05					
Quartile 3- $60-$99,999	-0.02	0.71		0.42	0.31	1.63	0.06	2.03		0.46	0.83	4.96
Quartile 2- $40-$59,999	-0.04	0.94		0.45	0.39	2.29	-0.02	1.12		0.50	0.42	3.00
Quintile 1- $0-$39,999	-0.04	1.23		0.48	0.48	3.17	0.04	1.42		0.55	0.48	4.20
Undergraduate Study and College Experiences												
Network Expansion												
Worked with faculty on research	0.04	0.74		0.36	0.37	1.51	0.11	1.41		0.39	0.65	3.04

Table 3 (Continued)

Results of Multinomial Logistic Regression Predicting Career Pathway Type Compared to a Non-STEM/Healthcare Pathway for WOC STEMH Bachelor's Degree Holders

Variables	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**	**r**	**Odds Ratio**	**Sig**	**SE**	**Lower Bound**	**Upper Bound**
Participated in an academic club or professional association	0.11	2.34	*	0.34	1.20	4.55	0.01	0.93		0.37	0.45	1.94
Participated in an ethnic club or organization	-0.11	0.34	**	0.35	0.17	0.67	0.01	0.88		0.36	0.44	1.78
Undergraduate Educational Endowments												
Overall undergraduate GPA	-0.01	0.96		0.07	0.84	1.10	-0.04	1.02		0.09	0.86	1.21
Participated in an internship or cooperative educational program	-0.03	0.70		0.32	0.37	1.32	0.06	0.97		0.37	0.47	1.99
Undergraduate Major												
Biological Sciences (Ref.)	0.22						-0.14					
Engineering	-0.25	0.22	*	0.57	0.07	0.67	0.30	3.37	**	0.46	1.37	8.30
Physical Sciences/ Mathematics/Statistics and/or Computer Science	-0.22	0.05	*	1.10	0.01	0.47	0.19	1.28		0.47	0.51	3.21
Health Professional Field	0.14	1.41		0.41	0.63	3.17	-0.25	.07	***	0.83	0.01	0.33
Science Socialization												
Academic Self Concept (2011)	0.13	1.03		0.02	0.99	1.07	-0.03	0.98		0.02	0.93	1.02
Science Identity (2011)	0.02	0.96	~	0.02	0.93	1.01	0.06	1.06	**	0.02	1.01	1.11

Table 3 (Continued)

Results of Multinomial Logistic Regression Predicting Career Pathway Type Compared to a Non-STEM/Healthcare Pathway for WOC STEMH Bachelor's Degree Holders

Variables	r	Odds Ratio	Sig	SE	Lower Bound	Upper Bound	r	Odds Ratio	Sig	SE	Lower Bound	Upper Bound
Extent to which undergraduate program contributed to ability to understand the role of science and technology	0.12	1.32		0.20	0.90	1.94	0.05	1.25		0.20	0.84	1.86
Extent to which undergraduate program contributed to ability to pursue graduate or professional school	0.24	1.57	*	0.19	1.09	2.26	-0.03	0.99		0.20	0.67	1.45
Financial Capital (2011)												
Work off campus during the academic year	0.01	1.19		0.31	0.65	2.17	-0.04	1.30		0.34	0.67	2.55
Estimated amount of money borrowed to finance undergraduate education	0.06	1.01		0.06	0.91	1.14	-0.09	0.90		0.08	0.77	1.04
Estimated amount of aid which must not be repaid	0.02	1.08		0.11	0.88	1.33	-0.01	1.07		0.12	0.85	1.34
Opinion: Economy affected decisions about career	-0.17	0.79		0.17	0.57	1.10	0.04	0.93		0.18	0.66	1.33

Table 3 (Continued)

Results of Multinomial Logistic Regression Predicting Career Pathway Type Compared to a Non-STEM/Healthcare Pathway for WOC STEMH Bachelor's Degree Holders

Variables	r	Odds Ratio	Sig	SE	Lower Bound	Upper Bound	r	Odds Ratio	Sig	SE	Lower Bound	Upper Bound
12 After College Entry												
Early Career Experiences and Opinions												
Opinion: When thinking about long-term career choice:												
importance of social recognition or status	0.12	1.18		0.24	0.42	1.06	0.001	0.93		0.25	0.57	1.50
importance of job security	0.16	2.14	**	0.21	1.07	2.47	-0.03	1.54	~	0.26	0.92	2.58
Advancement of knowledge	-0.04	0.66	~	0.16	0.74	1.41	0.03	1.10		0.26	0.66	1.82
importance of improving circumstances or health of minority communities	0.16	1.62	*	0.44	0.30	1.65	-0.11	1.11		0.21	0.73	1.69
Opinion: Importance of raising a family	0.17	1.02		0.39	0.42	1.90	-0.12	0.73	~	0.17	0.53	1.01
Inst. Control: Private	0.1	0.70		0.24	0.42	1.06	0.01	0.98		0.50	0.37	2.62
Inst. Type: 4-Year	-0.04	0.89		0.21	1.07	2.47	0.03	1.36		0.43	0.58	3.16
Most/Highly Competitive (Referent)	-0.012						-0.10					
Selectivity												
Very Competitive	-0.054	1.16		0.43	0.49	2.71	0.16	2.23	~	0.45	0.93	5.34
Noncompetitive to Competitive	-.098	0.58		0.53	0.21	1.63	-0.072	0.58		0.55	0.20	1.70
Non to Least Competitive	0.163	7.38	***	0.60	2.27	24.02	-0.002	1.10		0.65	0.31	3.94

Note: ~ < .10, *p < .05, **p < .01, ***p < .001

Predictors of a Healthcare Career Pathway. In examining predictors for remaining on a healthcare career pathway compared to leaving STEMH in 2016, Native American women are approximately 80% less likely than AAPI women to remain in healthcare ($p < .05$). Black women were also somewhat less likely than AAPI women to remain in healthcare, although this is just short of being statistically significant ($p = .05$). In terms of educational endowments, high school measures of ability (SAT, HSGPA) were not significant at this career stage. However, years of high school math continues to be a predictor in pursuing a health care pathway ($p < .05$). Early science socialization did not show significant effects in terms of degree aspirations or participating in summer health science research in high school for this pathway, which is in contrast to WOC in the STEM-only pathway. In examining social capital and networking during undergraduate study, participating in an academic club or professional association in college remains important ($p = < .05$) at this later career stage. However, WOC STEMHH degree holders who participated in an ethnic/cultural club or organization are approximately 70% less likely to remain in healthcare in 2016 ($p < .01$). Peer groups appear to influence majors, career goals, and long term outcomes. Unsurprisingly, WOC who majored in engineering were approximately 80% less likely ($p < .05$) and those who majored in the physical sciences, math, and/or computer science are approximately 95% less likely than biological science majors to pursue a healthcare pathway in 2016. Those with a higher science identity in 2011 were somewhat less likely to be in healthcare in 2016 ($p = .05$). Reflecting back on undergraduate experiences, WOC who believed their undergraduate program contributed to their ability to pursue graduate study were about 1.5 times more likely to remain in healthcare compared to others ($p= <.05$).

Regarding the role of institutional contexts, the strongest predictor of remaining in a healthcare pathway is the type of college chosen as a first year student. WOC STEMH bachelor's degree holders who attended institutions rated as the least competitive were over seven times more likely to end up on a healthcare pathway compared to those attending the most/highly competitive institutions ($p = < .001$). The most selective colleges seem to deter WOC from entering healthcare fields even though they complete a STEMH degree and are extremely talented.

Financial capital does not appear to influence remaining in a healthcare pathway in 2016, holding all other variables in the model constant, as neither 2004 income differences, parental education or occupation in STEMH, or 2011 amount of loans, or aid that need not be repaid distinguished those who left from those who stayed. Those WOC who stated the economy affected their careers decisions were neither more or less likely to leave a health care pathway. However, WOC STEMH bachelor's degree holders who value the importance of job security are twice as likely to be in healthcare field in 2016 compared to all others ($p < .01$). It may well be that the growing need for health professionals of all types has created this job stability for WOC in spite of economic shifts. Additionally, WOC who value the importance of improving the circumstances or health of minority communities are approximately 1.6 times more likely to be in healthcare ($p < .05$).

Predictors of STEM-only Career Pathways. Recall the numbers of WOC (and all women) revealed a much more exclusive pathway in STEM, compared to healthcare, which includes pure science as well as applied sciences such as engineering and we expected to find fewer significant effects. In predicting who enters and remains in a STEM pathway after college among WOC STEMH bachelor's degree holders, findings suggest that there are no significant

differences between racial/ethnic groups nor in the typical educational endowments students possess coming out of high school. SAT scores, high school GPAs, and family income levels do not seem to differentiate STEM career outcomes, holding all other variables in the model constant. However, WOC who participated in a summer research or health science research program before entering college were approximately 2.6 times more likely to end up on STEM pathway in 2016 ($p =< .05$). This suggests the importance of early science socialization.

Degree aspirations at college entry revealed something about the aspiring medical doctors, as this was the strongest negative predictor (compared to those who aspired to a B.A. degree) of entering a STEM field ($p =< .001$), yet there were no effects for the healthcare pathway that included physicians in that category. These WOC still received a degree in science but were least likely to pursue STEM. WOC who aspired to a masters or doctorate degree compared to a bachelor's degree at college entry were also less likely to be in STEM in 2016 ($p < .05$). Some of this may be influenced by majors that have much stronger corresponding occupations.

In examining undergraduate experiences, undergraduate major matters for predicting WOC that are more likely to be retained in a STEM career. For example, compared to biological science majors, WOC who majored in engineering were over three times more likely to be in STEM in 2016 ($p < .001$), whereas WOC who majored in a health professional field were significantly less likely to enter or remain in STEM ($p < .001$). WOC who had a higher science identity in 2011 are approximately 6% more likely to remain in STEM in 2016 ($p < .01$).

Twelve years after college entry, WOC who indicated that they value job security when considering long-term career decisions are somewhat more likely to be in STEM versus leaving STEMH ($p =< .10$). However, WOC who value the importance of raising a family were

approximately 30% less likely to be on a STEM pathway (p =< .10). In terms of college selectivity, WOC who attended a very competitive college were somewhat more likely to remain in STEM compared to those who began at the most or highly competitive colleges (p =< .10). Although the latter findings were marginal in terms of significance, they represent potential patterns to study in the future.

Discussion and Implications for Practice

This study sheds light on STEMH retention rates 12 years after college entry, extending results from previous studies on race and gender in STEMH career paths as well as raising new areas for inquiry. For all WOC STEM bachelor's degree holders in the study, 23.2% remained on a STEM career pathway and 35.8% on a Healthcare career pathway, with an approximate 41% attrition rate. In essence, we found that if WOC make it to STEMH baccalaureate degree completion, future career outcomes for WOC and White women are similar. Although women tend to have better retention rates in college compared to men, WOC are more likely to leave STEMH than Men of Color and continue to enter STEM-only fields at lower rates. The higher rates of STEMH pathway attrition for WOC and White women compared to men is troubling, especially after women have already overcome several barriers in K-12 and postsecondary education to earn a STEMH degree. Further, when considering actual numbers of individuals, the disparities are multiplied. For example, while it appears that a greater proportion of WOC are entering healthcare fields, the actual number of WOC is still relatively small. We connect the findings with previous research and theory, implications for practice, and recommend new and varied methods to extend the research on WOC in STEMH fields. We suggest continued research to unpack structural inequalities of racism and sexism that persist in spite of the

increasing demographic change to further explore these experiences that are part of the unexplained variance in this study.

Extending Previous Research and Theory

This study aimed to examine the factors that contribute to retention in STEM and Healthcare career pathways of WOC who finished college with a STEMH bachelor's degree. While programs have used Johnson & Bozeman's Asset Bundle (2012) model to guide interventions for diverse college students (Collins et al., 2017), this study aimed to find empirical evidence by applying the theoretical model to the educational and career trajectory of WOC STEMH baccalaureate degree holders. First, conceptualizing the assets that can be developed among WOC STEMH aspirants was a significant advancement over a typical deficit approach to research on underrepresented groups. Second, we found support for early science socialization and sustained reinforcement of science identity as well as interventions for summer research interventions before college for those entering a STEM-only career. This also extends longitudinal studies on WOC (Carlone & Johnson, 2007) and another on URM students in NIH-sponsored college intervention programs to find the relevance of science identity into the early career for STEM graduates but not for medical/clinical workers (Estrada, et al., 2018). We confirm those findings for healthcare pathways, although we do not dispute that early development of science identity and encouraging educational endowments (i.e. coursework in HS mathematics) should continue to be an important facet of WOC 's and all women's science socialization for STEMH. While we did not find that financial capital (either from families or during college), was a significant predictor for any of the pathways, at this career stage it was important that job security rose to the top of WOC concerns when thinking about a long-term career choice. We attribute this in part to the economic recession they experienced during

college, and while many were affected, it was not ultimately a predictor of career choice in STEMH. Presumably this was because WOC received STEMH degrees and also could find more stable jobs or could attend graduate school in areas more closely related to their major (Xu, 2013). Comparisons with WOC in non-STEMH fields in the future may reveal a different dynamic surrounding the link between chosen major and ultimate career choice.

Previous work has compared STEMH and non-STEMH majors and closely-related career choices (Xu, 2013), and did find differences in corresponding occupations, but the advancement we have added lies in examination of particular majors that may be more matched with specific occupations in STEM or healthcare. In contrast with that study, we look at variability among WOC and find that there are differences between WOC in STEM and those in the healthcare pathway. Moreover, we confirm a strong relationship for specific majors such as engineering and remaining in a STEM-only career, compared to other majors. Whereas, healthcare professional majors do just as well as biological science majors in matriculating to healthcare graduate study or employment in a healthcare field. However, students entering with aspirations for a medical degree may graduate with a STEMH degree but are significantly less likely to enter a STEM field and are as likely as other degree aspirants to enter healthcare as an occupation. Encouraging medical degree aspirants to consider STEM research remains a goal of some interventions that expose students to broader STEMH pathways.

While we did not find lasting effects of experiences with faculty, even though they are critical to students' science identity development, we found small but lasting effects of peer groups that play a role in not just increasing sense of belonging during the undergraduate years but also exposing students to other areas, as in ethnic/cultural clubs, that are associated with long-term career choices. More research is needed in this area. By far the most influential choice,

however, in selecting a healthcare pathway was attending a least competitive college. This confirms previous research on the importance of college contexts that show remaining in STEMH is least likely at the most selective institutions (Chang et al., 2008; Hurtado et al., 2011), and extends it to long-term career choices for WOC with STEMH degrees. Least competitive colleges are more diverse and often have different approaches to supporting URM students in STEMH careers because that is their primary student population (Hurtado, et al., 2011). Funding agencies may consider continuing to support the innovations occurring at noncompetitive or least competitive colleges in fostering STEMH majors and careers for the future (Collins et al., 2017).

Implications for Practice and Research

The study's findings have implications to inform college advocates' efforts to bolster undergraduate environments that encourage and empower career persistence for WOC in STEMH fields. Perhaps most important is the need for colleges and universities to create learning environments that promote the development of specific aspects of science identity (competence, performance, and recognition) and support retention in a student's aspired major and/or STEMH career. College presidents and deans would be wise to create departmental environments that continuously examine how faculty can be supported in their efforts to involve and create opportunities for undergraduates that can propel them toward STEMH graduate study or employment.

The responsibility for counterbalancing the legacy of exclusion of women and URMs in STEMH is moving away from individual students and toward institutions to provide effective campus contexts to improve retention (Campbell, 1996). More recently, a report from the National Academy of Sciences, Engineering and Medicine (NASEM) concluded that "better alignment of science, technology, engineering, and mathematics (STEM) programs, instructional

practices, and student supports is needed in institutions to meet the needs of the populations they serve" (2016, p. 4), suggesting that coordinated undergraduate efforts are needed in institutions of higher education to advance excellence and equity in the scientific workforce.

For the WOC STEMH baccalaureate degree holders who continue into the STEMH workforce, the mental and psychological toll of being one of only a few WOC in the workplace is only beginning to be examined in depth (Ong et al., 2011). Unfortunately, most research regarding the STEMH workplace is often centered around *all* women, which tends to ignore the unique challenges of WOC. While the present study was able to examine career outcomes and career goals and attitudes of WOC, future research can examine additional factors to understand the experiences of WOC in the STEMH workforce. Because of the small numbers, it is necessary to incorporate qualitative methods to obtain a more nuanced understanding of what might be contributing to attrition for WOC. For example, studies to understand workplace climate, availability of mentorship in the workplace, and strategies for overcoming sexism and racism are needed from the perspective of WOC.

It is vital that institutions explore the gender and racial climates and remove systemic barriers that adversely affect WOC, while employing evidence-based practices that help women of all backgrounds succeed. If WOC cannot access and complete undergraduate STEMH programs, they will essentially be shut out of future graduate study and/or employment in STEMH positions with additional influence and earning power. Commitment to dismantling historic oppressive systems that exist in STEMH fields requires keeping underrepresented populations at the center of related discussions taking place at the federal, state, and institutional level. Pushing the established boundaries of educational institutions for the purpose of inclusion is at the core of an intersectionality discourse, and must be continued to level the playing field

for underrepresented college students if we are to fulfill the nation's goals of broadening and diversifying the STEMH workforce.

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Appendix

Table A-1

Programs for Past and Current Graduate Degrees

STEM Graduate Programs	Biology, Animal Biology (zoology), Botany, Marine Biology, Microbiology, Molecular, Cellular and Developmental Biology, Neurobiology/Neuroscience, Plant Biology (botany), Agriculture/Natural Resources, Biochemistry/Biophysics, Environmental Science, Other Biological Science, Computer/Management Information Systems, Aerospace/Aeronautical/Astronautical Engineering, Biological/Agricultural Engineering, Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical/Electronic Communications, Engineering, Engineering Science, Physics, Environmental/Environmental Health Engineering, Industrial/Manufacturing Engineering, Materials Engineering, Mechanical Engineering, Other Engineering, Clinical Laboratory Science, Computer Science, Mathematics/Statistics, Other Math and Computer Science, Astronomy & Astrophysics, Atmospheric Sciences, Chemistry Earth & Planetary Sciences, Marine Sciences, Physics, Other Physical Science
Healthcare Graduate Programs	Health Care Administration/Studies, Health Technology, Kinesiology, Nursing, Pharmacy, Therapy (occupational, physical, speech), Other Health Profession

Table A-2

STEM and Healthcare Occupations in 2016

STEM Occupations	Natural Resource Specialist/Environmentalist, College Faculty, Computer Programmer, Developer, Computer Systems Analyst, Engineer, Research Scientist (e.g., Biologist, Chemist, Physicist)
Healthcare Occupations	Dietician/Nutritionist, Home health worker, Medical/Dental Assistant (Hygienist, Lab Tech, Nursing Asst.), Registered Nurse, Therapist (e.g. physical, occupational, speech), Clinical Psychologist, Dentist/orthodontist, Medical doctor/surgeon, Optometrist Pharmacist, Veterinarian

Table A-3

Description of Variables and Measures

Items	Scale and Range
Dependent Variable: Career Pathway	
Reported not being in STEM or medical/ Healthcare field (Referent)	0= no, 1 = yes
Reported working in a STEM-only career, or in STEM-only graduate program in 2016	0= no, 1 = yes
Reported working in a Healthcare career, or in a Healthcare graduate program in 2016	0= no, 1 = yes
Demographic Characteristics	
Race: Asian American/Pacific Islander (Referent)	0= no, 1 = yes
Race: Latina/o	0= no, 1 = yes
Race: Black	0= no, 1 = yes
Race: Native American	0= no, 1 = yes
Pre-College Preparation and Experiences	
Asset Bundle: Educational Endowments	
SAT score	Combined Verbal and Math scores or ACT composite score
Quintile 1: Less than 890	0= no, 1 = yes
Quintile 2: 900-1030	0= no, 1 = yes
Quintile 3: 1040-1180	0= no, 1 = yes
Quintile 4: 1190-1320	0= no, 1 = yes
Quintile 5: 1330-1600	0= no, 1 = yes
High school GPA	Average grade in high school: 1 = B- or lower, 2 = B, 3 = B+, 4= A-, 5 = A or A+
Years of HS Math	1= none to 7= 5+ years
Participated in a summer research program or health science research program sponsored by a university	0= no, 1 = yes
Asset Bundle: Family Expectations	
Mother: College degree or higher	0= no, 1 = yes
Father: College degree or higher	0= no, 1 = yes
At least one parent in STEMH	0= no, 1 = yes
Degree Aspirations (2004)	
M.D. Degree	0= no, 1 = yes
Doctorate Degree	0= no, 1 = yes

Master's Degree	0= no, 1 = yes
Bachelor's Degree (Referent)	0= no, 1 = yes
Asset Bundle: Financial Capital	
Family Income (2004)	
Quartile 1 – Less than $39,999	0= no, 1 = yes
Quartile 2 - $40-$59,999	0= no, 1 = yes
Quartile 3 - $60-$99,999	0= no, 1 = yes
Quartile 4 - $100+ (Referent)	0= no, 1 = yes
Undergraduate Study and Post-Baccalaureate Experiences	
Asset Bundle: Network Expansion	
Faculty Mentorship and Guidance Factor	An eight-item factor consisting of the following 2016 PBS survey items: • An opportunity to collaborate on research • Advice about your educational program • Feedback on your academic work (outside of grades) • Intellectual challenge and simulation • An opportunity to discuss coursework outside of class • Help in accessing professional networks • Letters of recommendation • Information related to available professional job opportunities
Participated in an academic club or professional association	0= no, 1 = yes
Participated in an ethnic club or organization	0= no, 1 = yes
Asset Bundle: Undergraduate Educational Endowments	
Overall undergraduate GPA	1= 1.33-1.66, 2=1.67-1.99, 3=2.00-2.32, 4= 2.33-2.66, 5=2.67-2.99, 6=3.00-3.32, 7=3.33-3.66, 8=3.67-3.99, 9=4.0 or higher
Participated in an internship or cooperative educational program	0= no, 1 = yes
Worked with faculty on research	0= no, 1 = yes
Undergraduate Major	
Biological Sciences (Referent Group)	0= no, 1 = yes
Engineering	0= no, 1 = yes

Physical Sciences/Mathematics/Statistics and/or Computer Science	0= no, 1 = yes
Health Professional Field	0= no, 1 = yes
Asset Bundle: Science Socialization	
Academic Self Concept (2011)	Unified measure of students' beliefs about their abilities and confidence in academic environments. Includes the following: • Self rating: Academic ability • Self rating: Drive to achieve • Self rating: Mathematical ability • Self rating: self-confidence (intellectual)
Science Identity (2011)	Factor composed of the following four items: • Goal of wanting to make a theoretical contribution to science • Wanting to be recognized as an authority in the field • Wanting to be recognized for Contributions to the field • Wanting to find a cure to a health problem
Extent to which undergraduate program contributed to ability to understand the role of science and technology	1= not at all, 7= to a great extent
Extent to which undergraduate program contributed to ability to pursue graduate or professional school	1= not at all, 7= to a great extent
STEM/Healthcare career aspiration (2011)	
Non-STEM/Health (referent group)	0= no, 1 = yes
STEM career aspiration	0= no, 1 = yes
Healthcare career aspiration	0= no, 1 = yes
Asset Bundle: Financial Capital (2011)	
Work on campus during the academic year	0= no, 1 = yes
Work off campus during the academic year	0= no, 1 = yes
Estimated amount of money borrowed to finance undergraduate education	Continuous, 0-$255,000 in increments of $10,000
Financial aid which must not be repaid	1= none, 2= < $1,000, 3=$1,000-$2,999 4= $3,000-$5,999, 5=$6,000-$9,999, 6=$10,000+

Opinion: Economy affected decisions about career	1=disagree, 4=agree strongly
Twelve Years After College Entry	
Early Career Experiences and Opinions	
Opinion: When thinking about long-term career choice, importance of social recognition or status	1= not important, 5= essential
Opinion: When thinking about long-term career choice, importance of job security	1= not important, 5= essential
Opinion: When thinking about long-term career choice, importance of the advancement of knowledge	1= not important, 5= essential
Opinion: When thinking about long-term career choice, importance of improving circumstances or health of minority communities	1= not important, 5= essential
Opinion: Importance of raising a family	1= not important, 4= essential
Institutional Characteristics	
Institutional Control	1= Public, 2 = Private
Institutional Type	1=University, 2 = Four-Year Comprehensive
Selectivity	Based on Barron's Admissions Competitiveness Index 2004
Most/Highly Competitive (Referent)	0= no, 1 = yes
Very Competitive	0= no, 1 = yes
Competitive	0= no, 1 = yes
Non- and Least Competitive	0= no, 1 = yes

Table A-4

Results for Science Identity (2011) Factor Analysis

Construct/Item	Mean	SD	Loading	α
Goal of wanting to make a theoretical contribution to science	2.12	0.97	0.60	0.714
Wanting to be recognized as an authority in the field	2.50	0.93	0.73	
Wanting to be recognized for contributions to the field	2.43	0.90	0.78	
Wanting to find a cure to a health problem	2.51	1.05	0.42	

Table A-5

Results for Academic Self Concept (2011) Factor Analysis

Construct/Item	Mean	SD	Loading	α
Self rating: Academic ability	4.03	0.65	0.78	0.701
Self rating: Drive to achieve	4.12	0.73	0.55	
Self rating: Mathematical ability	3.80	0.76	0.52	
Self rating: Self-confidence (intellectual)	3.77	0.79	0.62	

Table A-6

Results for Faculty Mentorship and Guidance Factor Analysis

Construct/Item	Mean	SD	Loading	α
An opportunity to collaborate on research	2.60	1.24	0.63	0.91
Advice about your educational program	3.10	1.16	0.85	
Feedback on your academic work (outside of grades)	2.81	1.17	0.81	
Intellectual challenge and simulation	3.73	1.16	0.70	
An opportunity to discuss coursework outside of class	3.55	1.11	0.66	
Help in accessing professional networks	2.72	1.15	0.83	
Letters of recommendation	3.32	1.19	0.73	
Information related to available professional job opportunities	2.74	1.21	0.78	

Table A-7

Descriptives: Scale and Range of Variables for all Women of Color STEMH Bachelor's Degree Holders (n=427)

	Mean	S.D.	Min.	Max.
Demographic Characteristics				
Race: Asian American/Pacific Islander	0.43	0.50	0	1
Race: Latina/o	0.26	0.44	0	1
Race: Black	0.24	0.43	0	1
Race: Native American	0.08	0.27	0	1
Pre-College Preparation and Experiences				
Educational Endowments				
SAT score				
Quintile 1: Less than 890	0.03	0.16	0	1
Quintile 2: 900-1030	0.11	0.31	0	1
Quintile 3: 1040-1180	0.21	0.40	0	1
Quintile 4: 1190-1320	0.26	0.44	0	1
Quintile 5: 1330-1600	0.30	0.46	0	1
High school GPA	5.23	0.10	1	5
Years of HS Math	6.05	0.57	1	7
Participated in a summer research program or health science research program sponsored by a university	0.17	0.38	0	1
Family Expectations				
Mother: College degree or higher	0.60	0.49	0	1
Father: College degree or higher	0.59	0.49	0	1
At least one parent in STEMH	0.42	0.49	0	1
Science Socialization				
Degree Aspirations				
M.D. Degree	0.34	0.48	0	1
Doctorate Degree	0.26	0.44	0	1
Master's Degree	0.23	0.42	0	1
Bachelor's Degree (Ref.)	0.09	0.29	0	1
Financial Capital: Family Income				
Quartile 1 – Less than $39,999	0.23	0.35	0	1
Quartile 2 - $40-$59,999	0.18	0.36	0	1
Quartile 3 - $60-$99,999	0.26	0.44	0	1
Quartile 4 - $100+ (Ref.)	0.25	0.43	0	1

Undergraduate Study and Post-Baccalaureate Experiences				
Network Expansion				
Faculty Mentorship and Guidance Factor	50.00	9.59	29.09	70.2
Participated in an academic club or professional association	1.68	0.47	1	2
Participated in an ethnic club or organization	1.56	0.50	1	2
Undergraduate Educational Endowments				
Overall undergraduate GPA	3.36	2.11	1	9
Participated in an internship or cooperative educational program	1.46	0.50	1	2
Worked with faculty on research	1.50	0.51	1	2
Undergraduate Major				
Biological Sciences (Referent Group)	0.52	0.50	0	1
Engineering	0.17	0.38	0	1
Physical Sciences/ Mathematics/Statistics and/or Computer Science	0.11	0.32	0	1
Health Professional Field	0.20	0.40	0	1
Science Socialization				
Academic Self Concept (2011)	50.00	8.66	17.50	66.58
Science Identity (2011)	50.00	8.77	33.16	69.34
Extent to which undergraduate program contributed to ability to understand the role of science and technology	4.07	0.89	1	5
Extent to which undergraduate program contributed to ability to pursue graduate or professional school	3.97	1.05	1	5
STEMH career aspiration (2011)				
Non-STEMH (referent group)	0.27	0.45	0	1
STEM career aspiration	0.25	0.43	0	1
Healthcare career aspiration	0.45	0.50	0	1
Financial Capital				
Work off campus during the academic year	1.50	.51	1	2

Estimated amount of money borrowed to finance undergraduate education	2.67	2.85	0	25
Estimated amount of aid which must not be repaid	4.29	1.73	1	6
Opinion: Economy affected decisions about career	2.45	0.94	1	4
Twelve Years After College Entry (2016)				
Early Career Experiences and Opinions				
Opinion: When thinking about long-term career choice:				
Importance of social recognition or status	2.02	0.81	1	4
Importance of job security	3.26	0.68	2	4
Importance of the advancement of knowledge	3.14	0.71	1	4
Importance of improving circumstances or health of minority communities	2.76	0.89	1	4
Importance of raising a family	3.03	1.02	1	4
Institutional Characteristics				
Institutional Control: Private	1.45	0.50	1	2
Institutional Type: 4-Year	1.32	0.47	1	2
Selectivity				
Most/Highly Competitive (Referent)	0.30	1.36	0	1
Very Competitive	0.27	0.45	0	1
Competitive	0.16	0.37	0	1
Non- to Least Competitive	0.23	0.42	0	1

Table A-8

Proportion of STEMH Bachelor's Degree Holders on a STEM or Healthcare Pathway, by Race & Gender (n=2,120)

	n		**Percent on a STEM Pathway**		**Percent on a Healthcare Pathway**	
Total	2120		36.7%		26.2%	
All Men	919		52.7%		17.6%	
All Women	1202		24.5%		32.9%	
All WOC	427		23.2%		35.8%	
	Women	**Men**	**Women**	**Men**	**Women**	**Men**
Native American	33	28	24.2%	39.3%	18.2%	21.4%
Latina/o	109	102	25.7%	50.0%	32.1%	19.6%
Black	102	37	19.6%	48.6%	33.3%	10.8%
AA/PI	183	143	23.5%	55.2%	46.2%	21.0%
White	775	609	25.3%	53.4%	31.2%	16.7%

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CHAPTER 3

Examining STEM/Health Career Pathways for Women of Color: A QuantCrit Mixed Methods Approach

Introduction

Women of color (WOC) remain severely underrepresented in the science, technology, engineering, mathematics, and Healthcare (STEMH) workforce (Williams, Phillips, & Hall, 2014). Efforts to increase the representation of WOC in STEMH acknowledge that experiences are rooted in structural inequalities based on the intersection of gender and race (Espinosa, 2011; Wilkins, 2017), particularly given that STEMH fields have historically been white and male-dominated. Extensive research has documented the negative impacts of racism and sexism for WOC in STEMH that contribute to their underrepresentation in college (Espinosa, 2011; Foor, Walden, and Trytten, 2007; Johnson, 2007; Malone and Barabino, 2009; Ong, 2005; Ong, Wright, Espinosa, and Orfield, 201) and in the STEMH academic workforce (Malcom, Hall, and Brown, 1976; Figueroa & Hurtado, 2013; Wilkins 2017). This body of literature infrequently addresses how sociohistorical context and other intersecting identities (e.g. socioeconomic class) impact educational experiences and career trajectories for WOC in STEMH.

The problem of WOC underrepresentation requires the development of theory and more creative use of methods to advance practice and address inequalities that persist from communities, through education, and in the workforce. The field of education is only beginning to employ critical quantitative methodologies to answer research questions that center multiple intersectional identities. For example, Covarrubias (2011) disaggregated data by race, class, gender, and citizenship status to provide a detailed portrait of the educational trajectory of Mexican-origin students along the Chicana/o education pipeline. Specific to the STEMH

workforce and education, Metcalf (2014) examined data from a critical lens to understand relationships between STEMH degree and occupations, using interaction models to account for race, gender, and socioeconomic status combinations. While critical quantitative studies begin to unpack how quantitative data can be used with an intersectionality framework, one specific approach emerging in education is Quantitative Critical Methodology, or "QuantCrit" (Garcia, Lopez, & Velez, 2017). As a subset of inquiry stemming from Critical Race theory (CRT), QuantCrit urges researchers to use statistics for racial justice and begin the long project of 'deracializing statistics' (Zuberi and Bonilla-Silva, 2008).

I expand upon QuantCrit methodologies through employment of a mixed methods sequential, transformative design to gain a richer understanding of the bridge between college and career outcomes among WOC during the Great Recession in the late 2000s and early 2010s. By centering intersectional race, gender, and socioeconomic status identities in a quantitative analysis, along with incorporating interviews with WOC in STEMH, this study design expands current intersectional approaches to understand career trajectories for WOC. This approach, in effect, "allows us to capture nuanced educational outcomes for this population as they are shaped by intersecting systems of oppression and privilege" (Covarrubias, 2011, p. 86).

Thus, the purpose of this study is to examine how multiple identities and context play a role in shaping pathways for WOC in STEMH careers, and at the same time, advance the use of QuantCrit to include mixed methods approaches to higher education research. Specifically, I examine how intersections of sociohistorical context and race, gender, and socioeconomic status shaped college experiences STEM and Health/Medical (STEMH) career pathways for WOC. While QuantCrit is relatively new, expanding its application to mixed methods will achieve the objective of deracializing statistics to study WOC with STEMH degrees who have overcome the

odds and evidence resilience in their career objectives. The use of a mixed methods sequential transformative design is ideal to convey the patterns and voices of marginalized groups or individuals (Creswell, 2009). This study is guided by the following research questions:

1) Are there differences in STEMH career post-baccalaureate destinations based on race, gender, and socioeconomic status, and what intersectional identities reveal the most disparities?
2) Considering sociohistorical context, what role does race, gender, and socioeconomic status play in shaping college experiences and post-baccalaureate pathways into a career in STEMH for WOC during the 2008 economic recession?

The aim is to situate the career pathways of WOC graduates in the larger social context of racism, sexism, and classism. To do so I present the guiding frameworks of intersectionality and Critical Race Theory (CRT), explaining how Quantitative Critical Methodology or 'QuantCrit' evolved from CRT. Next I present relevant literature to contextualize the history of racism and sexism in STEMH fields in the United States, with a particular focus on how WOC are situated in this history.

Theoretical Frameworks

Multilevel Model of Intersectionality

Intersectionality is a theory and lens for analysis that posits that interconnected systems of domination based on race, class, gender, sexuality, and other social identities simultaneously impact individuals as they engage with society and its institutions (Crenshaw, 1989, 1991). Intersectionality operates at both the macro levels of society and in micro and intimate relationships on a day-to-day basis (Covarrubias, 2011). While the notion of race is socially constructed (Omi & Winant, 1994), the impacts of race and racism are real, and are tied to the

history of Western European colonization and imperialism of people of color (Zuberi, 2001). Additionally, the history of patriarchal societies shapes gender roles and results in real and often negative impact on the experiences and outcomes for women (De Jesus, 2005; Lorber, 1994). Thus, the history of a White, male-dominated STEMH workforce in the U.S. is not a neutral, accidental pattern. Rather, it is the result of multiple forms of domination that continue to reproduce inequity. Understanding how multiple domains of oppression function for WOC, especially along career pathways, is critical in order to improve efforts to diversify the STEMH workforce to address national and global issues (Johnson, 2011; Ong, Wright, Espinosa, and Orfield, 2011).

To center the analysis on understanding the oppression for WOC during their educational and career trajectories, I draw from the Multilevel Model of Intersectionality by Anne Marie Núñez (2014). Núñez expanded on Floya Anthias' (2013) work to conceptualize a multilevel model of intersectionality that addresses relationships between levels of social categories. Consisting of concentric circles, the first level and core of the model includes social categories and relations, which influence the development of social positions, division, and hierarchies. The second level of the model refers to practices within domains of society that contribute to inequality. These domains include "(a) organizational (e.g., positions in structures of society such as work, family, and education), (b) representational (e.g., discursive processes), (c) intersubjective (e.g., relationships between individuals and members of groups), and (d) experiential (e.g., narrative sensemaking)." (Núñez, 2014, p. 88). The third level, called "historicity," situates the group or individual in the historical context. Applied to this study, the history of exclusion, racism, sexism, and the palpability of the 2008 economic recession for this cohort of STEMH degree holders are important to an intersectional QuantCrit analysis.

Critical Race Theory and Quantitative Critical Methodology

Quantitative Critical Methodology, or "QuantCrit", is a methodological sub-field of Critical Race Studies in education (Garcia, Lopez, & Velez, 2018). Scholars writing about QuantCrit urge researchers to use statistics for racial justice because they have historically been used to justify racist policies and programs (Zuberi and Bonilla-Silva, 2008). Quantitative approaches cannot simply be adopted for social justice aims because quantitative methodologies and the ways researchers interpret findings can often reify racism. For example, it is known that WOC are underrepresented in STEMH but some use these statistics to indicate underrepresentation is the fault of individuals—not institutions. Faulty logic might lead to an interpretation that WOC are simply not interested in STEMH because they are not selecting STEMH majors or STEMH careers upon graduation, and those that are interested cannot earn grades good enough to stay in science (Cole & Barber, 2003). Zuberi (2008) posits that faulty "race-neutral" logic underlying most statistical analysis can be remedied if race is placed within a social context and if researchers keep in mind how the history of race relations inform current day structural oppression. Applied to the example of WOC in STEMH, the history of oppression, particularly within STEMH careers in the U.S., is important for explaining why the "lack of interest" or "lack of capability" assumption is inaccurate. Moreover, some resilient WOC have overcome these problematic social and academic contexts to succeed in STEMH. Understanding how history is tied to social identities challenges such deficit-based explanations. Thus, to contextualize the state of WOC in STEMH, I provide a brief history of the research examining racism and sexism in these disciplines, and discuss how the compounding effects of these oppressions impact WOC STEMH career aspirants.

Racism and Sexism in STEMH

The experiences of WOC in STEMH have been described as a "*double bind"* to convey the notion that they experience oppression and discrimination based on their race or ethnicity and gender, resulting in less recognition, less perceived value, less visibility, and increased marginalization compared to other underrepresented groups in STEMH (Malcom et al., 1976). To clarify, "it is not a question of how race causes disadvantage and discrimination. The real issue is the way society responds to an individual's race" (Zuberi, 2001, p. 133). Thus, this critical report laid a foundation for literature on WOC in STEMH by beginning to rigorously examine how society responded to race, as well as gender within the science disciplines. Since then, advances in feminist theory and research on the topic of WOC in STEMH have shifted toward thinking of oppression of WOC in STEMH as intersectional (Bowleg, 2008; Crenshaw, 1991), rather than additive as the double bind suggests. Hence, being a WOC in STEMH is an integrated identity, rather than a summation of racial/ethnic and gender identities. Accordingly, social identities such as first-generation status and socioeconomic status also intersect with race and gender and contribute to uniquely shaping experiences of WOC.

Despite the challenges for WOC in STEMH, some have found support and resilience in spite of the racial and gender oppression (Brown, 2008; Johnson, 2006; Ong, 2005; Tate and Linn, 2005). Studies have found that the development of a strong sense of racial or ethnic identity gave WOC the agency and resilience to cope with the stereotypes and marginalization they experienced in STEMH (Brown, 2008; Malone and Barabino, 2009; Tate and Linn, 2005). Additionally, goals such as a desire to give back to one's marginalized community or wanting to make a difference in society can be beneficial in motivating persistence in STEMH (Espinosa, 2011; Trenor et al., 2008) and contributing to the development of a science identity (Carlone and Johnson, 2007).

Recent research on diversifying STEMH is beginning to explore the unique experiences and interventions that better serve WOC throughout various points in their educational and career pathways (Borum & Walker, 2012; Carlone & Johnson, 2007; Espinosa, 2011; Xu, 2013). This suggests that attrition for WOC at different points in time (i.e. college entry, major selection, STEMH graduate school study, employment, etc.) can possibly be solved by looking to certain college experiences and contexts that might increase their persistence. It is also crucial that research continues to simultaneously acknowledge systems of domination that are at play during critical points along the trajectory.

Impacts of Socioeconomic Status on Career Plans

Scholars have examined the impact of the recession on college enrollment (Long, 2014; Mitchell & Leachman, 2015), the labor market (Abel, Deitz, & Sue, 2014; Langdon, McKittrick, Beede, Khan, & Doms, 2011), and outcomes for college graduates (Carnevale, Cheah, & Strohl, 2012; Stone, Van Horn, & Zukin, 2012). Overall, recent college graduates during the recession were both unemployed and underemployed (i.e. working in a job that does not require a baccalaureate degree) at higher rates than the rest of the college-educated population (Abel et al., 2014). However, rates of unemployment by STEMH major were not all the same. For example, healthcare bachelor's degree earners tended to have lower unemployment rates compared to students who majored in the humanities or liberal arts (Carnevale et al., 2012). Yet, less is known whether access to jobs that aligned with one's STEMH degree differ by race, class, and socioeconomic status during a time of extreme competition for fewer job openings as Black, Latinx college students and some Asian American and Pacific Islander groups are more likely to come from low income families compared to White students (Jackson & Reynolds, 2013). For example, Black STEMH bachelor's degree graduates' unemployment rates were higher for all

STEMH degree types compared to the national average for STEMH bachelor's degree graduates (Jones & Schmitt, 2014). The multiple impacts of the recession have been examined for women (Christensen, 2015; Hartmann, 2009), pointing to evidence that both White women and WOC are disproportionately earning less money compared to their male counterparts after the recession despite having lower unemployment rates overall. Understanding how a specific sociohistorical context has shaped the experiences of a cohort of WOC who graduated with STEMH bachelor's degrees at the height of the recession can shed light on how intersections of structural racism, classism, and sexism simultaneously shape career pathways.

Decades of evidence indicate that, rather than following a linear "pipeline" into the STEMH workforce, individuals with STEMH degrees follow numerous pathways leading to careers in and out of their STEMH field of study (National Science Board, 2015). Carlone and Johnson (2007) examined how "women of color experience, negotiate, and persist in science" (p.1188) and developed a sense of science identity in the process of their educational training for a STEMH career. This study seeks to expand upon the current literature based on career trajectories of WOC in three main ways: 1) by centering race and racism, sexism and gender stereotypes in analyses, 2) by examining how sociohistorical context or historicity plays a role, and 3) by focusing on higher education and the workforce as sites for hindering or helping WOC along their trajectory. There is still much to understand about higher education's influence on long-term STEMH career persistence for WOC while intentionally centering the history of intersecting oppressions of race, class, and gender in STEMH.

Positionality

In alignment with the tenets of CRT and QuantCrit, it is important for me to state my positionality as a researcher and how I came to this present study. I am a multiracial woman who

grew up in California, and came to this work as a higher education scholar interested in research on intersectionality and finding new ways to study college students with interlocking identities. I position myself as a scholar who advocates for racial justice through engaging in scholarly inquiry to advance higher education's understanding of the experiences of underrepresented communities. I engage in research that ascribes to a transformative paradigm to advance knowledge of phenomena by contextualizing data sources through the lens of intersectionality and employment of QuantCrit methodology. My interest in this research topic is partially rooted in my experiences as an undergraduate student at a large, public research university where many students are pushed out of STEMH majors due environments in introductory courses. I also entered college the same year as the cohort of survey participants for the dataset used in this analysis, and I am the same age as participants. Another connection to the data for this work is my affiliation as a graduate researcher in the Higher Education Research Institute at UCLA.

Research Design and Methodology

I combine quantitative and qualitative inquiry to examine how gender, race, and SES affect STEMH career outcomes to answer the research questions. A mixed methods design incorporates quantitative and qualitative data collection and analysis within a study (Jones, Torres, & Armínio, 2006; Tashakkori & Teddlie, 1998). I employed a mixed methods sequential, transformative design (Creswell, 2009) to gain a richer understanding of the bridge between college and STEMH career outcomes. Specifically, I used semi-structured interviews to explain results obtained from national longitudinal survey data to fulfill the aims of the study.

A mixed methods design provides an opportunity to balance the limitations of one type of research method with the strengths of the other (Creswell & Piano Clark, 2007; Johnson & Onwuegbuzie, 2004). Indeed, quantitative data offers precision and is effective for research that

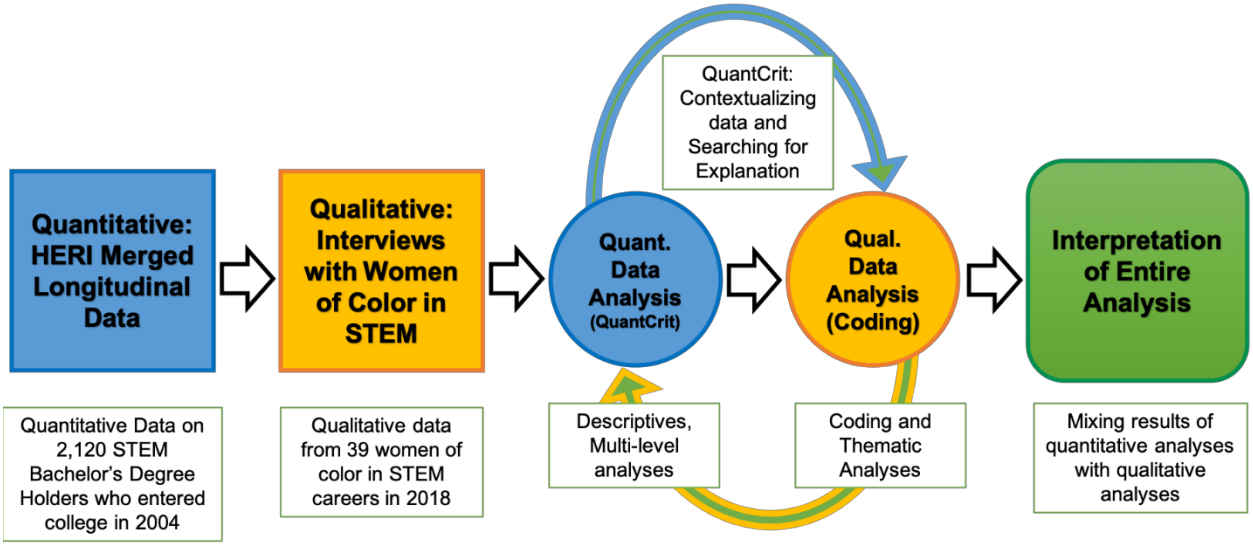
includes large populations. It is also useful for testing hypotheses about phenomena, and producing findings that are generalizable. However, limitations of quantitative research include: failure to ascertain why a phenomenon transpires; not explaining the meaning and understanding of what is analyzed; and omitting significant findings due to the emphasis that is placed on proving a hypothesis (Johnson & Onwuegbuzie, 2004). Qualitative methods address several of the limitations inherently found within quantitative research, such as offering richer and more detailed understandings. Furthermore, qualitative research highlights contextual and situational factors, furthers our understanding of the relationship of certain variables, and helps to untangle nuances of how individuals make meaning of phenomena. The merging of qualitative with the QuantCrit analysis adds depth and meaning, with a focus on unpacking the multivariate results for WOC of different racial/ethnic backgrounds and income levels and providing an additional layer of depth to this investigation into intersectionality theory as applied to the STEMH workforce. Specifically, the quantitative analysis lends to examining intersectionality via career outcomes in STEMH, while the qualitative analysis furthers our understanding with respect to the "hows and whys" of students' lived experiences.

Sequential, Transformative Design

This study is informed by a sequential, transformative approach (Creswell, 2009). This mixed methods design is guided by a theoretical orientation or advocacy lens (Hanson et al. 2005) where data is collected in two phases. Theoretically driven by intersectionality, the quantitative phase of the study was followed by qualitative interviews. These interviews enabled me to examine nuances and seek explanation for the findings from the quantitative study. Thus, the findings from both data collection phases are integrated during the interpretation phase (Kroll & Neri, 2009). Figure 1 illustrates the transformative design using 1) the merged national

longitudinal survey (Cobian & Hurtado, 2019) and logistic regression models, 2) semi-structured interviews of WOC in the STEMH workforce, and 3) using the results from the qualitative analysis to elaborate on the results from the quantitative analysis, and reviewing quantitative results again to seek more codes in the qualitative data. In general, the qualitative methods employed in this study also broaden our understanding of contextual elements that impact career outcomes and shape the professional experiences of WOC in STEMH that may not be captured solely using survey data.

Figure 1. Sequential, Transformative Model



Quantitative Design

In following the recommendation for structuring a sequential transformative design as well as this study's aim to advance QuantCrit, the quantitative analysis is conducted first and is foregrounded as the primary method of analysis utilized to examine intersectionality with a focus on race, gender, and socioeconomic class.

Data source and sample. This longitudinal study used three national surveys conducted by the Higher Education Research Institute (HERI) at the University of California, Los Angeles. The surveys include the 2004 Cooperative Institutional Research Program's (CIRP) Freshman Survey (TFS), 2011 Post-Baccalaureate Survey (2011 PBS), and the 2016 11-Year Follow-Up Survey (2016 PBS). The surveys were merged to examine educational and professional trajectories of the cohort who entered college in 2004, reported information again in 2011, and responded to a final survey in 2016, or 12 years after college entry. These longitudinal data are from a larger research project on underrepresented groups in STEMH sponsored by the National Institutes of Health (NIH) and National Science Foundation.

The baseline sample is from the Cooperative Institutional Research Program's (CIRP) 2004 Freshman Survey (TFS). The purpose of using the dataset for students who entered college in 2004 is due to the fact that the NIH provided funds to study NIH-sponsored undergraduate interventions for underrepresented groups, and researchers focused on expanding the sample of Black, Latina/o, and Native American entering college students and encouraged the institutions where they were enrolled to participate in the baseline survey (TFS).The TFS asked first-year students about their high school educational experiences, educational and career ambitions, expectations of college, and demographic characteristics. In 2011, the researchers collected additional information from the cohort entering college in 2004 to learn more about educational and career pathways using the Post-Baccalaureate Survey (2011 PBS). The 2011 PBS asked about participants' undergraduate experiences, career plans, perceptions, and posttest data on several attitudinal and behavioral items collected on the 2004 TFS.

The research team created an updated version of the PBS and administered the 2016 12-Year Follow-up Survey (2016 PBS). For the 2016 PBS, invitations to participate were sent to

individuals who completed the 2011 PBS. Of the 3,767 participants in 2016, 2,333 indicated that they had completed a STEMH bachelor's degree (27.6% response rate). The data are unweighted. After removing cases that had not participated in all three surveys (2004 TFS, 2011 PBS, and 2016 PBS), the sample was further reduced to 2,120 students across 335 institutions. Among the STEMH bachelor's degree holders who responded to all three surveys (2004 TFS, 2011 PBS, and 2016 PBS), 43.3 % were male and 56.7 % were female, 65.2% identified as White, 15.4% identified as Asian American/Pacific Islander, 6.6% identified as Black, 9.9% identified as Latina/o, 2.9% identified as American Indian/Alaska Native, and 2.2% identified with another race/ethnicity. Considering this study's focus on using QuantCrit to examine intersectionality in STEMH, I utilized the entire sample that includes men, women, and white women as a starting point to understand different career outcomes for this cohort of STEMH bachelor's degree holders.

Variables

Dependent variable. The dependent variable is in this study is the persistence into a STEMH career pathway. I created the dependent variable by including all participants who indicated they were employed in a STEMH occupation full time, part-time by choice, or working part-time while attending graduate school in 2016. To account for individuals who were attending STEMH graduate school in 2016 but may not have indicated they were employed in a STEMH occupation, I also included participants who indicated that they were in STEMH graduate study at the time the participant responded to the survey (for the list of STEMH occupations and STEMH graduate programs see Appendix). Thus, a value of zero was assigned to participants who left STEMH, and a value of 1 was assigned to participants who either were employed in a STEMH occupation (as previously defined) and/or enrolled in a STEMH graduate

program. Individuals who switched job occupations or graduate study within a STEMH field are still considered as remaining on a STEMH pathway. For example, a student who earned a bachelor's degree in chemistry, but reported working in a technology occupation at the time the survey was administered is considered someone who persisted in a STEMH pathway.

Independent Variables. The analyses accounts for demographic variables and institutional variables, as students were initially identified based on an institutional sampling design for the TFS. I accounted for racial/ethnic identity, gender, and socioeconomic status. I measured socioeconomic status (SES) by creating a standardized three-item factor that used parental income, father's highest level of education, mother's highest level of education. Rather than simply using parental income, this variable is a more robust measure of a participant's cultural capital as it considers the additional opportunities that often come with a parent having a college degree (see Appendix for factor loading). I then established cut points in the data to create dummy variables for low, medium, and high SES groups. While I initially attempted to disaggregate participants' racial/ethnic identities in the analysis, the small cell sizes for each race x gender x SES group were making it difficult to run a regression model that could be accurate in its estimations. Instead of deciding to drop cases for a racial/ethnic group, I decided to combine Asian and Pacific Islander, Black, Latinx, Native American to determine whether WOC and Men of Color differed from their White counterparts in terms of career outcomes in 2016. This comparison hypothesizes that WOC may face more discrimination and/or obstacles along the STEMH pathway towards a career, and thus their odds of remaining in STEMH might be lower compared to their male, White women, and White male counterparts. High SES White men were the referent group for this study because I am examining STEMH workforce retention, and

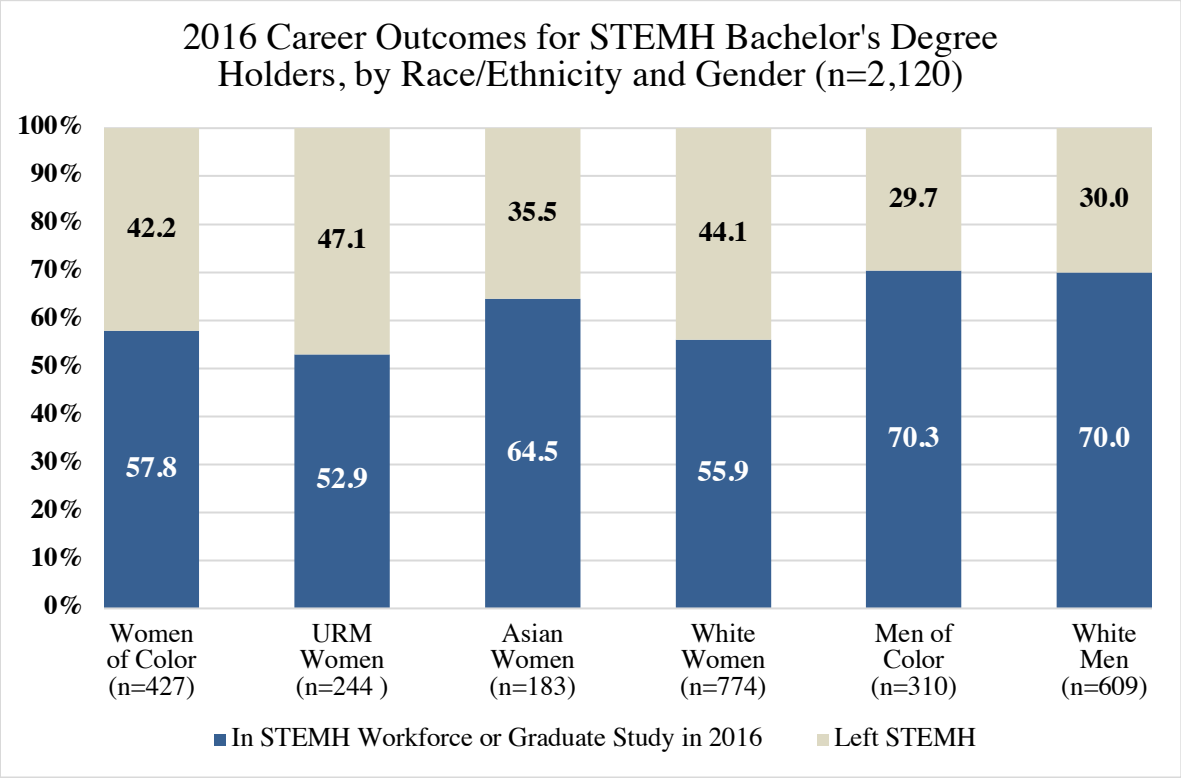
White high-income men have the highest level of participation in the STEMH workforce of any of the other social locations I aim to investigate.

While some scholars critique the use of dominant groups as referent groups for quantitative analysis, White high SES men are intentionally used in this study for both theoretical and practical reasons. Theoretically, White men not only are most represented in almost all STEMH fields (except for healthcare occupations such as nursing), they also hold positions of authority in STEMH. Secondly, considering the use of interaction terms in this study and the interest in examining coefficients for women of color, White high SES men are left out of the model so that the quantitative analysis can show the results for WOC in in various SES groups. Lastly, because career outcomes in 2016 for WOC and White women become similar (see Figure 2), examining whether there were statistical differences between White men versus White women made more sense. Figure 2 shows Asian women, among WOC, are retained at higher rates (64.5%) than White women (55.9%) or URM women (Black, Latina, Native American) (52.9%). All women are significantly less likely to be retained than White men or Men of Color, including AAPI men (70%).

Differing from the analytic model used in López et al., 2018, I also accounted for sociohistorical and institutional contexts as part of an intersectional approach. Because this cohort graduated college during the economic recession that began in 2008, I included a variable that captured participants' opinions in 2011 about whether they believed the economy impacted their career decisions. If participants strongly disagreed or disagreed, they were assigned a zero, and those who agreed or strongly agreed were assigned a 1. Institutional-level variables include whether the student attended a public versus private undergraduate institution, university versus

four-year comprehensive institution, and a highly selective (mean first year cohort SAT score > 1155) institution compared to those who did not.

Figure 2. 2016 Career Outcomes for STEMH Bachelor's Degree Holders, by Race/Ethnicity and Gender (n=2,120)



Quantitative Analyses

I employed logistic regression models using interaction terms similar to the methods used in Lopez et al., 2018. The models predict whether an individual remains on a STEMH pathway in 2016, using race x gender x SES interaction terms along with main effects of each of the race and gender variables. The models also control for institutional-level variables. This model is appropriate for the analysis because the point is to show intersections of identity that reflect distinct experiences often ignored in typical studies of long term outcomes. While institutional

variables are in the model, multilevel modeling was not appropriate for this study due to 222 institutions having less than 5 cases per campus.

To predict whether or not STEMH bachelor's degree earners ended up on a STEMH pathway versus not in 2016, I ran a logistic regression model that accounted for separate main effects of gender (women and men), racial/ethnic identity (combined Black, Native American, Latinx, & AAPI individuals and compared them to White individuals), and scores from the socioeconomic status (SES) factor (low, medium, and high). I also included institutional control (public versus private), institutional type (four year comprehensive versus university), and institutional selectivity (mean SAT score over 1155 versus mean SAT score less than 1155). I then ran two regression models to test interaction effects for a sample of AAPI and White STEMH bachelor's degree holders, followed by a similar process for a sample of URM and White STEMH bachelor's degree holders, These regression models included gender x race in the first model, followed by gender x race x SES interaction variables for a total of 12 possible social locations (e.g., low SES Asian women or Mid-SES White men). Finally, to compare AAPI and URM women together, I ran two regression models testing URM x SES interaction terms with the sample of all WOC.

I ran the regression models in Stata using the logit function. Results are explained in odds ratios, which is the exponentiated measure of the logistic regression coefficients. Odds ratios are the odds of the event occurring (e.g. remaining in STEMH). For the interaction terms that were significant in regression models, I also present findings in adjusted predictions using the Stata margins function. Adjusted predictions make results more tangible for interpretation by computing the average probability of the event occurring (i.e. remaining on a STEMH career

path in 2016) for an individual with a particular racial/ethnic identity x gender x SES social location.

Missing Data. Accounting for incomplete cells in a dataset is important for conducting analyses using predictor variables (Horton & Kleinman, 2012). In the sample, the SES factor was missing 10.6% of data. I investigated the missing data and determined that the data were not missing completely at random (MCAR) nor missing at random (MAR), an assumption required for several methods to recoup missing data. Typically, missing income data and/or missing data on parental level of education is biased toward certain groups at the extremes of the income scale who might choose to not report. While it is possible to employ multiple imputation to impute missing value data, this technique is not appropriate for this data set because the data are likely not missing at random. Instead, I employed listwise deletion, reducing the final analytic sample down to 1,895 cases with complete data.

Toward Deracializing Statistics: Social and Historical Context of Dataset

The Cooperative Institutional Research Program (CIRP) is a national longitudinal study of the U.S. higher education system (HERI, n.d.). To date, over 15 million students at over 1,900 institutions have participated in the survey since its debut (HERI, n.d.). Historically Black Colleges have participated free of cost in these national surveys. Additionally, these data have produced reports disaggregated by gender since the beginning of the survey in 1965, and data on full cohorts of entering students are returned to campuses for use in improving student experiences. Since HERI was established at UCLA, several additional national surveys were developed to achieve its mission. The National Institutes of Health (NIH) project at HERI focused on the progress of URM students and researchers added questions on the main surveys

as well as created the Post-baccalaureate Survey (PBS) to focus on students and their progress in STEMH.

Critical quantitative research takes into deep consideration the variables and their underlying measures, contexts (social, political, historical, etc.), and potential interpretations and the implications of each of these for respondents, researchers, policy makers, and stakeholders (Metcalf, 2014). In survey data, the categories with which a respondent may select to identify are created by the developer(s). These categories also have power, as respondents who answer the survey must mark a checkbox or perhaps have some areas for free-response but that nevertheless are constrained by the survey developer(s). For example, a question on many surveys asks for a participant's "gender," with the "acceptable" categories of response most often being binary, and biologically based categories (Metcalf, 2014). Survey participants who do not fit into this forced binary may either not proceed with the survey or feel forced to select an option that is not accurate to their actual desired choice. Thus, these participants are rendered marginalized, despite their gender-fluid lived experiences (Butler, 1999; Spivak, 1988). Similar challenges are can be said for marking checkboxes for race/ethnicity. QuantCrit acknowledges these constraints, as well as the role of power and oppression within quantitative data. In essence, it allows us to "find ways to engage with and contextualize the data, despite these limitations, in critical ways" (Metcalf, 2014, p. 80). This study applies a QuantCrit theoretical approach to HERI survey data, and illustrates new ways of understanding how socially-constructed identities impact career trajectory outcomes, while also acknowledging the challenges and constraints of forced choice on survey data, and thus addressing some of the constraints through a qualitative analysis to further identify the experiences of specific intersectional identities (e.g. low-income Asian or Latinas in STEMH).

Survey data has long been used in ways that reify systems of oppression. Zuberi (2001) traces the origins of statistics to the eugenics movement, and urges all researchers to decouple the logic used in eugenics from statistical analyses. Fortunately, many education scholars have used HERI data for transforming education, measuring inequality, and addressing social injustice. Zuberi has influenced social science researchers to advance quantitative methods for racial justice by providing a blueprint for rectifying the mechanical and decontextualized use of statistics (Du Bois 1899; Morris 2015; Zuberi 2001; Zuberi and Bonilla-Silva 2008).

Two of the tenets of QuantCrit call for researchers to 1) acknowledge that numbers in quantitative research are not neutral and should be interrogated for their role in promoting deficit analyses that benefit white racial interests, and 2) recognize that categories in survey data are not natural, nor given, and thus the units and types of analysis must be evaluated with a critical lens (Garcia et. al., 2017). Given the call to acknowledge numbers are not neutral, QuantCrit analysis as applied to this study examining STEMH outcomes aims to disrupt the notion that WOC are uninterested or incapable of succeeding in the STEMH workforce by use of interviews to understand how STEMH is raced, classed, and gendered, and how WOC of color resist systemic oppression and navigate their STEMH career trajectories. The second tenet is addressed in this study by incorporating a qualitative analysis to address the limitations of reductionist, forced-choice answers inherent in survey design. Participants were volunteers who self-identified as WOC in STEMH fields and who were able to share more about how they conceptualized their social identities. In addition, whereas the survey item I use to measure the impact of the recession forces participants to choose one of four responses, participants were able to go in depth about the impact of the 2008 recession, for example. Even with forced choices, however, survey data can still reveal important findings and be utilized for social justice aims as long as

researchers remain reflexive, critical, and transparent of limitations during all phases of the quantitative research process.

Qualitative Design

To address some of limitations of using survey data within a critical framework, I include a qualitative component to the study. Findings from the QuantCrit dataset and analysis informed my qualitative interview recruitment, protocol, and data analysis. I sent a recruitment email message to women who participated in the 2004 administration of the survey and listed the criteria for participation (i.e. had to identify as a either being Black, Native American, Latina, Asian American, Pacific Islander, multiracial, and as a woman, and had to either be working in a STEMH-related occupation or enrolled in a STEMH-related program. Interested individuals were asked to complete a demographic screening survey. I then contacted individuals that completed the screening survey, matched my criteria, and scheduled phone interviews with participants. Some individuals who were interested in participating either did not respond to follow-up correspondence to schedule an interview or were in a STEMH field such as economics or psychology and therefore were outside of the scope of the present study's definition of STEMH. There were 39 participants—10 Black women, 6 Latina women, 8 multiracial women, 1 Native American woman, and 14 Asian American/Pacific Islander women.

I conducted semi-structured phone interviews ranging from 60-120 minutes, with the average time being approximately 80 minutes. For the interview protocol, specific questions focused on aspects of college and post-baccalaureate experiences, and how their race, gender and socioeconomic class shaped their STEMH career pathway. Due to time constraints of participants who are working professionals, the interview process utilized an adapted version of Seidman's (2013) three interview series, which allows for understanding the lived experiences of

WOC and how they make meaning of those experiences. The three-part interview structure may still be explored using a single interview, as long as participants are still able to discuss and reflect upon their experiences (Seidman, 2013). Interviews were recorded, transcribed, and loaded on to MAXQDA for analysis. For the protocol of semi-structured questions, see Appendix C.

Analysis. Intersectionality-informed research calls for identifying relevant intersections by keeping social and historical context in mind throughout analysis (Hunting, 2014). Indeed, "it is not the intersection of race, class, and gender in a single social group that is of interest but the relationships among the social groups defined by the entire set of groups constituting each category" (McCall, 2005, p. 1787). Thus, to capture themes from the data through the lens of intersectionality, I used a modified 'two-step hybrid approach' by Sirma Bilge (2009). This type of analysis combines both inductive thematic analysis and a deductive template approach. For the first step, I employed open and axial coding in an effort to avoid treating individual narratives as representative of all social identities (e.g., gender, ethnicity, sexual orientation, etc.). Next, I developed a deductive reinterpretation of the previous data by making connections between individual participant narratives, social identities, and broader social relations. This second step of analysis can make visible the often hidden or overlooked structural oppression. For example, when the impact of the recession became a salient theme from coding during the inductive phase of analysis, I mapped on the WOC's multiple social identities and broader context of her education and work environment in order to examine how systemic oppression may be uniquely operating.

Credibility and Trustworthiness

To ensure credibility and trustworthiness, after conducting each interview I wrote analytic jottings, or notes taken during a research journey to capture initial thoughts (Saldaña, 2013). These jottings allowed me to make relevant notes about a participant's life experience while keeping in mind my research questions and connections between intersectionality, STEMH career decisions, and the impact of the economic recession. Over the course of four months, I wrote analytic memos (Saldaña, 2013) to track my decisions with data analysis, synthesize my post-interview jottings, and to make connections between individual participant narratives, social identities, and broader social relations or contexts (Bilge, 2009). This can make visible the often hidden or overlooked factors and processes that shape career decisions and life experiences. To ensure the trustworthiness of my findings, member checks were conducted by double-checking demographic information, transcription, and a summary of my themes with participants as needed in order to ensure accuracy and clarity (Jones, Torres, and Armínio, 2006).

Limitations and Narrowing the Scope

There are several limitations to the study, especially given the aim to ensure that steps taken were in alignment with the goals of QuantCrit and transformative design as well as the requirements and constraints of statistical analysis. First, nonresponse error, or the potential difference between participants who responded to the 2016 PBS and those who did not, may limit generalizability of the study's findings. Nonresponse in surveys can be thought of as a pre-study attrition, making nonresponse error akin to selection bias in studies since both are concerned with research participant recruitment prior to the start of a study (Sivo, 2006). Next, the use of an aggregate variable for racial/ethnic groups in the sample including all women is problematic since use of one overarching group for analysis inherently assumes that women from

varying racial/ethnic backgrounds experience college in similar enough ways. I was unable to disaggregate by racial/ethnic identity in the quantitative analysis, which limits our understanding of unique STEMH pathway trajectories for WOC. When considering the use of longitudinal data in STEMH, similar problems exist for Black, Latina, and Native American women when conducting quantitative analysis with shrinking sample sizes and limitations to survey items for race/ethnicity.

In an attempt to not lose additional cases, I included every STEMH bachelor's degree earner in the analytic sample as there were a sufficient amount of men and women to analyze by a dichotomous race and gender variable. Samples for both the quantitative and qualitative analysis are another limitation. For example, the quantitative sample is limited to students who began full-time as first year students and does not include transfer students. Furthermore, while this study predicts whether or not individuals remain in a STEMH career, my qualitative sample only examines WOC who remained in STEMH after obtaining a degree/major in STEMH. Finally, while a majority (37) of the WOC who were interviewed were recruited from the pool of participants who completed the Post-baccalaureate survey (PBS) used in the quantitative study, two participants were recruited outside of the PBS pool. I included them in this study because the two participants met my analytic criteria (i.e. started college in 2004 as first-time, full-time students, graduated with a STEMH degree, and identified as a woman of color in STEMH).

Findings

When Intersectionality is Absent from Analysis

Table 1 shows the results of the logistic regression model with main effects only, and thus does not specify women of color. The assumption is that all women STEMH baccalaureate degree holders are less likely to pursue a career in STEMH than men. However, there are no

differences between racial/ethnic groups (including Asians) and overrepresented white men. Similarly, the analysis shows that there are no SES differences in pursuing a STEMH career after graduate. These results change with an QuantCrit approach shown in Tables 2 and 3, however. Findings also show that students who entered private colleges and also universities (as opposed to four-year comprehensive colleges) were more likely to pursue a STEMH pathway.

Table 1

Model Without Focus on Women of Color, Main Effects: Logistic estimates of all STEMH Bachelor's degree earners remaining on a STEMH career pathway in 2016 (n=1,895)

ALL (n=1,895)	**Odds Ratio**	**Sig.**	**95% Confidence Interval**
Women	0.55	***	(0.45, 0.66)
Racial/Ethnic Groups (White ref.)	1.03		(0.84, 1.26)
Low SES	1.01		(0.79, 1.29)
Mid-SES	1.02		(0.80, 1.29)
Economy Impacted Career Decisions (2011)	0.81	*	(0.67, 0.98)
Inst. Control: Private (Ref. Public)	1.35	**	(1.10, 1.66)
Inst. Type: 4-Year (Ref. University)	0.77	*	(0.63, 0.95)
Inst. Selectivity: High (Ref. Mean SAT < 1150)	1.13		(0.91, 1.39)
McFadden's Pseudo R2	0.03		
Prob > Chi2	0.00		
LR Chi2(8)	62.30		

Note: *p < . .05, **p <.01, ***p <.001.

Building Intersectionality into Analysis

Table 2 shows the results of the logistic regression analyses examining AAPI and White STEMH bachelor's degree holders. The first model uses gender x AAPI interactions and the second model adds low, medium, and high SES groups to understand STEMH career outcomes compare for individuals socialized by their racial/ethnic x gender x SES identities. Overall, women are significantly less likely to remain in STEMH compared to men, which is similar to the regression model with main effects. Similarly, STEMH bachelor's degree holders that went

to private institutions and universities verses 4-year schools were more likely to remain in STEMH.

In examining interactions in Table 2, AAPI women STEMH degree holders are approximately 2.8 times more likely to remain in STEMH compared to White men. However, low and mid-SES women are less likely to remain in STEMH compared to high SES men ($p < .05$). Interestingly, low SES AAPIs were almost five times more likely to remain in STEMH compared to White high SES men ($p < .001$) and mid-SES AAPIs were also more likely to remain in STEMH compared to White high SES men. Disaggregating AAPI low SES groups with the full race/ethnicity x gender x SES interactions revealed significant differences for low SES AAPI women in that they are significantly *less likely* to stay in a STEMH career. This suggests that without implementing intersections of race, gender and SES, researchers will conclude that all AAPI women are doing better in long term career outcomes.

Table 2

Model Using Intersectional Identities, Main Effects and Interactions: Logistic estimates of AA/PI and White STEMH Bachelor's degree earners remaining on a STEMH career pathway in 2016. n=1,533

ASIAN & WHITE n=1,533	Model with Gender x Race			Model with Gender x Race x SES		
	OR	**Sig.**	**95% CI**	**OR**	**Sig.**	**95% CI**
Women (Ref. Men)	0.53	***	(0.41, 0.67)	0.42	***	(0.28, 0.63)
AAPI (Ref. White)	1.37		(0.88, 2.14)	0.56		(0.28, 1.11)
Low SES (Ref. High SES)	0.92		(0.70, 1.22)	0.72		(0.45, 1.16)
Mid-SES	1.03		(0.80, 1.34)	0.75		(0.48, 1.17)
Gender x Race/Ethnicity						
Women x AAPI (Ref. White Men)	1.02		(0.58, 1.80)	2.84	*	(1.15, 7.02)
Economy Impacted Career Decisions (2011)	0.81		(0.65, 1.00)	0.80		(0.65, 1.00)
Inst. Control: Private (Ref. Public)	1.47	**	(1.16, 1.86)	1.47		(1.16, 1.86)
Inst. Type: 4-Year (Ref. University)	0.72	**	(0.57, 0.91)	0.71		(0.56, 0.90)
Inst. Selectivity: High (Ref. Mean SAT < 1150)	0.98		(0.77, 1.25)	0.98		(0.77, 1.25)
Gender x SES						
Women x Low SES (Ref. High SES Men)				1.37	*	(0.75, 2.49)
Women x Mid-SES				1.43	*	(0.81, 2.53)
Race/Ethnicity x SES						
AAPI x Low SES (Ref. White High SES)				4.92	***	(1.67, 14.46)
AAPI x Mid- SES				3.46	*	(1.14, 10.56)
Race/Ethnicity x Gender x SES						
AAPI x Women x Low SES				0.11	**	(0.03, 0.45)
AAPI x Women x Mid-SES				0.35		(0.09, 1.47)
McFadden's Pseudo R2	0.030			0.037		
Prob > Chi2	0			0		
LR Chi2(8)	60.09			74.21		

Note: *p < .05, **p <.01, ***p <.001

Table 3

Margins Table: Probabilities of AAPI and White STEMH Bachelor's Degree Holders Remaining in STEMH in 2016 for Race x Gender x SES Groups who Agreed that Economy Impacted Career Decision in 2011 (n=1,533)

Group	Marginal probability	Sig.
AAPI x Women x Low SES vs. AAPI x Men x Low SES	-0.348	**
AAPI x Women x Low SES vs. AAPI x Men x Mid-SES	-0.271	*
AAPI x Women x Low SES vs. AAPI x Men x High SES	-0.102	
AAPI x Women x Low SES vs. White x Female x Low SES	-0.029	
AAPI x Women x Low SES vs. White x Women x Mid-SES	-0.049	
AAPI x Women x Low SES vs. White x Women x High SES	-0.032	
AAPI x Women x Low SES vs. White x Men x Low SES	-0.162	
AAPI x Women x Low SES vs. White x Men x Mid-SES	-0.170	
AAPI x Women x Low SES vs. White x Men x High SES	-0.231	

Note: *p < . .05, **p <.01, ***p <.001

To further understand the three-way interaction term that was significant in the model with AAPI and White STEMH Bachelor's Degree Holders, Table 3 shows the margins, or average probabilities of remaining on a STEMH pathway in 2016, using a Bonferroni correction to account for the degrees of freedom in the interaction term. In order to simplify comparisons, the table shows the difference in probabilities when comparing two unique race x gender x SES groups and only presenting results for groups compared to low SES AAPI women. Additionally, the average probabilities are held constant for the 2011 variable in the model that accounts for individuals who agreed or strongly agreed that the economy impacted their career decisions. While significant in the regression model, the difference in probabilities of remaining in STEMH

between low SES API women who agreed that the economy impacted their career decisions in 2011 compared to White high SES men did not remain significant once employing the Bonferroni correction. However, low SES AAPI women are significantly less likely to remain in STEMH compared to their AAPI men counterparts.

Table 4 shows the results of regression models for URM and White STEMH bachelor's degree holders. Again, main effects show that women are significantly less likely to remain in STEMH compared to men ($p < .001$). Institutional variables also remain consistently significant, which suggests that attending a private undergraduate institution (relative to public) or a university (relative to a 4-year comprehensive institution) results in a higher likelihood of remaining in STEMH in the future. The race x gender and race x gender x SES interaction terms were not significant in this model. This suggests that career outcomes for URM women STEMH degree holders might not be different from career outcomes for White men when generally focusing on STEMH career fields.

Finally, I ran regression models in order to compare AAPI women from URM women. Table 5 shows that URM women are significantly less likely to remain in STEMH compared to AAPI women. Additionally, all WOC who agreed in 2011 that the economy impacted their career decisions were almost half as likely to remain in STEMH.

Table 4

Model Using Intersectional Identities, Main Effects and Interactions: Logistic estimates of URM and White STEMH Bachelor's degree earners remaining on a STEMH career pathway in 2016, n= 1,599

URM & WHITE n=1,599	Model with Gender x Race			Model with Gender x Race x SES		
	OR	**Sig.**	**95% CI**	**OR**	**Sig.**	**95% CI**
Women (Ref. Men)	0.53	***	(0.041, 0.67)	0.42	***	(0.28, 0.63)
URM (Ref. White)	0.75		(0.5, 1.10)	0.55		(0.26, 1.15)
Low SES (Ref. High SES)	1.01		(0.70, 1.90)	0.73		(0.45, 1.17)
Mid-SES	0.97		(0.74, 1.22)	0.75		(0.48, 1.17)
Gender x Race/Ethnicity						
Women x URM (Ref. White Men)	1.15		(0.71, 1.90)	1.21		(0.45, 3.3)
Economy Impacted Career Decisions (2011)	0.88		(0.72, 1.08)	0.89		(0.72, 1.09)
Inst. Control: Private (Ref. Public)	1.32	*	(1.06, 1.66)	1.32	*	(1.05, 1.65)
Inst. Type: 4-Year (Ref. University)	0.76	*	(0.61, 0.95)	0.75	*	(0.60, 0.94)
Inst. Selectivity: High (Ref. Mean SAT < 1150)	1.13		(0.90, 1.42)	1.11		(0.89, 1.40)
Gender x SES						
Women x Low SES				1.39		(0.76, 2.52)
Women x Mid-SES				1.44		(0.81, 2.55)
Race/Ethnicity x SES						
URM x Low SES (Ref. White High SES)				1.79		(0.69, 4.68)
URM x Mid- SES				1.31		(0.48, 3.58)
Race/Ethnicity x Gender x SES						
URM x Women x Low SES				0.92		(0.26, 3.24)
URM x Women x Mid-SES				0.83		(0.22, 3.10)
McFadden's Pseudo R2	0.026			0.0280		
Prob > Chi2	0.00			0		
LR Chi2	54.73			60.04		

Note: *p < .05, **p <.01, ***p <.001

Table 5

Model Using Intersectional Identities, Main Effects and Interactions: Logistic estimates of AAPI and URM STEMH Bachelor's degree earners remaining on a STEMH career pathway in 2016, n= 378

AAPI and URM n=378	Model with Gender x Race			Model with Gender x Race x SES		
	OR	**Sig.**	**95% CI**	**OR**	**Sig.**	**95% CI**
URM (Ref. AAPI)	0.63	*	(0.40, 0.98)	0.44		(0.19, 1.01)
Low SES (Ref. High SES)	1.14		(0.67, 1.97)	0.63		(0.29, 1.40)
Mid-SES	1.16		(0.67, 2.05)	1.35		(0.60, 3.07)
Economy Impacted Career Decisions (2011)	0.56	**	(0.37, 0.86)	0.58	*	(0.38, 0.89)
Inst. Control: Private (Ref. Public)	1.37		(0.89, 2.13)	1.37		(0.88, 2.13)
Inst. Type: 4-Year (Ref. University)	1.07		(0.64, 1.78)	0.99		(0.59, 1.65)
Inst. Selectivity: High (Ref. Mean SAT < 1150)	1.41		(0.86, 2.31)	1.38		(0.84, 2.28)
URM x SES						
URM x Low SES (Ref. High AAPI)				2.73		(0.93, 8.00)
URM x Mid-SES				0.87		(0.28, 2.70)
McFadden's Pseudo R2	0.0365			0.048		
Prob > Chi2	.009			0.004		
LR Chi2	18.91			24.60		

Note: *p < .05, **p <.01, ***p <.001

Putting Quantitative Findings in Conversation with Qualitative Narratives

To summarize the main effects of the quantitative findings, several of the models suggest that women who started college as first-time, full-time students in 2004 and earned STEMH bachelor's degrees were approximately half as likely to remain in STEMH compared to men. Additionally, those who indicated in 2011 that they were impacted by the economic recession were less likely to remain in STEMH in 2016. Institutional contexts also seem to contribute to career outcomes, with those who attended private institutions and universities more likely to remain in STEMH.

The results from examining interactions in the regression models reveal several nuances that were not captured by only examining main effects and require careful examination to tease out the differences. Since the findings indicate that AAPI women are more likely than White men to remain in STEMH, yet low SES AAPI women are less likely to remain in STEMH compared to high SES White men, this suggests a significant difference in experiences or socialization between mid/high SES AAPI women compared to low SES AAPI women. The marginal probabilities revealed that between AAPI STEMH bachelor's degree holders, AAPI low SES women were significantly less likely than AAPI men to remain in STEMH.

Lastly, in examining differences between URM women and AAPI women, regression results indicate that URM women with STEMH bachelor's degrees were approximately 40% less likely than AAPI women to remain in STEMH, though there were no differences in examining the interaction of racial/ethnic identity x SES. The following section brings in analysis from interviews with WOC in STEMH to understand what might be driving these differences in STEMH outcomes. I examine the experiences of AAPI low SES women, URM women, differences between URM and AAPI women's educational and career trajectories, the impact of

being a woman while navigating in the STEMH workforce, and end with how institutional contexts and the sociohistorical context of the recession impacted trajectories for WOC.

Experiences of AAPI Low SES Women. Four AAPI women and multiracial women with AAPI heritage identified as coming from working class families: Zoe, Carol, Leilani, Melissa. While these women made it into STEMH careers, their experiences shed light on how their socialized identities impacted their career trajectory. Overall, what helped these AAPI women remain in STEMH consisted of financial opportunities and pipeline programs.

Leilani, a Filipina engineer, grew up in a working-class household and a community where schools were underserved. She attributes her success in college to a member of her church community who paid for Leilani to attend a private high school to get a better high school education. Her church community also served to be helpful in that Leilani just really liked engineering and was afforded opportunities through a church group. Zoe was also able to move to better schools by following her best friend to a more well-resourced middle school than the one in her area. She also was able to attend a different high school: “I borrowed my grandma's address cause otherwise I would've just been sent to another school that was like in another poorer area, and that area maybe the education wasn't as good.”

Carol, a medical physicist of Chinese descent, grew up extremely poor and shared how she found a flyer that said that she would be able to get in-state tuition for a polytechnic university she wanted to attend outside of her own state, as long as she declared her major in nuclear engineering. Then, in her college career, she learned from people in her major that she could apply for a five-year MSBS program that made it easier for her to enter into graduate school for a medical physics program by streamlining the process:

> Since I found out about medical physics, somewhere in my first year, I think I applied for that program in my second year. I don't know the requirements were to get into the program. I guess you have to have a certain grade point average, then they even waive the GRE and all that. So I didn't even have to take the GRE. And I'm definitely the type of person that chooses the path of least resistance. So I applied and got in… It wasn't just necessarily the best medical physics program, I was just happy not having to take the GRE and study for it, apply for other schools because you know, [take the path of] least resistance.

For Carol, who felt motivated to do decently enough in school in order to get a good-paying job but was not necessarily tied to a specific STEMH career, this program made sense for her goals and priorities. She explains:

> I can't deny that my mother's influence, she definitely pushed [me and my sister] towards certain career types. But you know, we also came to realize that being in the STEMH fields did offer better pay. Also not to get into too much detail, but my home life was not great, and I wanted to get out. And I wasn't going to get out unless I was able to fend for myself somehow. So, um, that definitely lit fire under my butt.

Both Carol and Zoe pointed out the influence of their parents and how the challenges of immigrating to this country influenced the messages they received about the importance of school and career decisions. For them, a career in a STEMH field was partially motivated by a desire to achieve financial stability for both themselves and their families. Zoe shares:

> I got a lot of Pell grants and I qualified for government aid a lot. And I got a lot of scholarships too, so that was like never really a problem for me. Um, and then so after I

graduated and then I worked, I actually saved up a lot of money and I ended up buying a home for my family.

Differences Between URM Women and AAPI Women. WOC experience racism, sexism, and disadvantage related to socioeconomic status differently, which plays a role in shaping their pathways to STEMHH careers. While the qualitative analysis limited comparisons to AAPI and URM women, interviews from WOC reveal some more nuances. I expand upon how some WOC experienced different isolation than others, more complexly interwoven opportunities and challenges, and anti-blackness along the educational and career pathway. Isolation for Native American woman appears extremely challenging because of their representational isolation in STEMH fields. Maya, a Native American woman from a working class family, was working as a researcher and program director while preparing her medical school applications at the time of her interview. She had been aspiring to become an MD since she was young but encountered several people and failings of the premed advising system at her university that delayed her progress. She explains how her motivations for aspiring to work in healthcare as an MD are beyond individual career interests:

> I grew up on a reservation in Western New Mexico… And so I had all of my, you know, K-12 schooling there and I didn't have any opportunities to really know what it all took to study a science [field] to get into medical school. All I knew was that I wanted to be premed. I didn't know that premed wasn't a major. I had a lot of people behind me at a lot of people rooting for me. But our tribe, our Pueblo of about 11,000 people, we still have not yet produced a physician…And so I didn't have a role model really to look up to.

Maya participated in an internship program at an out-of-state children's hospital thanks to the recommendation by an English professor who took an interest in supporting Maya's medical

school career aspirations. However, she encountered problems with getting accurate information and advising for medical school applications:

> I was kind of told that you don't have enough of this or you don't have enough of that. And majority of it was, they said I didn't have enough clinical experience and they said I would have to be, I would have to work in a hospital or in a clinic to be able to fulfill that requirement. So although I shadowed physicians and got to do clinical research and you know, partake in clinic activities, they said it wasn't enough. So in order for me to try to get that experience, I sought out our hospital and they said, you know, well, you can't just come in here and work in the hospital and be in contact with patients. You need this, this, and this. And I said, okay, how do I get that? And they said, you need to go back to school. You need be a nursing aide … you know, get an RN degree in nursing degree or a nurse's aide.

Her isolation from other peers or mentors who could look out for Maya required her to rely on direction from advisors and staff who were not taking the time to comprehensively assess Maya's situation so that they could provide substantive guidance to help her get accepted into medical school. Instead, she got the runaround and this lack of support veered her off from her medical school aspirations as she followed their advice to get a nursing aid degree, and then work for several years because of the need to provide for herself and her family.

Latina women experienced simultaneous racist, classist, and sexist challenges, alongside opportunities provided through higher education such as structured programs targeted at URM students. This complex interplay of simultaneous oppressions and opportunities via programs designed to address systemic inequity impacted Latina women participants by both stalling progress toward STEMH careers, but also suggests how these programs serve as catalysts for

fostering strong STEMH interests for Latinas despite the overwhelming challenges they encounter.

Susana and Therese, both Latina microbiologists, had similar stories regarding the importance of programs in supporting their interests, and the challenges of navigating their STEMH career paths as they experienced the impact of racism and sexism. While in college, Susana encountered people who made comments that she was only accepted because of affirmative action (which did not exist at her undergraduate institution). She struggled, yet pushed on with her goals to study science despite moments where she lacked confidence because her grades were not as high compared to her peers, making her doubt her ability to be a scientist on top of already experiencing external racism causing her to doubt herself. She attributes her remaining in STEMH to mentorship she received during her post-baccalaureate program:

> Somebody encouraged me to apply to grad school and I didn't want to, I still really wanted to do like medical school or an MD/PHD or something. And then I applied to graduate school because I was in this post-baccalaureate program at [large R1 university] and I was doing research and my mentor was like, “Hey, just apply to graduate school.” And I was like, you know, I'm thinking of applying to medical school. And he was like, ‘Well it's part of your funding situation that you have to apply to at least one school.’ And I was like, all right, fine. And so I applied and I got in… and then I just didn't want to give up the opportunity because it is like a good opportunity and I really liked research. So that's how I ended up going to grad school.

Therese also benefited from working in a microbiology lab and having her interest in STEMH fostered by faculty, but despite her passion and amount of experience and training, she encountered racism at one of her early jobs as a lab coordinator at a meat-packing plant. The

company was hiring more positions and posted a job that would have supervised her current role at the time as the sole lab coordinator. Initially, she just thought they didn't tell her about the job for a number of unknown reasons. However, she found out that her racial/ethnic identity also contributed to the decision not to promote her:

> It didn't come from [management] directly, but I did hear through the grapevine exactly what had happened and it was that they didn't want to pay me more for--it came down to…it sounds really bad, but they didn't want to pay me more. And because of the fact that I was Hispanic it made it harder. Because of all the people that were--because it's a meat packing plant--the majority of the people that were working in the meat packing plant were Hispanic. There were very few people were Hispanic on the leadership [management]. So they viewed me more as a worker, and not as a leader.

A few WOC shared that they planned to leave the field because of dissatisfaction with the social environment from the compounding impact of microaggressions.

For example, Jessica, a Black chemist said, "I just have to like bare and smile. I need my paycheck. Right. Yeah, there's, it's been a very interesting experience and I'm really, I'm only 32 but I'm getting really just exhausted with all of it." She shared more about the challenges of her work environment for a government agency:

> It's been really frustrating actually. I feel like people around me are not very…like social justice, like [not aware] about all that stuff. I'm surrounded by predominantly white people and they're very comfortable and they're privileged in where they are. I just had a number of experiences, just the way things are said to me. Like comments that are made like, "I don't drive through that neighborhood. You know, it's a bad neighborhood." It's

just bad. You know, I'm reading the code in between that. I'm like, “Oh, that must be a black neighborhood”, you know, whatever.

Aside from daily racial microaggressions, Jessica went on to explain why the support systems at her workplace were also problematic:

> It's been really frustrating here lately because my contracting group has tried to do this diversity inclusion thing. They're like, “Oh yes, this is our first year and we have a group for retaining African American talent and the name of the group is called ‘Harambe’. Like the gorilla [in the zoo]. It was very offensive to me even if they are in the process of reclaiming that name. So I was like, okay, great. Here we go. So I go online and read the mission statement of this group. And it's typed by the leader of the group, which I believe is a black woman. They have these courageous calls… they were saying for this particular call that the goal of the call was to talk about experiences in the workplace as an African American and how to manage--how to properly manage our emotions and expectations... Like okay, so you're acknowledging that there is a problem, you are acknowledging that there's inequity, and then we have to talk about how we need to properly manage ourselves around other people's ignorance? So that was another thing that was like, wow ok. And you have this black woman writing this sentence and it's just up here online for people to see? And so that was a really big turn off.

Jessica’s frustration at work by her colleagues’ programs show that the priority of accommodating the White male majority by “properly managing emotions and expectations” is entrenched in her workplace climate.

While WOC experience racism in the STEMH workplace, a greater proportion of black WOC participants in this study shared more explicit acts of racism throughout their entire

educational and training trajectories. Anti-blackness is widespread in STEMH, just as in the rest of U.S. society. Toward the end of my interview with Jessica, she recalled another incident of anti-blackness and disregard and ignorance of symbols of slavery:

> I just did a training for my time card and this was the day that I like, I totally just like flipped my shit and like left because it was like, it was ridiculous. I was doing my time card and it said that there will be consequences for not completing your time card on time. And there was this some e-card-- that little company that does the little [meme] pictures [online], and there was a guy holding a whip and another man with his arms up in chains and his back was exposed. Yeah. So this is like corporate America, right? I did contact HR and [the representative] said, " I didn't get to look at that, it must have went through without my approval."

Impacts of Discrimination on WOC. While several women leave STEMH, the WOC who stay in the field have to deal with the intersectional challenges of harassment (Crenshaw, 1989). Intersectionality calls for analysis that might reveal how sexual discrimination is raced and how racial discrimination is gendered even though targets of discrimination might not explicitly make intersectional connections in reflecting on their experiences. For example, many WOC participants shared several stories of sexual harassment, ranging from daily microaggressions to sexual violence in both the workplace and during their graduate programs. Unsurprisingly, many of the examples came from WOC in more male-dominated fields, such as tech and medicine. Sanaa, a South Asian attending physician, shared several incidents of harassment that her and her women colleagues experienced during her medical school training in Texas, stating that "there are some pretty famous cardiothoracic surgeons in Houston, and some

of those guys--I mean they can literally get away with anything." Sanaa reflected on what she noticed regarding her responses to harassment compared to her fellow White women colleagues:

> In all my surgical rotations sexual harassment was rampant and I never said anything. And I think some of my female colleagues who didn't want to go into surgery—they didn't feel that as much because their motivations were different and so they would not stand for that kind of thing but my motivation was that I just needed to keep my mouth shut and get this done so I can get what I needed to move on to the next stage of my life. But it [sexual harassment] was everywhere and it was blatant.

Indeed, the choices can feel slim for WOC, especially when trying to aspire to stay in a certain field (e.g. surgery) while constantly navigating power dynamics in the field of medicine where White men are still predominantly in positions of power. An intersectional analysis of Sanaa's story would ask why her response to harassment was different from her White colleagues. For Sanaa, it was her desire to stay in surgery and belief that the only way to do so was to not expend energy on filing complaints every time she encountered harassment. While WOC might "stay" in a STEMH field and deal with harassment in order to stay in their desired career field, others take the strategy of shifting to other subfields in efforts to avoid hostile work environments, as in the women who avoid surgery to not be in a confined environment with sexist men. Yesenia, Brenda, and Noel all went into OB/GYN during their medical training, for example. Yesenia, a Black OB/GBYN resident in Chicago, shared how she initially wanted to go into Orthopedics, but eventually became drawn to OB/GYN and because she felt uncomfortable in the Orthopedics environment:

> My first rotation was OB/GYN and I just thought it was amazing because you get the run around and deliver babies and take out uteruses. It's really active and vibrant and elastic.

> And I didn't really like the environment of Ortho[pedics]. I mean those people aren't my people. I mean they're cool, you know, it was just too many men probably too much humor that's actually not funny. Conservative people. I mean those are generalizations of course. But I just felt myself, like I watch a lot of those people who became Ortho residents and they just look like they lost their joy. And so I'm a very joyful person and I didn't want it to steal my shine. So I said no thanks.

Yesenia shared that the gender ratio in her OB/GYN clinic was 7 women to 3 men, which is similar to the national statistic for residency of 83.1% women in obstetrics and gynecology (Long, Arendt, Elliott, & Rose, 2018). However, even with a high proportion of women in certain STEMH fields, not all environments feel welcoming for WOC. Brenda, a Black OB/GYN Reproductive Endocrinology & Infertility Fellow, reflected on the emotional challenges of her residency as well as the climate challenges regarding the lack of racial diversity at her residency compared to her medical school:

> OB/GYN I think is the worst because you have that baseline badness, but then you also have two lives in your hands. We have a baby's life in your hands and also the mom's life. And so that adds a layer of emotional stress… And then on the other side, when you're not doing OB, there's like gynecologic cancer you're dealing with. So it was just a very high emotional time…The other added layer is that it's physically demanding…So OB/GYN is just a really tough residency for all of those reasons. And then I also just didn't love being at UCLA. Um, it was very different from my experience at Duke. Duke was extraordinarily academic and extremely diverse and very collaborative and very genuine. And I felt like UCLA was not very [racially] diverse. People are very collegial. So that was not an issue. It wasn't like people were treated poorly for the most part or like

there was racism, but it just didn't feel like genuine and it wasn't diverse. I just, I didn't love it. So I was ready to get away after residency.

Similar to Brenda's experience, some of the WOC participants struggled to find words to explain the feeling of being *in* STEMH, but not *of* STEMH. These participants did not experience explicit acts of harassment or discrimination, yet felt like outsiders or just felt uneasy and unable to have genuine connections with peers or advisors during their training due to the lack of racial diversity in their environment.

A few participants identified themselves as multiracial women who "pass" for White women. Cat, a postdoctoral scholar in genetics, shared how she experienced discrimination during her STEMH training:

> I think the majority of discrimination has been almost entirely because I'm a woman. I don't think it comes from me being a person of color because only my middle name is Chinese, my first and last name are not. And I pass as fully white in most places.

Cat went on further to share her challenges as a woman who experiences privilege as a multiracial, white-passing woman from an upper-middle class and well-resourced family while simultaneously experiencing personal discrimination and observing structural oppression in her field:

> It's crazy to me because I simultaneously have the odds stacked against me while at the same time, I come from a massive amount of privilege…It's kind of like, if I can't make this work, like who the hell could? [For] anybody with less privilege? Like the cards are stacked against most people and I have less than a lot of people, but it's still ridiculous. My research focuses on health disparities and racial disparities in genomics. And they always say like, "Why don't we have better representation for women, and women of

> color and people of color in the research?"…If you have stakeholders doing the research, the more of it gets done. You look around this room and I'm involved in these NIH efforts to reduce health disparities. And it's all older white folks. A lot of them are actually from Europe and not even from the states. Well, you know, the irony isn't lost on me that we're at this meeting and we don't have a lot of diversity in terms of the researchers.

Social identities interacting with institutional contexts. From the quantitative analysis, students who earned their STEMH degree at private undergraduate institutions were more likely to remain in STEMH than those who attended public institutions. Additionally, students who went to four-year master's comprehensive institutions were less likely to be on a STEMH career path. Related to social identities of WOC, institutional context such attending an MSI was powerful for Ayanna, a Black research project manager at a cancer research lab. She reflected upon why she was still in STEMH and partly attributes her retention to her undergraduate experience at a private HBCU. She shared that she felt prepared and was not fazed by the negative racial experiences she has had in her current PhD program:

> And I think at Howard, they taught us that. "Ain't nobody gonna love you the way we love you, boo." And I'm grateful for it. And that's why I don't care about [Current graduate program institution]. If you look at my car and anything that I have, nothing says [graduate program institution]. Everything is Howard, cuz Howard's most important. Howard was the best.

Sociohistorical Context of the Recession. The unemployment rate during a survey conducted in 2012 found that only 51% of bachelor's degree earners who graduated between 2006-2011 were employed full-time, with only 4 in 10 reporting that their job required a

bachelor's degree (Stone et al., 2012). In other words, STEMH bachelor's degree earners during this time period may have also faced the challenge of being underemployed in a STEMH field for their first jobs after graduating from college.

Considering this group graduated with their bachelor's degrees at the beginning or midst of the Great Recession, WOC interview participants fell into two groups—those who perceived feeling lucky that they obtained jobs right before the nation felt the full effects of the recession, and those who experienced extreme difficulty obtaining STEMH jobs and already experiencing the lack of job opportunities due in part to the recession. June, a Filipina American chemical engineer, shared how she felt fortunate to get hired right before jobs got scarce and how her company fared during the recession:

> I graduated in 2008. It's probably the last group of grads that got jobs right after college. I ended up at an engineering firm in Chicago. They hired me right before graduation, so I was feeling pretty good. As far as the job was concerned, it was so great because they were hiring a bunch of college graduates…There were I think four of us, um, that got all hired … like as college grads. Toward the end of 2008 into 2009, there were a lot of people being laid off…I was just happy to have a job so I kind of just learned as much as I could and I stuck with it…Lots of people were still trying to find work. [The company] ended up having to lay people off and that kind of thing, but it wasn't until probably like 2011, 2012 so, um, but yeah, at that point I had already been there for a while. As long as we were doing our job well, they weren't firing any of us.

Comparing experiences of the participants to data, the unemployment rate for college-educated STEMH professionals was slightly higher than the rate for their non-STEMH counterparts in 2009, but the unemployment rate converged to 4.7 percent in 2010 for both STEMH and non-

STEMH groups (Langdon et al., 2011). Rae, a Latina woman who came from a low-income family, was involved in several high school and undergraduate research programs aimed at supporting underrepresented racial minorities in STEMH. However, when she graduated in 2008, which she sarcastically called the "best year ever" to transition from college to the STEMH workforce:

> I feel like going to college was kind of sold to us in this like, hey, if you had a college or have this great job waiting for you when you're done, like that's what's going to college is for. So it's my last year, it's April, I'm going to start looking into planning and putting my name out there. And I was feeling really confident, especially with all of the experience that I've had thanks to the university programs. And it just wasn't happening… I remember applying for things that I was overqualified for… even just like washing scientific equipment and like dishes basically, like washing all the beakers and stuff…at least if I could get my foot in the door, you know?...A lot of the job postings were requiring a master's or a PhD at that point. Um, and I tried for about three years.

Due to her need to earn income, Rae eventually took a job in retail in September of 2008:

> I actually got picked up by [Coffee retail company]… I would look every so often [for STEM-related jobs]. I actually never scored an interview. I was taking community college classes… anatomy and physiology and like speech, just kind of like random things, that I would see what people were looking for in some of the job postings… It was actually really demoralizing. It was a pretty hard time, pretty rough, like three years after graduation, you know, and it was my parents or my family asking me like when I'm going to get a real job… So at that point, I was like, all right, I can make more money being a manager than going back into science.

Rae's departure from STEMH is troubling because she was highly interested in a STEMH career, had significant training and research experience upon graduation, and put in significant effort to search for STEMH-related jobs over the span of three years. Upon reflection regarding what else made the STEMH-career search process challenging, Rae shared:

> I think if you're not in a lab, you know, you kind of lose a lot of that like technique. I mean, it's not like I have a bunch of pipettes and beakers and stuff to play around with in my house. So [after a few years] I really felt like a new graduate would have an upper hand compared to me. And so I just kind of let it [STEMH career aspiration] go.

Considering race, class, and gender in understanding systems of oppression, Rae's narrative as a low-income Latina woman points to the confluence of her identities shaping her career decisions, the lack of career options afforded to her after graduation,

Implications for Research and Practice

Quantitative Critical Methods (QuantCrit) aims to utilize statistical analysis for social justice aims. This paper shows how QuantCrit used in a mixed methods design can reveal important intersectional findings that would have otherwise been missed by quantitative methods that do not approach a problem from a critical nor intersectional lens. Both longitudinal data and qualitative data can contribute to providing a better story to compensate for the limitations in the other method. In this study, for example, the quantitative analysis could be critiqued for being problematic due to aggregating URM women. However, qualitative interviews can provide important information about differences in socialization, opportunities, and strategies for resistance employed by WOC based on their ethnic/racial identity.

Additionally, without the quantitative data, it would not have been possible to see social locations of inequity like in the case of AAPI low income women. In higher education, and

especially in STEMH education, research questions often examine URM students because Asian American students are not underrepresented. This QuantCrit mixed methods approach allows for a richer understanding of unique challenges facing AAPI women and contributes to dismantling the model minority myth and stereotypical assumptions that faculty and employers might have of AAPI women.

While STEMH pathway retention outcomes for WOC are similar to that of White women compared to Men of Color, the qualitative data indicate that WOC's experiences are laced with layers of additional racial/ethnic barriers. Whiteness and its privileges can be seen from the self-identified "White-passing" multiracial women in the study who found themselves experiencing a unique vantage point of bearing witness to racism whereas other WOC in the study often second-guessed or questioned but were not always sure whether they were being treated differently. QuantCrit provides a richer understanding of the origins of the data in order to contextualize the study with a lens focused on revealing and being transparent about oppression even within the study. While rigorous methods are important, however a focus on statistical significance can lose sight of practical significance. The benefits of a QuantCrit mixed-methods approach allow researchers to explain why they may or may not have found significant findings in their quantitative analysis.

Whether through quantitative or mixed methods, it is important to keep in mind that intersectionality research and QuantCrit methodologies should be used for racial justice (Harris and Patton-Davis, 2019), which means examining systems of inequity, not simply identities, and striving to avoid further harm to marginalized communities through deficit analysis and faulty logic in all aspects of the research process. Attempting to simultaneously address limitations of quantitative research and refrain from committing further harm to marginalized communities is a

challenging, yet vital direction for the future of research. The strengths of QuantCrit include the expansion of quantitative methods to researchers who ascribe to epistemologies that are not typically associated with statistics research (i.e. postcolonial, feminist, etc.). In other words, QuantCrit provides another way to do quantitative research especially for scholars who are interested in racial justice but have rightful concerns about the ways quantitative data has been used in past.

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Appendix A

Table A-1

Programs for Past and Current Graduate Degrees

STEM Graduate Programs	Biology, Animal Biology (zoology), Botany, Marine Biology, Microbiology, Molecular, Cellular and Developmental Biology, Neurobiology/Neuroscience, Plant Biology (botany), Agriculture/Natural Resources, Biochemistry/Biophysics, Environmental Science, Other Biological Science, Computer/Management Information Systems, Aerospace/Aeronautical/Astronautical Engineering, Biological/Agricultural Engineering, Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical/Electronic Communications, Engineering, Engineering Science, Physics, Environmental/Environmental Health Engineering, Industrial/Manufacturing Engineering, Materials Engineering, Mechanical Engineering, Other Engineering, Clinical Laboratory Science, Computer Science, Mathematics/Statistics, Other Math and Computer Science, Astronomy & Astrophysics, Atmospheric Sciences, Chemistry Earth & Planetary Sciences, Marine Sciences, Physics, Other Physical Science
Healthcare Graduate Programs	Health Care Administration/Studies, Health Technology, Kinesiology, Nursing, Pharmacy, Therapy (occupational, physical, speech), Other Health Profession

Table A-2

STEM and Healthcare Occupations in 2016

STEM Occupations	Natural Resource Specialist/Environmentalist, College Faculty, Computer Programmer, Developer, Computer Systems Analyst, Engineer, Research Scientist (e.g., Biologist, Chemist, Physicist)
Healthcare Occupations	Dietician/Nutritionist, Home health worker, Medical/Dental Assistant (Hygienist, Lab Tech, Nursing Asst.), Registered Nurse, Therapist (e.g. physical, occupational, speech), Clinical Psychologist, Dentist/orthodontist, Medical doctor/surgeon, Optometrist Pharmacist, Veterinarian

Table A-3

Results for Socioeconomic Status Factor Analysis

Construct/Item	**Mean**	**SD**	**Loading**	**α**
Father's highest level of education	5.99	1.93	.819	.719
Mother's highest level of education	5.78	1.82	.753	
Parental Income	9.34	2.88	.574	

Note: Scale of three items: Mother's education (1=grammar school or less to 8=graduate degree); father's education (1=grammar school or less to 8=graduate degree); and parental income (1=less than $10,000 to 14=$250,000 or more). Cut points were created to make three evenly distributed groups (low, medium, high).

Table A-4

Women of Color Interview Participants (n=39)

Name	Race/Ethnicity	Family Income	Occupation in 2018
Sara	API	Middle	Healthcare/MD
Vicki	API	Middle	Optometrist
Sanaa	API	Upper Middle	MD, Attending Physician
Pia	API	Middle	Graduate Student and Data Scientist--Public Policy, Criminology
Mia	API	Upper Middle	Product Manager, Technology Sector
Yesenia	API	Upper Middle	MD, OB/GYN Resident
Carol	API	Low	Medical Physicist
Leilani	API	Low	Aerospace Engineer
Gabriela	API	Middle	Electrical Engineer
Zoe	API	Low	Pharmacist
Aya	API	Upper Middle	Mechanical Engineer
Annabelle	API	Upper Middle	MD, Pediatric Rehabilitation Fellow
Connie	API	Middle	MD, Primary Care Physician
June	API	Middle	Chemical Engineer
Katherine	Black	Middle	User Researcher--Information Technology
Jessica	Black	Low	Chemist
Heather	Black	Middle	Research Associate, Epidemiology and Biostatistics
Noel	Black	Middle	MD, OB/GYN Maternal Fetal Medicine Fellow
Espie	Black	Low	Engineer

Dorothy	Black	Middle	Dentist
Ayanna	Black	Middle	Project Manager, Cancer Center Research Lab
Brenda	Black	Middle	MD, OB/GYN Reproductive Endocrinology & Infertility Fellow
Mary	Black	Middle	Epidemiologist
Jackie	Black	Middle	Nurse Practitioner
Lety	Latina	Middle	PhD Student--Neuroscience
Maria	Latina	Low	Science Teacher, K-12
Susana	Latina	Low	Microbiologist
Therese	Latina	Middle	Microbiologist
Rae	Latina	Low	Area Manager, Technology Sector
Ana	Latina	Low	Science Teacher, K-12
Olivia	Multiracial	Middle	Research Scientist, Chemistry
Mae	Multiracial	Middle	Chemistry teacher
Melissa	Multiracial	Low	Civil Engineer
Heidi	Multiracial	Middle	Environmental Chemist
Cat	Multiracial	Upper Middle	Postdoctoral Scholar--Genetics
Katrina	Multiracial	High	Faculty, Genetics
Ashlee	Multiracial	Low	General Manager, Technology Sector
Midge	Multiracial	Middle	Faculty, Physics
Maya	Native American	Low	Environmental Health Researcher and Community Programs Coordinator

Appendix B

Demographic Screening Survey

Pseudonym:
What is your age?
What city and state do you live in?
What is your current occupation?
In what STEMH field would you classify your occupation?
What degree is your highest level of education?
What college did you attend for your undergraduate degree?
What was your undergraduate major?

How do you identify?
Race:
Ethnicity:
Gender:
How would you define your socioeconomic class?
When you were growing up:
Now:

Appendix C

Interview Protocol

As this is a semi-structured interview these are guiding questions; not all question may be asked, and question may not be asked in this exact order. Follow-up question may also emerge during the conversation

Thank you for agreeing to participate within this study and share your experiences with me. Please know that you participating is voluntary and you reserved to stop the interview or withdraw from the study at anytime.

I. BACKGROUND & EDUCATION HISTORY

1. Please state your name and current role/occupation for the recording.
2. What careers in STEMH did you aspire to in college?
    a. Probe: How was your career aspiration supported in college?
        1. Probe: Were there any influential people or events that sparked or reinforced this interest?
    b. What was your major? How did you decide to major in (insert major here)?

II. INTERSECTIONALITY IN COLLEGE AND STEMH WORKPLACE

3. In thinking about your race/ethnicity, gender, socioeconomic status, or other parts of your identity, what identity or identities were you most aware of in college?
    a. Probe: Have you ever experienced discrimination because of your (sex, gender, race, class) identity while in college?
        i. Probe: What was the nature of the discrimination?
        ii. How do you think your college experiences are similar or different compared to students who differed from you in either their race/ethnicity, gender, or socioeconomic class?
4. What curricular, co-curricular, interaction with peers or interaction with faculty were you involved in and how did they contribute or deter you from your STEMH career goals? (Probe for any specific programs, people, or courses).
5. What college experiences, academic or social, were most critical to the reason why you are in a STEMH-related career today?
    a. Probe: how did confidence impacted your experience in your major and/or in your career trajectory.
    b. Probe: how did faculty supported or guided your experience in your major and/in your career trajectory.
6. In thinking about your race/ethnicity, gender, socioeconomic status, or other parts of your identity, what identity or identities were you most aware of now in your field of work?
    a. Probe: Have you ever experienced discrimination because of your (sex, gender, race, class) identity in the workplace?
        i. Probe: What was the nature of the discrimination?

7. What resources, training, or support do you find most critical to the reason why you are in a STEMH-related career today?

III. REFLECTION

8. What are your thoughts on underrepresentation in the STEMH workforce?
    a. Probe: What is it like for minority women in particular?
    b. Probe: What does it mean to you to work in a STEMH-related career?
    c. Probe: What lessons have you learned from your experiences in college and since college about working in the STEMH field?
    d. Probe: What advice would you give to college students aspiring for a STEMH-related career who share a background and upbringing similar to yours?
9. Is there anything else that you would like to share that I have not asked you?

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CHAPTER 4

Multiple Pathways, Shared Struggles:

Understanding STEM and Healthcare Career Development for Filipina American Women

"Makibaka! Huwag Matakot!"
[Dare to struggle! Do not be afraid!]

Introduction

In 1936, medical student Fe Del Mundo, stepped foot onto Harvard's campus. Graduating as valedictorian of her college class in the Philippines, she received a full scholarship to study at any university in the United States. However, upon her arrival to campus, Del Mundo was surprised to find herself assigned to an all-male dormitory. University officials were also surprised that Del Mundo was a woman. And thus, by accident, Fe Del Mundo became the first woman and first Filipina student to be admitted into Harvard Medical School (Engel, 2013). Del Mundo's story reflects several themes and contextual issues that reveal inequality in higher education. First, it highlights the history of women barred from access to advanced education in the sciences. Second, it provides visibility for Filipina women who aspire to obtain Science, Technology, Engineering, Mathematics, and Healthcare fields (STEMH) in the United States. Third, Del Mundo's story draws attention to international agreements that reflect both colonialism and U.S.-Philippine selective immigration patterns via the structures set up that provided her with the opportunity to earn a scholarship to attend any university in the U.S.. Taken together, these themes continue to have implications for modern-day Filipina women aspiring to obtain STEMH careers.

Knowledge about what propels Filipina American women into STEMH fields today remains relatively unknown and understudied. A call to increase the capacity for STEMH jobs nationwide (NASEM, 2011; National Research Council, 2010; Olson & Riordan, 2012), depicted

the need for changing practices in order to meet the urgent need for U.S. trained STEMH workers. To answer the charge, researchers in higher education have focused on how college contexts can broaden and diversify the STEMH workforce. However, much of the literature focuses on increasing the proportion of Black, Latinx, and Native American students, or underrepresented racial minorities (URMs). Asian Americans as an aggregate group are considered overrepresented at all levels of the STEMH pathway to the workforce (Victorino, 2016). However, research that aggregates Asian Americans tends to focus on East Asian Americans (i.e. Chinese and Japanese Americans) (Agbayani-Siewert, 1994; Nadal, 2004), resulting in neglect of underrepresented Southeast Asian groups (e.g., Vietnamese, Asian Indians, and Filipina/os) whose needs remain unknown or unmet (Nadal et al., 2012). One study of disaggregated data revealed that Southeast Asian, Filipina/o, and Pacific Islander students are underrepresented in STEMH environments (Chinn, 1999), suggesting that Filipina/os likely continue to be underrepresented today. Unfortunately, disaggregated data for Asian Americans is not often collected or reported nationally (Maramba, 2011; Ramakrishnan, Junn, Lee, & Wong, 2011) and Asian American data disaggregated by racial/ethnic subgroup and gender is even more difficult to obtain.

Although the number of Filipina American women in STEMH is not easily accounted for, there are, at minimum, estimates of Filipina/os living in the United States. In 2017, there were over four million Filipina/os living in the U.S. (U.S. Census Bureau, 2017), which accounts for 18% of the total Asian population in 2017 and the second largest Asian/Pacific Islander group behind Chinese individuals (Lopez, Ruiz, & Patten, 2017). Furthermore, Filipina/os are the third largest immigrant group in the U.S., just behind Mexicans and Chinese (Ocampo, 2016). Thus, considering such a large population of Filipina/o individuals living in the U.S., their

invisibility in both national STEMH data and in research on STEMH education is troubling. The lack of knowledge about this group, especially with respect to STEMH workforce outcomes, serves as an opportunity to study Filipina/os living in the U.S.

In addition to addressing the invisibility of Filipina/os in STEMH education literature, an urgent need exists to focus specifically on Filipina American women. Women of color (WOC) remain underrepresented in the STEMH workforce in the U.S. (Alfred, Ray, & Johnson, 2019; Williams et al., 2014). Considering the sizeable number of Filipina/os living in the U.S., and the fact that WOC are expected to become the largest proportion of the U.S. population by the year 2050 (U.S. Census Bureau, 2014), Filipina Americans will make up a substantial proportion of the U.S. population. Yet, they are likely to be significantly underrepresented in STEMH fields if the status quo remains.

Finally, immigration patterns from the Philippines to the U.S. contribute to the uniqueness of the Filipina/o American experience. The Philippines is the only Asian country that experienced direct U.S. colonization, having been a commonwealth from 1898 until 1946 (David & Okazaki, 2006). Filipina/o educated professionals in healthcare generally (Kanjanapan, 1995), and nursing specifically (Choy, 2003), migrated to the U.S. at rates higher than any other immigrant group due to policies that fast-tracked educated professionals to meet U.S. labor needs. Further, migration patterns after 1965 consist of two distinct cohorts that differ in their educational attainment and socioeconomic status (Liu, Ong, & Rosenstein, 1991). Less is known about how the migration of highly-trained Filipina/o professionals influenced the career trajectories of the subsequent generation born in the U.S. This study sheds light on these origins for Filipinas in STEMH-related careers.

While Fe Del Mundo's story is in the past, the ever-growing number of WOC interested in STEMH nationwide is the narrative of both the present and future. Studies have explored career choices for Asian American students (Poon, 2014) and perspectives of Filipina Americans in college (Maramba, 2008; Wolf, 1997). Collectively, these studies suggest patriarchal norms and family influence uniquely impact Filipina American women's college experiences. However, Filipina American women's voices have been largely absent from the STEMH education discourse at the national level. Given the need to increase the number of STEMH workers in the U.S., it is important to examine how Filipina American women's unique backgrounds, socialization, and college experiences shaped their pathway into a STEMH career.

Purpose

The purpose of this study is to examine how Filipina American women's multiple social identities and college experiences shaped their pathways into STEMH careers. To do this, I employed a qualitative study to capture the journeys of Filipina Americans who currently work in a STEMH or Allied Health occupation. I analyzed their journeys through the theoretical lens of intersectionality (Crenshaw, 1989; 1991; Núñez, 2014), that posits social identities, systems of oppression, and historical context are complexly interwoven and must be examined simultaneously to truly understand unique perspectives, social status, and social problems. Accounting for shared gender and cultural/ethnic identity allows an opportunity to examine how social identities such as class, immigration status, and college experiences play a role in shaping a career pathway into STEMH. Thus, the intentional focus on Filipina American women serves as an anchor that allows for an empirical study of a finer intersection of social categories and lived experiences (McCall, 2005). The study is guided by the following research questions:

Research Questions

1) What are the career pathways of Filipina Americans who work in STEMH careers?
    a. How do their social identities shape STEMH career pathways?
2) Reflecting on their pathways, what are the college experiences Filipina American women believe helped or hindered their STEMH career trajectories?

Framing the Study of Filipinas in STEMH

Intersectionality as a Guiding Framework

In the 1970s, the notion of additive oppression was a dominant paradigm in feminism and in research on WOC. For example, the "double jeopardy" theory (Beale, 1979) argued that the greater the number of marginal categories to which one belongs, the greater the number of disadvantages one will experience. In other words, being a woman + being a person of color = the doubling of oppression within STEMH. In contrast to double jeopardy, feminism has evolved over the past few decades to coopt intersectionality, a framework for understanding how multiple social identities of individual experience reflect and are embedded in interlocking systems of privilege and oppression at a societal level (Crenshaw, 1989; 1991).

Intersectionality urges researchers to conceptualize social categories as "differentially experienced, fluid, and mutually constituted" (Hunting, 2014, p. 8). It allows the researcher to think beyond categories as additive or isolated, create space for the complexities of identity and life experiences, and potentially reveal which intersections and processes are most salient in a given context (Hankivsky & Grace, 2014). Applied to this study, certain social identities may be more salient than others in impacting Filipina American women's STEMH career trajectory decisions. Intersectionality has been applied to study marginalized groups in STEMH (Charleston, Adserias, Lang, & Jackson, 2014; Ko, Kachchaf, Ong, & Hodari, 2013; O'Brien, Blodorn, Adams, Garcia, & Hammer, 2015; Ong 2005; Ong, Wright, Espinosa, & Orfield, 2011).

For example, researchers have examined the isolation of Black women undergraduate and graduate students in computer science (Charleston et al., 2014), the effects of gender and race stereotypes between African American and European American college students aspiring to major in STEMH (O'Brien et al., 2015), and the unique experiences of WOC in physics (Ong 2005).

Intersectionality can be used as an analytic tool to examine the unique experiences of Filipina American women in STEMH, as well as the differences of experiences within this group as a result of differences in other identities (e.g. socioeconomic status, education level, etc.) For example, the matrix of domination (Collins, 1990) is useful in considering privileged and oppressed identities of Filipina women. A sociological concept derived from Black Feminist theory, the matrix of domination posits that systems of oppression are not additive, but interlocking parts of one overarching structure of domination with multiple levels (individual, community, and systemic). Systems of oppression cannot be quantified, but are instead viewed through a matrix to see commonalities in sources of inequality in specific contexts. A Filipina American woman in a STEMH career may have benefited from having the support and influence of a parent who immigrated to the U.S. from the Philippines with a professional healthcare degree. However, she might simultaneously experience gendered challenges from both her family and masculine cultures found in STEMH fields. This nuanced analysis of simultaneous oppressions and privileges can provide a clearer perspective of how inequalities are experienced and can be addressed.

Filipina Americans in STEMH

Efforts to increase representation of underrepresented minorities in science acknowledge that the experiences of WOC in STEMH are rooted in structural inequalities based on the

intersections of gender and race (Espinosa, 2011; Wilkins, 2017). Extensive research has documented the negative impacts of racism and sexism for WOC in STEMH that contribute to their underrepresentation (Espinosa, 2011; Figueroa & Hurtado, 2013; Foor, Walden, and Trytten, 2007; Johnson, 2007; Malcom, Hall, and Brown, 1976; Malone and Barabino, 2009; Ong, 2005; Ong, Wright, Espinosa, and Orfield, 2011; Wilkins 2017). However, because Asian Americans as an aggregated group are typically considered overrepresented in STEMH, empirical studies on specific racial/ethnic groups of Asian Americans are scarce (Vogt, 2005). This dearth of literature as a result of their perceived overrepresentation plays into the "model minority myth", the belief that Asian Americans are well-educated and successful in the U.S. (Suzuki, 2002). This myth poses an additional challenge to Filipina Americans for two reasons. First, the model minority myth is a stereotype that is detrimental to Asian Americans who do not share the same origins, racial, ethnic, or representation status (Nadal, Pituc, Johnston, & Esparrago, 2010). In this case, the stereotype unfairly leads to the invisibility of the needs, challenges, and experiences of Filipina American women within the STEMH education discourse. Second, the myth is especially challenging for Filipina Americans who may reject an Asian American identity due to looking phenotypically different, and holding varying cultural values from their East Asian counterparts (Nadal, 2004).

Despite the general dearth of literature on Asian American and Filipina American women in STEMH education, there is research on challenges to promotion and barriers to obtaining leadership positions once Asian Americans enter the STEMH workforce. In 2011, Wu and Jing reported that 80% of Asian STEMH women in academia were in non-faculty positions, such as postdocs, researchers, and lab assistants, or non-tenured faculty positions. Further, 95% of Asian women in industry and over 70% employed in government were employed in non-managerial

positions. Indeed, “the scarcity of Asian women in upper management and leadership positions merits greater attention, more targeted programmatic efforts, and inclusion in the national discussion of the STEMH workforce” (Wu & Jing, 2011, p. 82). While not focused specifically on U.S.-born Asian women, these findings indicate the additional challenges Asian American may have when they do not see themselves represented among colleagues and/or leaders within their STEMH field.

Filipina American women face several challenges due to racialized and gendered socialization. Wolf (1997) conducted a study of Filipinx college students and found gendered differences in the upbringing of daughters of Filipinx immigrants whereby Filipinx families exerted additional control over women’s educational aspirations by encouraging academic achievement, yet limiting or pressuring daughters to stay at home for college in order to exert cultural and religious beliefs to control their bodies and sexuality. Another study examined Filipina American college women to understand their experiences as they negotiated gender, ethnic identity, family, and college; the author found themes of simultaneous gendered expectations, with family pressure to do well in school, while also maintaining duties at home that differed from other males in the household (Maramba, 2008). Together, these studies underscore gender inequity passed on to the American-born generation, as well as the unique messages about education that Filipina women received while growing up.

Multi-Level Model of Intersectionality

In addition to examining how privileged and oppressed identities shape experiences at the individual, community, and systemic level, an intersectional examination of Filipina women must also take into account the importance of historical context due to the accumulated impact of colonization, imperialism, and globalization. Anne Marie Núñez (2014) drew on the work from

sociologist Floya Anthias (2013) to conceptualize a multilevel model of intersectionality that "addresses societal arenas where dynamics of identity, power, and history play out to shape educational experiences and outcomes in differential ways" (p. 87). Consisting of concentric circles, the first level and core of the model includes social categories and relations, which influence the development of social positions, division, and hierarchies. Núñez states, "because social categories are not neatly bounded due to individuals' multiple identities, within- and between-group comparisons are appropriate when exploring influences on societal inequality" (Núñez, 2014, p. 87). Anchored in race/ethnicity, gender, and career field, I examined patterns across the entire group of Filipina Americans in the study, as well as differences between each individual based on their social locations.

The second level of the model refers to practices within domains of society that contribute to inequality. These domains include "(a) organizational (e.g., positions in structures of society such as work, family, and education), (b) representational (e.g., discursive processes), (c) intersubjective (e.g., relationships between individuals and members of groups), and (d) experiential (e.g., narrative sensemaking)." (Núñez, 2014, p. 88). The third level, called "historicity," situates the group or individual in the historical context to understand how aspects of the first and second levels of the model are constructed in specific places and times. Applied to this study, race/ethnicity, gender, the legacy of colonialism, and immigration history are important to the examination of Filipina American women in STEMH careers. For example, immigration history and U.S. policies have helped to shape educational attainment and class status for this racial/ethnic group and their descendants. The next section expands upon the third level of the intersectionality model—historicity—by providing context for the impact of colonization on the Philippines and on individuals of Filipina/o origin or descent.

Historical Context: Filipina/o Migration in the United States. The unique history of U.S. colonization and Filipina/o migration to the U.S. is important to better understand the current climate that Filipina American STEMH workers may encounter. The Philippines was a formal U.S. colony from 1898–1946 (Buenavista, 2010). The history of colonization has significant lasting impact for the Filipina/o community, most notably summed up in the concept of a *colonial mentality*, "a term used widely by ethnic studies scholars and by the Filipina/o American community to refer to a form of internalized oppression among Filipinxa/o and Filipina/o Americans" (David & Okazaki, 2006, p. 1). For Filipina/o immigrants and the American-born children of immigrants, it is likely that the psychological legacy of colonialism continues to exist, and operates by cementing the notion of U.S. superiority over the Philippines and Filipina/o culture (Espiritu, 2003). For example, in a quantitative study examining colonial mentality and its relationship with racism and sexism for Filipina women, Felipe (2016) found that approximately one third of Filipina American women sampled in the study embodied some degree of colonial mentality related to both sexism and racism. The author's suggest that Filipina American women's continued experiences with racism and sexism lends to internalized inferiority. Considering STEMH fields, where racist and sexist oppression is prevalent, Filipina women with a high degree of colonial mentality may not perceive that they encounter sexism or racism.

The other manifestation of colonization is the subsequent diaspora of Filipina/os to work around the world, especially in the U.S. (San Juan, 1994). Exposure to White American culture via colonization, "created a workforce on which the United States continues to rely, and has led to the mass movement of Filipina/os to the U.S. (Buenavista, 2010, p. 116). Among all Asian immigrants with professional degrees who immigrated to the U.S. during 1988-1990,

approximately 26,000 professionals came from the Philippines alone (Kanjanapan, 1995). Liu and colleagues (1991) examined Filipina/o immigration to the U.S. after 1965 and identified two major chains of Filipina/o migration. Furthermore, they found that the basic differences in socioeconomic position and educational attainment distinguished the two chains. One group of migrants was made up of Filipina/os coming to join family members already living in the U.S., while the second chain consisted of highly-trained and educated professionals. Due to a shortage in medical personnel in the U.S., policies were changed that encouraged a large number of educated Filipina/os in the health professions to immigrate to the U.S. (Kanjanapan, 1995; Reimers, 1985). Filipina/os are now especially overrepresented in nursing. Choy (2003) examined the reasons for massive Filipina/o migration to the United States to fulfill a nursing labor shortage, explaining that the culture of American imperialism continues to persist and affects how Filipina/o nurses are received in the U.S. today. In terms of perceptions, colonial mentality is pervasive within the Filipina/o community, although less is known about how this phenomenon specifically impacts Filipina American women in STEMH. Moreover, it is likely that the immigration policies and patterns skew the STEMH career interests of Filipina American women toward healthcare professions.

Careership. To understand how second level contextual forces contribute to shaping Filipina women's identity and career decisions, I draw from the concept of careership developed by Hodkinson and Sparkes (1997). Careership is a sociological theory of career decision-making that acknowledges the role of social and cultural factors within individual's career choices and merges individual preferences with opportunities to which the individual is exposed. According to this theory, *how* career decisions are made matters in addition to the types of decisions made. For example, "Siann & Knox (1992) argue that Muslim girls are more likely to see decision-

making as a collective decision, by and for the family, than were girls of non-Muslim beliefs" (Hodkinson & Sparkes, 1997, p. 34). This illustrates intersectionality in career decision-making by showing how family and cultural influence can be salient for specific groups based on their multiple social identities such as ethnic identity, gender, and religion. Considering the important role of family for Filipinx college students (Maramba, 2008), it is likely that Filipina women will also perceive career decisions to also be a collective decision. Finally, the model "opens up useful perspectives on wider sociological issues such as the nature of identity, the relationship between structure and agency, and even qualitative research methodology" (p. 41), which aligns with this study's goals of understanding the role of Filipina women's multiple identities and the interplay between the contextual forces (e.g. parents' careers, the role of family influence, college experiences, workplace culture, etc.) and women's agency.

College as a Critical Site for Intervention. The college environment is a critical second level context, involving organizational aspects, interactions (intersubjectivity), and experiences where students' science identity and Filipina American women's social identities are formed and reinforced or disrupted. Specific college contexts (e.g., level of selectivity and experiences of racial stigma) influence STEMH degree completion (Eagan, Hurtado, Chang, 2010; Hurtado, Cabrera, Lin, Arellano, Espinosa, 2009), and likely influence the rest of Filipina women's career trajectories. Research on diversifying STEMH is beginning to explore the unique experiences and interventions that better serve WOC throughout various points in their educational and career pathways (Borum & Walker, 2012; Carlone & Johnson, 2007; Espinosa, 2011; Rodriguez, Cunningham, & Jordan, 2017). This suggests that WOC's increased interest in STEMH and subsequent attrition in college can possibly be solved by addressing college experiences and contexts that might increase their persistence while simultaneously acknowledging systems of

domination that are also at play. Specifically, such issues as joining STEMH-related student organizations (Espinosa, 2011), frequently engagement with peers to discuss course content (Borum & Walker, 2012; Espinosa, 2011), receiving recognition as a scientist by meaningful others (Carlone & Johnson, 2007), connections to family (Rodriguez, Pilcher, & Garcia-Tellez, 2019) and mentorship (Borum & Walker, 2012) indicate WOC success in STEMH retention. However, the majority of large scale studies in STEMH only indicate the differences between underrepresented racial minority (URM) men and women, and or do not disaggregate Asian groups because the numbers of Filipinas in most colleges are relatively small.

On an individual level, minority students in STEMH graduate programs reported that an ethic of care shown by faculty was paramount to their persistence (Figueroa, 2015). Faculty support reinforces students' belief in their ability to become a STEMH professional in their field (Coldbeck, Cabrera, & Terenzini, 2001). For WOC in particular, positive recognition from a faculty member can draw students further into their STEMH domain of study (Carlone & Johnson, 2007). On an institutional level, the following were found to be important to minority graduate student success: an institution's financial resources allocated to STEMH departments, federally-funded programs that provided tuition, fees, and socialization opportunities for graduate students, and discipline-based student organizations on campus (Figueroa, 2015).

Research Design and Methodology

Data Collection and Methods

The objective of this study is to implement a retrospective analysis that highlights the relationship between gender, class, and ethnicity among Filipina women working in STEMH. This study used a subset of seven Filipina-American STEMH professionals from a larger data collection of 39 WOC in STEMH (see Chapter 3). I used purposive sampling to recruit

participants who identify as WOC over the age of 26 who work in a STEMH-related field. I recruited participants by emailing women who participated in a National Institute of Health-funded longitudinal STEMH study that began at college entry in 2004 through early career entry (Cobian & Hurtado, 2019). Because of the small numbers of Filipinas in the longitudinal study, I also employed purposive sampling by utilizing network contacts to disseminate a participant recruitment email message to a national Filipinx organization and Los Angeles-based Filipinx women's organizations. Participants completed a questionnaire prior to their interview (See Appendix A). I conducted semi-structured phone interviews that lasted approximately 60-90 minutes in length with each participant.

Interviews were conducted to allow for understanding the subjective experiences of participants and the meaning ascribed to their experiences (Seidman, 2013). In alignment with an intersectional approach, interview protocol questions were phrased in a manner that avoids additive interview questions and interpretations that separate gender and race observations (Bowleg, 2008). Questions focused on aspects of college and post-baccalaureate experiences, and how their race, gender and socioeconomic class shaped their STEMH career pathway. The interview process utilized an adapted version of Seidman's (2013) three interview series due to time constraints of participants who are working professionals. The three-part interview structure allows for understanding the lived experiences of WOC in STEMH, and may still be explored using single interviews as long as participants are still able to discuss and reflect upon their experiences (Seidman, 2013). Interviews were recorded and transcribed. (See Appendix B for the semi-structured protocol questions).

Researchers who are members of marginalized groups at times, may have "insider" advantage (Baca Zinn, 1979). In other words, because I collected the interviews and also identify

as Filipina American, participants may perceive a sense of trust due to our shared gender and ethnicity, thus adding a different dimension to the results of the study. Each participant was given a pseudonym. When participants requested additional anonymity, names of the company or organization where they worked were also given a pseudonym. The interviews were coded, and analyzed using MaxQDA for further extraction of commonalities and distinct themes. Table 1 shows each participant profile, including age, family income, parents' occupation, postsecondary education, current occupation, and career pathway as well as plans to stay in STEMH. Though participants had different career pathways, they were similar in age (29-36) and thus could be affected by similar socio-political contexts.

To answer my research questions, I developed categories to explain each participant's career pathway, using *trajectory type* to explain the course of their career development and planned *career direction* to explain their future STEMH career intentions at the time of the interview. For *trajectory type*—participants' either had a *direct*, *disrupted, or derived* trajectory. A *direct* trajectory is conceptualized as having started college with a STEMH career interest and having minimal changes in career-related decisions over time (e.g., career aspirations, undergraduate major, field of employment, etc.). In examining science identity of WOC in STEM, Carlone & Johnson (2007) labeled a subset of their participants as having a "disrupted science identity", meaning that "all women in this group expressed dissatisfaction about how they were positioned in science and felt their goals to become scientists and doctors were disrupted" (Carlone & Johnson, 2007, p. 1197). I use *disrupted* trajectory to describe the women who moderate to substantial changes to one or many of the aforementioned career-related decisions. A *derived* trajectory is conceptualized as beginning college with non-STEMH career aspirations, and developing a desire to pursue STEMH toward the end of college or a few years

shortly thereafter. For planned *career direction*, participants indicated whether they planned to *enter, stay*, or *leave* the STEMH field.

Table 1 displays a chart of demographic characteristics of the participants to begin to examine how interlocking systems of domination contribute to career pathways. All participants had two parents born in the Philippines, and all participants' parents immigrated to the United States either before participants' were born or before participants turned 2 years old. While not asked explicitly, it is likely that most of the participants had parents that fell into the second chain of migration to the U.S. (i.e. highly-trained and educated professionals) because of the careers of the parents of each participant and their stated socioeconomic status. Interestingly, these demographics are similar to the sample used in a quantitative study on Filipina American women (Felipe, 2016). All participants started college immediately after graduating high school, and all but one participant earned their bachelor's degree at some time between 2008 and 2011, which coincides with the years of the Great Recession (2007-2009). Interestingly, six participants grew up in a middle to upper-middle class household, and one grew up in a low-income household. Most of the participants' parents were either nurses or engineers, which aligns with the literature regarding immigration patterns from the Philippines to the United States (Liu et al., 1991; Tyner, 1999). Additionally, it is important to note that only one participant grew up in Texas, while six participants in the study grew up in California and ended up attending college in California. While a significant population of Filipina/os is concentrated on the west coast, it is important to keep in mind that the experiences of Asian Americans are likely shaped by geographic contexts and likely influence how Asian American students experience race (Chan, 2017). Considering the present study, Filipina American women who grow up

surrounded by other Filipina/os or Asian Americans on the West coast might be less exposed to feelings of isolation or overt racist experiences in school.

Table 1

Study Participants

Name	Age	Family Income	Parents' Occupation	Postsecondary Education	STEMH Occupation	Career Pathway Type
Gabriela	33	Middle	Mother: Nurse Father: Nurse	University of California campus, Electrical Engineering Graduate Degree: Texas Private Institution	Engineer, Private Company	Direct path, Staying in STEMH
Leilani	32	Low	Mother: head hunter	University of California campus, Aerospace Engineering	Aerospace Engineer for a Government Organization	Direct path, Staying in STEMH
Stacy	31	Upper-Middle	Mother: Nursing Supervisor Father: Computer Systems Engineer	Public West Coast University, English Graduate Degree: Private Institution, Physical Therapy	Physical Therapist	Disrupted path, Staying in STEMH
Pia	29	Middle	Mother: Nurse Father: Engineer	University of California, Mass Communications Graduate Degree: East Coast Public University, Public Administration & Criminology	Policy Analyst for a government organization	Derived path, Entering STEMH
Kamille	32	Upper-Middle	Mother: Science and Language HS teacher Father: Hardware engineer	University of California campus, Psychology	Project Management in technology sector	Disrupted path, Staying in STEMH
Emily	36	Upper-Middle	Mother: Nurse Father: Engineer	Nursing Degree: Southern CA Community College	Nurse	Direct path,

						Leaving STEMH
June	32	Upper-Middle	Mother: Lab corporation administrator Father: Electrical Engineer	Catholic Private University, Chemical Engineering Graduate Degree: Midwest Private University, Public Policy	Chemical Engineer	Direct path, Leaving STEMH

Analyses, Credibility, and Trustworthiness

Intersectionality-informed qualitative research calls for the task of identifying relevant intersections of social identity within this study's research questions by also keeping social and historical context in mind throughout analysis (Hunting, 2014). Indeed, "it is not the intersection of race, class, and gender in a single social group that is of interest but the relationships among the social groups defined by the entire set of groups constituting each category" (McCall, 2005, p.1,787). Thus, Núñez's multilevel model of intersectionality (Núñez, 2014) and careership (Hodkinson & Sparkes,1997) were used as theoretical lenses to analyze career pathways and the multiple dimensions of intersectionality for each participant.

It is also important to note that "the interpretive task for the intersectionality analyst is to make explicit the often implicit experiences of intersectionality, even when participants do not express the connections" (Bowleg, 2008, p. 11). Thus, to capture themes from the data through the lens of multiple dimensions of intersectionality while recognizing that participants do not always explicitly acknowledge their social identities, I used a modified 'two-step hybrid approach' by Sirma Bilge (2009). This type of analysis combines both a data-driven inductive analysis followed by a theory-oriented deductive analysis.

Because I am looking for intersections of social identities, contexts, and career paths, I added a pre-step that involved attribute coding to describe the social identities, educational backgrounds, and family history of the participants. I created matrices to "see" the data and map out each individual's identities and career course. For the inductive analysis, I employed a first round of open coding (Charmaz, 2006) in order to reflect deeply on the contents and nuances of the data and create tentative codes (Saldaña, 2013). For second cycle coding, I employed axial coding (Boeije 2010; Charmaz, 2006) to refine and reassemble initial codes "to determine which [codes] in the research are the dominant ones and which are the less important ones" (Boeije, 2010, p. 109). This grounded approach aimed to understand participants' perspectives without making assumptions about how micro-, meso- and macro-level oppression based on social identities.

Next, the deductive analysis involved a theory-oriented approach to analysis. In a second round of analysis, the researcher asks "how these individual accounts were related to broader social relations structured in dominance and contexts" (Cuadraz & Uttal 1999, p. 173). I created a careership and multidimensional model of intersectionality template to apply onto the codes developed in the inductive analysis. I wrote analytic jottings or notes taken during a journey (Saldaña, 2013) after conducting each interview to capture my initial thoughts, while keeping in mind my research questions and connections between careership and intersectionality.

I wrote analytic memos (Saldaña, 2013) over the course of four months to track my decisions with data analysis, synthesize jottings, and to make connections between individual participant narratives, social identities, and broader social relations or contexts (Bilge, 2009). This can make visible the often hidden or overlooked factors and processes that shape career decisions and life experiences. To ensure the trustworthiness of my findings, member checks

were conducted by double-checking demographic information with participants and returning a summary of themes to each participant that were reviewed for accuracy and clarity (Jones, Torres, and Armínio, 2006).

Positionality

I position myself as a scholar who engages in research that examines power dynamics, broadly. At the time of the study, I was a research analyst and doctoral student in the Higher Education an Organizational Change program at UCLA. I grew up in Southern California, and attended public education from kindergarten until I graduated with a bachelor's degree from UCLA and a Master's degree in student affairs from Seattle University. I self-identify as a Filipina-Mexican woman and come from a working class, immigrant household situated in a socio-economic and racial/ethnically diverse community 40 miles east of Los Angeles.
My research interests are partially rooted in my experiences as a multiracial Filipina American woman. I also chose this research topic due to my background knowledge of the complexities that contribute to Filipina STEMH career pathways, and the need to contribute to the dearth of literature on this topic. As a scholar who is committed to social justice and guided by Chicana Feminist Epistemology (Delgado Bernal, 1998) and Asian American Feminisms (Wu, 2018), I aim to advance knowledge of phenomena by contextualizing data sources through the lens of intersectionality.

Limitations, Terms, and Scope of Study

In terms of the scope of this study, I defined STEMH to also include health professions, such as nursing and physical therapy. Thus, I use STEMH or STEM/Health fields interchangeably throughout the paper. Due to the subset of interviews coming from a larger study on WOC, STEMH (both as an area of study in college and as an occupation) does not

include social sciences such as psychology and sociology. For example, while one of the participants graduated with a psychology major, I define her actual participation in STEMH based on her initial career and major aspirations and her eventual entrance into a STEMH occupation. Additionally, this study is limited by the geographical perspectives of the participants due to my convenience sampling approach. Six out of the seven participants grew up in California and went to college in California, which also shapes their experiences. While parts of their experience growing up in California are mentioned in the findings as related to intersectionality, this study is limited in its ability to explain experiences for Filipina American women from across the U.S., including the east coast and Midwest. Pinay is a term referring to both women in the Philippines and women of Filipinx origin or descent. I use Filipina Americans and Pinays interchangeably to describe the participants in this study.

Findings

STEM/Health Career Pathways of Filipina American Women

In examining the career pathways of the Filipina American women in this study, I identified STEM/Healthcare career pathway types based on type of trajectory (i.e. direct, disrupted, or derived) and attitude at the time of interview about next career steps (i.e. plans to stay, leave, or enter STEMH). Four participants—June, Emily, Gabriela, and Leilani-- had a *direct* trajectory toward their STEM/Healthcare job. June, Gabriela, and Leilani went into engineering, and Emily went into nursing. Of the four participants who had a direct path toward their career, June and Emily entered the same career as one of their parents, with June becoming an engineer similar to her father and uncles, and Emily becoming a nurse like her mother and three out four of her siblings. Two participants—Stacy and Kamille-- had a disrupted trajectory toward their STEM/Healthcare job. Stacy began her undergraduate education at a UC campus

but was on academic probation for several quarters, and eventually dismissed for low grades. Stacy ended up taking courses at a community college to eventually return to her undergraduate institution to earn her bachelor's degree. However, her undergraduate institution did not permit her to graduate with her original intended STEM major, thus graduating with a bachelor's degree in English literature instead. At the time, Stacy's circumstances regarding her academic probation and struggles to succeed in STEM courses severely impacted her mental health before getting back on track with her degree progress and eventual career as a physical therapist. Kamille began her college education interested in math and science, but graduated as a psychology major and eventually ended up in the technology sector after applying to a position at a tech startup upon graduation. Pia had a derived STEM/Healthcare career trajectory. She was pre-law when she started college and had no initial intentions for a STEM career. After graduation, Pia was highly impacted by the recession, which got her working in union organizing and eventually into graduate school for a public policy program as she moves into the field of data science.

Considering the need to understand what keeps WOC interested in staying in their STEM/Healthcare career, I asked participants about their future career intentions. Four participants—Stacy, Gabriela, Leilani, Kamille—indicated they planned to stay in their careers at the time of the interview. Pia was just entering the STEMH field at the time of her interview, while June and Emily shared their plans to leave the field. I will expand upon the stories behind why Pia chose to enter the STEMH field and why June and Emily plan to leave their careers in subsequent sections.

The Influential Role of Family Members in Participants' Career Choices

Five participants mentioned that family played a significant role (whether positive, negative, or both) in shaping career choices, lending additional evidence to the integral role that family members play in Filipina Americans' lives (Maramba, 2008). Even now well into adulthood, Gabriela shared, "So even to this day I still value my family's opinion and their thoughts on my career." Two participants, June and Gabriela, attribute part of their decision to pursue engineering to family influence. For example, June was already interested in math and science at an early age, but exposure to her father and uncle's engineering careers allowed her to see a career option where she could apply her academic interests:

> Yeah, so I definitely thought about it more in high school, probably, you know, you kind of start thinking about it even sophomore, junior year, just kind of like, what am I good at?...And for me it was always math… I was interested in biology and that stuff, but never had like a passion. So I wasn't really going to go the doctor medicine route. When I was just trying to think of what I wanted to do, I knew how my dad is an engineer, His brother was a chemical engineer…I had a little idea of what it was and just knowing that you need to know math…it was great because, um, I had like computer classes and that kind of stuff in my high school…I had a feeling that I kind of already liked it. So when I was going off to college, I wasn't picking schools for engineering, but that was kind of what I was thinking I was going to do.

Hodkinson & Sparkes propose that individuals make career decisions within their *horizons for action*, or their perceived opportunities within which decisions can be made. For example, "The fact that there are jobs for girls in engineering is irrelevant if a young woman does not perceive engineering as an appropriate career" (Hodkinson & Sparkes, 1997, p. 35). In

June's case, seeing her own family in engineering expands her horizons for action at a critical time (i.e. prior to entering college), where she was able to begin her academic training in engineering. Of course, aside from June's father and uncle influencing her interest in engineering, her exposure to computer courses at her high school and her overall quality high school education supported June's capacity to pursue this interest and thus expanded her horizon for action. For Gabriela, the lack of an opportunity at her college of choice, coupled with influence from her older brother who had already started his college path toward engineering ultimately helped her see engineering as a viable subject to pursue once she had to make college decisions:

> So I would have open discussions with my parents about nursing, and I would always remember hearing their dialogue about how their day went and how it was at the hospital. Honestly, one of the reasons why I didn't pursue nursing was because the schools that were available at the time for a [nursing] BS were other [campuses], and because I had already been accepted into UCLA, my heart was kind of set on going there… I had to weigh it out and decided to pursue engineering. But I think it was very valuable to have a home that not only valued education and higher education, but also was very supportive of me throughout school. And so education was my parents' number one priority… And it also helped to have a brother that was ahead of me because I just turn to him and just ask him about engineering or you know, what does it need, what are some of the skill sets, and will I be able to get a job after college? Even to this day I'm really close to my brother so his opinion obviously matters a lot to me.

Gabriela was open to pursuing a nursing career and taking after her parents, but attributes support from her family for valuing education, and guidance from her older brother for helping

her find a way to pursue college at her dream school which did not offer a nursing program at the time. Family influence—by mere exposure to parents' careers in Gabriela's case—or by parents' resolve in ensuring financial stability and success of their U.S.-born children, is well-known in Filipina/o American culture. For example, Filipino American comedian Jo Koy discusses the tensions of Filipina/o parents' desires for their children's careers versus their children's career goals, particularly toward the field of nursing (Koy, 2017). Emily's mom was deliberate in her attempts to convince Emily and her siblings to pursue nursing. Four out of Emily's siblings, including herself, ended up pursuing nursing as a financially lucrative career:

> So growing up [my mom] marketed the nursing profession like nobody's business to all of us. Yes. All the siblings. She was very successful because four of [us] are nurses out of the five…I love travel and [my mom] knew my value is freedom. So she would always say, "You know, if you take nursing, you can go anywhere in the world. You'll always have a job. And if your husband loses their job, you can always pick up the slack." Like you can always, your salary alone would hold the both of you, which is her story. Because that's what happened to my dad. And I was like, I saw that. I'm like, she's right. And I convinced myself too because I love science. But of course initially when I got into this profession, it's like-- just give me the money (laughter) because I knew how quickly she made it, and I knew how we were living.

While Emily loved science, it was really her mom's messaging regarding the opportunities that would open up for Emily as a result of having financial freedom. Similarly, Kamille enjoyed the performing arts but was ultimately told by her parents that she needed to pursue a career with more financial stability. Stacy, on the other hand, was influenced by the presence of healthcare workers in her family, but ultimately believes her aspirations to become a medical doctor were

truly her own. Stacy shared, “Well, being [in] a Filipino family, a lot of my aunts or ‘titas’ were nurses, so they always encouraged you to go into the medical field. Of course wanting [you] to be even more successful and be even like a doctor in that field...that definitely pushes you into the healthcare practice versus anything else I would say.” Stacy’s quote underscores the relationships between family influence, social identities, and career decisions. Specifically, immigration patterns and policies that led to large proportions of Filipina/o healthcare workers immigrating to the U.S., in combination with influential role of family in Filipina/o culture contribute to the messages passed down to Filipina women.

While many of the participants discussed how family support was critical to their success, there were also times where cultural norms and family influence posed challenges to emotional and mental health. Stacy shares:

> I was actually on academic probation several times. And then, so my 5th year, it was the end of spring quarter. I actually got [academically] dismissed…it was really a rough time because I didn't tell my parents…I came up with a bunch of lies and told my parents that I could go home, that I was done or something. They thought that I had finished my classes but I hadn't. So I was really depressed. And I ended up trying to hurt myself.

Stacy’s dismissal from school and decision to keep this secret from her family contributed to her depression, and ultimately to a suicide attempt. Only then did her parents find out about everything Stacy had been struggling with in her science major. When asked to explain why Stacy felt she could not be honest with her parents:

> I mean being part of an Asian family and having that shame...that was like a big part of my college life…like I honestly couldn't tell you right now what kind of lies I was telling them in order to make it seem like everything was ok…it was hard because it felt like

> when it came to my parents and more specifically with my dad—I feel bad putting it on my dad, so I guess my parents in general—I don't know why I felt this…but at that time, I felt that their love was conditional to my success. If I was doing well they would love me more. And if I wasn't doing well and I was feeling like a burden to them then they wouldn't love me as much. So that's what kind of drove me, I felt like I was a burden because I wasn't doing well.

In Stacy's case, her family was both a source of support and stress while she was an undergraduate struggling to get through her STEMH courses. *Hiya*, the Tagalog word for shame, is well-documented as a characteristic of Filipino culture (Pe-Pua & Protacio-Marcelino, 2000). Stacy's attempt to avoid shame by not telling her family about how she was struggling in her STEMH major stemmed partially from her desire to not want to burden her family with her academic challenges. Interestingly, Stacy mentioned additional shame she felt when thinking about her father. In focusing on gender, influence from participants' mothers and fathers seemed to be evenly split—with a few of the women attributing much of their family's influence coming from fathers and brothers, and a few attributing their source of inspiration coming from the women in their family.

Family influence also manifested in the form of recognizing family history and seeing oneself as imbedded in U.S. imperialism. Kamille shared a moment that became a career turning point (Hodkinson & Sparkes, 1997) as she realized that the work she was doing in providing software to reduce the use of call centers for major corporations impacted her family and economic conditions in the Philippines. She shared, "It dawned on me…where are most of the world's call centers focused? In the Philippines. I was like, oh my God, I'm putting my own

people out of work." She went on to explain the connection she made between her great grandmother's life and her own company's business decisions:

> My great grandmother, amazing....She was this, imagine this little Filipina girl in the province of Bataan carrying sacks of rice, taking buses into Manila to sell bags of rice...she was able to have enough capital to put up her own rice mill. Huge. You know, that's huge...Something from nothing. And that was the start. She was able to give work to her community and expand her businesses and properties... she was the person that was helping, um, not only give jobs but enough money that people could send their kids to college... She put up her own sewing shop so moms could sew and be with their families and still make money. And then, yeah, those kids ended up going to college. Like that was unheard of. I was thinking, "Oh my God. Of all those people that work in the call centers that are losing their jobs, how many of them had some connection to my family?"…I couldn't sit with the fact that I was undoing, potentially undoing, what my grandmother has had worked so hard for.

Kamille decided she needed to find a new job as a result of making these connections between economic harm caused by the large American corporations that her company did business with and the personal ancestral harm as she perceived herself "undoing" the positive impact of her great grandmother's efforts in the Philippines. She decided to move to the Philippines in 2014, and through the help of an angel investor, she was able to do market research on peer-to-peer lending systems and build networks there. This work eventually morphed into her current career as a tech entrepreneur and business consultant in the U.S. while providing pro bono help and angel investments to tech startups and small businesses in the Philippines.

Religion and Colonial Mentality in Shaping STEMH Career Trajectories

Roman Catholicism was brought to the Philippines via Spanish rule. Catholicism, Christianity, and religion more broadly, continue to play a significant role in Filipina/o cultural norms and practices (Gonzalez, 2009; Lagman, Yoo, Levine, Donnell, & Lim, 2014). For the Filipina Americans in this study, religion and spirituality helped with persevering through difficult times. Aside from providing a foundation from which to draw strength during challenges the women faced throughout their educational and career trajectories, religious communities provide access to networks and resources that supported career interests.

Three participants attended Catholic school for some or all of their education. In June's case, her Catholic education in Texas provided her with at least a handful of other Filipina/o peers as classmates:

> So for early years [my sibling and I] were both put into a private Catholic school for K through 8th [grade]. That was kind of important to my parents, having Catholic education, and I guess they also knew some other Filipinos that were at that school. So that's why we ended up going to that school. You know, it was, it was great…I was probably one of two or three other Filipinos in my class. Um, but in general it was, it was usually most of my friends were, were white. I had maybe one other friend who was of color, but, um, that's certainly kind of the type of people that I grew up with.

June later ended up going to Catholic women's high school, and at this point was accustomed to being one of the few people of color at school. Reflecting on the racial/ethnic makeup of her classes, she recalled, "I never felt like that was an issue or anything. And, you know, for the most part, I know that I excelled there. So it wasn't, it wasn't a big deal." Her all-girls school was also where she attributes her early interests in science and math, recalling that she learned and excelled at those subjects in school. June later went on to a private Catholic university, and

recalls again that she had already grown accustomed to a majority-white student body as a result of her K-12 education:

> I never felt like [racial/ethnic identity demographics] was a big discrepancy. Like I don't know, I guess it could also be because I just grew up in that same type of environment. So I didn't, I mean same Catholic school, you know, I did Catholic schooling pretty much kindergarten through college. So at that point it was pretty, um, pretty normal for me.

June's reflection on her early education highlights the influence and complexity of multiple social identities and colonial mentality on career decisions. Findings on the role of colonial mentality for Filipina American women suggest that "colonized thinking is not only present, but it plays a role in the realization of sexist and racist oppression" (Felipe, 2016, p. 28). Attending school and growing up in a predominantly white area was "not a big deal" for June, which may be what shielded her from perceiving racism in her early schooling and subsequent college environment. Regarding her religious identity and exposure to Catholic schooling, June shared how having smaller classes and peers who supported each other at her Catholic university contributed to her persistence in her engineering major. For June, her parents' decision to enroll her in Catholic education gave her at least one identity that she shared with students, in addition to the environment of a private all-women's high school where she could excel at science and math compared to women who attend co-ed high schools (Cherney & Campbell, 2011). When asked to reflect on her social identities, June shared:

> When I was a kid I never really felt different, so I think it was just the fact that I was already in this, uh, like Catholic school where, and it was already like smaller classes and I knew everybody. I don't know, I never felt like that was a big issue I even sometimes

didn't realize, I guess, that I was different from the rest of my classmates, which was really great.

In addition to religious education, some of the participants discussed how their religious upbringing and spirituality helped them get through difficult times during their lives, including struggles they faced during schooling. The spiritual part of their religion brought guidance, strength, and hope. For Emily, her family's reliance on their Catholic faith was an example of the power of faith to get through difficulties, particularly for difficulties faced while struggling with completing STEMH course requirements and/or overcoming challenges at work:

> I know my mom, both my mom and dad, Catholic, very faithful, they're always thanking God, and [they] instilled that in us too, even though we kind of moved away from just attending church and then just opening up the other spiritual practices-- just for me anyway, that I've learned. Yeah, they had so much, they had faith in something greater than themselves and they have really strong, um, spirituality, to lean on when things got really crazy or rough….They always bounced back.

Leilani, the only participant in the study who came from a low income background, was very active in her church community while she was growing up and was able to attend a better-resourced high school thanks to the financial support of a member of her church:

> So my parents couldn't afford my education, but I was kind of the smart one. I was always interested in puzzles and figuring out problems. And one of those that did math-- algebra in junior high. So, um, we attended church and one of the guys there, actually paid for me to go to private school for junior high and high school. So I was fortunate enough to actually get an education because you know, when you're-- when you don't live in the best area, the school system isn't exactly the best. So my parents wanted me to get

> a better education than what they could afford. And so I was able to go to those schools and able to get like the higher math classes that I wanted to take.

In Leilani's case, while she attributed her religious identity to helping her throughout life, it was her access to additional networks and resources through her church community that provided her with an opportunity to attend a private school with more resources and college preparation compared to the public schools in her area. Aside from significant financial support to pay for private school, this social network provided additional tangible benefits ranging from access to a place to do her laundry during college, to mentorship from people who were already working in the engineering field:

> [In college I went to] bible studies for church. And that was helpful supportive group because I was able to do laundry at people's houses, get fed. There were other people in my major that were able to help or other engineers that were able to help, and you know, and some of the, you know, people at Church were also engineers. So they were able to give like advice and all that.

Thus, for Leilani, being part of a religious community financially supported her high school education in order to provide her with academic opportunities to be successful in college.

College Experiences for Persistence

The Filipina American women in this study attributed their persistence in their STEMH major and/or STEMH career aspiration to peer support, mentorship from Asian Americans, and career fairs. With respect to peer support, Stacy explained that emotional support from her peers during her physical therapy program was integral to her success:

> Interestingly enough, too, was the support through grad school was the friends that I made there. There were maybe like, I don't know…how many of us were there? There

> were probably less than 10 people of color in my class in grad school and I like became close friends with three or four of them so almost half… And well, maybe it doesn't have to be that specific, I don't know…I feel like I wouldn't attribute me being where I am to any resources or training. I don't know if this is just who I am, but I just feel that I get to where I am [because of] the emotional support that I get from other people rather than the training or what I learn, because I usually understand [training].

Emotional support is often associated with femininity (Reevy & Maslach, 2001), which suggests that for Filipina women, the encouragement from others is just as, if not more critical to their persistence in STEMH compared to mastery of knowledge and scientific skills. Similar to emotional support, recognition from significant others was found to be an integral part of science identity for Women of Color (Carlone & Johnson, 2006).

For June's undergraduate engineering major at a small private institution, her and her peers experienced a non-competitive environment where they felt they could be supportive of one another's success, which motivated them to help each other rather than focus on their individual success:

> It was really working with everybody else and just getting things done that helped. And you weren't as concerned about grades anymore. It was just kind of like, let's just get this homework done and being able to study for the test. And it wasn't very competitive. So that was also really good. It was more of just everyone's, everyone's there to just help each other and pass.

As the only participant who was entering the STEMH field at the time of the interview, Pia attributes both her exposure to data science and her decision to move toward the field to an Asian American mentor who served as the program director of her graduate program in public policy.

He took the time to engage with her, and helped guide her interests toward big data and quantitative analysis:

> I realized after talking to [Mentor's name]...he has a lot of like really adding like the technology aspect of like R, python, program evaluation through big data...And then just like weekly, just like he's from Burma and we have similar background and then did a lot of work in regards to increasing diversity... And so I just wanted to hang out with him. And I guess the weekly meetings change with like the things that I liked, what I enjoy and he kind of honed it in like, oh, "You like data things, you should do statistics. You can do all these things with policy analysis and think tanks and actually have the numbers and make sense when people write legislation." And I was like, that's great.

Pia's mentor eventually went out of his way to also help Pia quickly fill out a graduate program application for admission into a more STEMH-related graduate program so that she could obtain a dual master's degree. Thus, this mentor was critical in turning Pia's interests into action and deriving a STEMH career interest while she was mid-stream in her public policy graduate program.

Lastly, college career fairs helped the engineer majors in particular. Both Gabriela and Leilani found their jobs at fall career fairs hosted by their respective universities. As a result of their exposure to employers via the career fair, they were able to interview and secure employment with government organizations prior to graduation. Gabriela for example, was able to learn more about a government job that she would have never considered had it not been for the opportunity to chat with recruiters at the career fair:

> So my first job I found by going to engineering winter career fair. I know they have their engineering career fair about like two times a year. And so I went around the booths and

> towards the end I ended up talking with [government agency] booth and at the time I talked to a person that eventually became my first supervisor. I didn't really know much about [government agency]. At the time I was really looking for something in design and, um, honestly I was keeping my options open of looking at maybe consulting jobs… So the opportunity arose after speaking to the individuals at the [government agency] booth about a position out there.

Involvement in Filipinx Organizations

None of the participants were involved with Filipina/o STEMH-related organizations (e.g. a Filipina/o engineering society), however, a few participated in broad-based Filipina/o organizations in college that are focused on expression of Filipina/o identity and promoting awareness. Stacy and Gabriela shared their regrets about the amount of time and energy they spent with these organizations. For example, Gabriela shares how she wished she would have spent more time focusing on co-curricular activities that supported her engineering aspirations:

> I would say that I wasn't super actively involved in [undergraduate Filipina/o organization] but I would say that's probably why I didn't do that great with my career. If I had to do it over, I probably would have participated more in engineering organizations maybe a little bit more and early on.

This is not to say that participants should not join Filipina/o organizations, or that engagement with Filipina/o social organizations is not conducive to supporting STEMH degree aspirations. Stacy's experience highlights that while she believes her involvement was not conducive to her academic career, her connection to the Filipina/o community through the organization was critical to her sense of belonging at her college campus:

> I guess because [Filipina/o organization] was just the only avenue where I felt like I had support. Because otherwise, I wasn't involved in any other groups or anything like that. So I had no way of having any sort of social connection, or feeling any sort of… yeah just feeling any sort of support…It was just like...emotional and psychological support—having friends and having people that you can relate to.

For Kamille, who grew up in a predominantly Filipina/o community prior to even attending college, the lack of Filipina/o peers in her time exploring an architecture major during undergraduate years made her realize how different she was from her non-Filipina/o peers in the program:

> There were always Filipinos around us [in grade school and high school]. And high school more so as well. More so just because it was like, oh, Filipino pride, you know, and um, like how do I describe this? Um, it was trendy, you know… Filipinos, in my area, we stick together. So it was a whole bunch of Filipinos hanging out with Filipinos. Um, and then yes, in college I did break away from the Filipino crowd for the first two years when I was in architecture, not many Filipinos in architecture…that's when I really started, I really started becoming more aware of, you know, my belief system, how conservative and almost limiting it was, and how it differed from how other people were raised or what privileges were given unto them versus me.

Involvement in Filipina/o organizations both helped Filipina American women feel supported in college and raised their awareness, yet when reflecting back, participants wished they would have given less of their time in order to focus on involvements that could help their careers. In examining WOC engineering students, Tate & Linn (2005) found that ethnic organizations keep students connected to their cultural heritage, while academic networks

contribute to their academic achievement. Both networks are "likely to impact student persistence" (p.489). Concerning the women in this study, it could be that participants were drawn to Filipina/o organizations at the time for much-needed support and a sense of belonging on their campuses, especially given the racial and gender isolation they experienced on campus and especially within their STEMH courses. However, spending time seeking a racial/ethnic community is an additional burden that Filipina women and WOC have compared to their white peers. Not only did Filipina women reflect back on the pressure to succeed in their STEMH courses, but they also blame themselves, as Gabriela and Stacy did, for not having done well in STEMH. As Gabriela stated, "I don't believe that I applied myself as much as I could have" despite the fact that she was one of a few women of color to have graduated with an engineering degree from her institution and to remain gainfully employed in a STEMH career today.

Experiences that Hindered Progress

Unsurprisingly, large introductory college classes, and course content being too abstract or theoretical made college even more difficult for the participants. Stacy felt like she prioritized her time with the Filipina/o organization because she lacked meaningful experiences with university faculty or staff:

> It's not like I had support from my faculty I mean with like being one out of how many thousand students. It's not like I had a counselor that was checking in with me… I mean I had a [Filipinx organization] counselor but it's not like I had a biology counselor that was checking in with me about how I was doing and feeling….I guess that. Like especially when you're going into a school where you don't really know anyone going into it…like you're just trying to find any sort of connection so that you feel like you belong there.

Indeed, four of the seven participants went to large public institutions and all four participants recall that large class sizes made it difficult to get to find study groups, to feel a sense of belonging to their science major, or to feel comfortable going to office hours. Stacy and Gabriela struggled to do well in these courses and internalized the challenges they experienced. Stacy's challenges in school disrupted her initial career aspirations when she was dismissed from her university due to low grades. Gabriela made it through to graduation, however she attributed her struggles in college to her lack of effort when she was an undergraduate rather than structural issues of underrepresentation and isolation:

> Looking back at it, I wish I had honestly applied myself a lot better than I had. I went out, I went from being one of the top students in my high school to one of the bottom students in all honesty. Sometimes I feel like it was because I waited too late to apply myself and also the adjustment of knowing how to study in the course. Early on, I don't think I took advantage of office hours later that, you know, I eventually took advantage of. So that was my initial experience of transitioning.

Kamille, the other participant with a disrupted career path, begrudgingly started college as an architecture major to satisfy her parent's wishes. Similarly to Emily's mother influencing her to pursue nursing for financial stability, Kamille said of her parents, "they always wanted me to have a very secure job. That was the emphasis-- secure job." Kamille and her parents ended up with a compromise that incorporated practicality with creativity—pursuing architecture:

> My parents are very practical people, in professional fields where you have somewhat financial security and your career is pretty clear-cut. But I was always more creative growing up. I did a lot of dancing and drawing, winning art contests when I was little, and performing. So there was a huge part in me that was battling, well, how do I

> incorporate this creativity into a more practical and financially secure lifestyle? Right. So I started college as an architect because I was like, oh, you're designing, but there's still a very clear way to make money.

Kamille found the culture in the architecture major at her institution to be "toxic" due to demanding deadlines and a culture of competition because of the program's reputation. After two years, she decided to switch majors:

> I moved to math and art, kind of do a double major in math and art because I already satisfied a lot of the requirements from architecture, but even, I don't know, something just wasn't hitting the spot. Um, I think it's because the math was too theoretical and I wanted something more applied.

Gabriela, who majored in engineering, also critiqued her undergraduate major for being too theoretical. Now that she works as an engineer, she reflected back on her education and wished the curriculum was more applied, "I felt like a lot of what I learned was very theoretical without the hands on or 'Hey, why am I doing this?' How does this relate to like the real world?" Kamille also found her own interests and she eventually ended up majoring in psychology:

> I really enjoyed it just because I've always been fascinated in people's behaviors and um, you know, what motivates them, and nerdy stuff that what can happen in the brain. So I really enjoyed being a research aide to graduate students working on MRI studies. So I got really interested. I was able to learn how to read MRIs and just weird stuff that happens when people injure their brains.

Interestingly, at Kamille's campus she was able to get involved with psychology research right away and found fulfilment in the subject of psychology being focused on people, while also still

able to use her scientific thinking. Upon preparing for college graduation, she was still undecided about a career direction:

> I mean, at [large public institution] we were fed, you know, either you're going to go to graduate school or you're going to work for a big company like [regional corporation] or The Gap, you know, the big corporations around us. And so I did a couple interviews. I was not as equipped as the business students. So obviously I didn't get into a big corporation.

College contexts, due to their regional location and the perception of the institution by employers, also influence horizons for action when it comes to career decisions after earning a baccalaureate degree. Since Kamille did not feel equipped to get a position with a large business in the region, she ended up getting hired by a tech startup. While Kamille attributed this to being more of a random decision rather than deliberately planned, this initial job opportunity right out of college re-directed her back onto a STEMH pathway.

The Recognition of Interlocking Oppressions after Entering the Workforce

Participants more often shared being peripherally aware of sexism and racism, and more often were able to recall more overt and personal experiences of discrimination once they started working in their careers. These findings are in line with studies that have examined the impacts of colonial mentality (David & Okazaki, 2006; Felipe, 2016). Considering colonial mentality and the messages passed down in families that perpetuates feelings of fondness for American white and patriarchal norms, it might be that some Filipina Americans are unable to recognize the injustice of racial and sexual discrimination.

For June, who grew up in the South, the lack of racial diversity during her schooling and when she began working at her engineering company did not bother her as much because she

was used to being one of the few people of color growing up and at her school. Pia also said the same thing, thanking her family for putting her in a school where she would have to interact with white peers so that she would not experience the challenges her parents faced when interacting with white people:

> This thing that I've talked with my dad about is that I could have stayed in my area after the gifted program in high school, but he pushed me to stay because if we're able to take the gifted program in the rich area, we'll be able to have a better chance of going to that area's high schools and junior high schools. [My dad] was like, "I pushed you to do that because you would have more opportunities and you'd be more culturally used to interacting with white people." So that was the really big thing that my dad pushed for to keep me in that area, to be able to feel comfortable with that socio-economic demographic so that I feel comfortable around white people. There's still-- he's recognized that there's still, he feels like a deference to [white men] even though like he's a senior engineer at [major company].

In Pia's case, her father's messages lend to the ways that colonial mentality is manifested and passed down—with Pia later explaining how she became the first in her family to begin to grapple with this tension of hating that her family felt a deference to white people in the U.S. and also having gratitude for her early schooling socializing experiences and her father's good intentions. While Pia felt relatively comfortable interacting with white people because of her early experiences, her early work as a union organizer and her experiences in additional jobs she held began to help her begin to recognize social injustices based on racism, sexism, and xenophobia. When she moved to the east coast for graduate school as she began her path toward a STEMH career, she experienced microaggressions but was more bothered by the absence of an

ethnic community. To get through these new challenges of isolation and racial discrimination in the workplace, Pia shared how the skills she learned from her work experience with the union helped her advocate for herself in future work and graduate school environments:

> The union…You learn your rights. You learn like these discriminatory practices…I think I realized that when doing the database project [at work]. It was all white people and I thought that the fault of it being so mismanaged was going to fall on me. And I realized, and then that's when I started making my case. Like I represented myself like a union person, like just putting like keywords there, and adding words like, "As a woman of color, I did my best here." So really using my union education and asserting my rights and having that kind of knowledge…And then my friends that have had similar experiences. It's like, well, you know, white people have their advantages already, so why not have things on our side too, you know? Like someone says, "I have to prove myself a hundred to a hundred times more to be able to keep up." I'm like, why do I need to do that?!

Stacy experienced microaggressions that she perceived to be based on her gender while working as a physical therapist at a hospital:

> Because I'm in a job that can be physically demanding, then definitely as a female you can be discriminated against. Because there might be days when I have to help a 250 lb person stand up, and they may look at me and be like, "You're not going to help me." So it's having to learn how to push past that and educate people on the fact that we're trained to do this, we know how to do this safely. Sometimes too… you'll get people who will staunchly say, "No you can't help me" and they will unknowingly make it harder for you to help them because they're resisting your help. Like they're physically resisting your

help resisting your help out of fear or anxiety because they don't trust your abilities since you're smaller than they are and/or a female.

Kamille was sexually harassed by her coworkers during her first job for a tech startup. She started in her role along with five other coworkers who were all men. As part of their training, they were all sent to live in a house and work in Paris for their first month. Kamille was hit on several times by her coworkers, which was further exacerbated by having no separation between work and home during their time in Paris. In addition to the sexual harassment, she shared how the challenges of being the only Filipina American woman impacted work dynamics with her male coworkers:

> It was, it was really hard. Not to generalize, but they were kind of douchey frat bros (laughter) and I'm an Asian [woman], so I don't know how much interaction they've had with Asian girls other than frat parties. And being in France was also kind of bad in reinforcing gender biases because France is a very chauvinistic culture. Um, so it was, you know, it was like the quiet, demure Asian, trying to get a say in with all these loud, very strong, opinionated American white men. Yeah. So I was overshadowed a lot. If it weren't for me having a female manager advocating for me, I probably-- nobody would pay attention to me.

While not directly related to the workplace, Pinays encounter challenges with their relationships as a result of their jobs. Leilani, for example, shared, “Yeah, and there are some guys out there that are just like, I don't date engineering women.” Indeed, WOC still meet men who hold stereotypical views of who is meant to be an engineer, or men who actively discriminate against women because of their participation in a male-dominated profession.

In addition to personal experiences of discrimination, the women also noted systemic oppression in the workplace. For example, one of the main reasons June wants to leave STEMH is because her job was not conducive to the needs of her family:

> I had been looking for a job probably since--- so I worked there for like five or six years and then was like I don't like this. I was traveling a lot. I had to do, um, a lot of long trips. So like a week over in the middle of nowhere in Nevada and was just getting tired of it. And it wasn't even necessarily like having to travel. It was the, I need you to be in Houston and you know, Thursday. And it was just, it was very difficult to plan my life, you know? And even at that time I wasn't, didn't have a kid. I wasn't, yeah, no I might've been married by then, but it was just like one of those times where I'm like, I don't want to do this, you know? So I was getting really tired and that was when I started looking for other jobs.

Even Kamille, who wasn't ready for a family at the time of the interview, reflected upon how she was already thinking about whether her career in the tech industry would conflict with the option of having children in the future:

> I was just pissed off. I was just angry and I hated work. And you know, there's just so many things to be mad about, but I didn't have like a framework for understanding what it was that I was so unhappy with. It always just came back to me like, what's my fault? What am I doing? Or being, playing victim…it's not very balanced in tech, and yeah, that also caused me some anxiety. Like where's the work life balance? Like how do women, how do women have families and kids here? And a lot of the women I had worked with or had come and gone through the office, were all single or had life partners but weren't married and weren't having kids. Or you know, much older, successful executives that

never married. So it just seemed like this tech lifestyle wasn't compatible with having work life balance and having a family.

While Leilani felt more supported than not at work, she is aware that the leadership at her workplace is predominantly male:

> There's some groups where you can kind of tell they're not as comfortable working with a female. And that's usually with the older demographic. The younger people though, they don't care. There's definitely more people who are supportive of you than there are of people who are not supportive of you. But sometimes it still kind of feels—at least with upper management—kind of more like, a boys club…It's basically all male…Yeah, at least in my department it's all male. There's some departments that do have some females in the lead.

Discussion

This study extends the work of intersectionality in studies of Women of Color in STEMH. The career development of Filipina American women in STEM/Healthcare illustrated the utility of an intersectional approach that gives precedence to their multiple social identities in a historical context, acknowledging contexts of organizations, representation, intersubjectivity, and experience. This study reveals the patterns and differences among Filipina American women in STEM/Healthcare, to develop a more nuanced understanding of how their social identities and the contexts encountered, including college experiences, that shape STEMH career pathways. Examining the interconnections between the seven Filipina American women in this study provides additional understanding of how the legacy of Western colonization, Christianization, and systems of oppression that value white male norms in STEMH continue to shape the experiences of Filipina American women's career pathways. However, maintaining cultural links

with family, religious social networks, and peers are what sustained their interest in STEMH and contributed to their support.

Several participants reflected on turning points that led to having to make a career decision that also is related to larger power dynamics in intersectionality and careership. For Kamille, finding out how her company was undoing her great grandmother's efforts to provide jobs and income to Filipina women back in the Philippines made her decide to quit and find another job in the tech sector where she could focus on providing pro bono help and angel investments to tech startups in the Philippines. June and Gabriela's exposure to engineering from their family members expanded their horizons for action, or perceived opportunities with which one can make career decisions.

From the lens of historicity (i.e. the third level of multilevel model of intersectionality), an understanding of immigration policies during the time period when most of the participants parents migrated to the United States from the Philippines situates the resulting experiences and career opportunities for the daughters of Filipinx immigrants. Similar to how U.S. economic conditions "historically have framed a cyclical, bipolar, and complex relationship with Latino labor" (Núñez, 2014, p.89-90) Filipinx migration to the U.S. has been shaped by U.S. economic conditions. Núñez argues that the U.S. encouraged im/migration when it suited the U.S. economy's needs, as with the case of the Bracero worker program (Calavita, 2010).
Almost all of the participants in the study had parents who immigrated to the U.S. through immigration policies that allowed, and at times, actively recruited, STEM and healthcare professionals from the Philippines (Choy, 2003; Liu et al., 1991). All but one participant had parents who worked as nurses or engineers, and a few did share that their parents were recruited to come to the United States to work. Considering intersectionality from the lens of the matrix of

domination, in which privileged and oppressed identities are simultaneously considered, almost all the Filipina Americans in this study reported growing up in financially stable households. Participants benefited from the privilege of their parents' ability to legally migrate to the U.S. and for the most part work in well-paying professions where there was a labor shortage. Hence, the families emphasis on getting stable and secure jobs that resonated in Pinay choices.

Another aspect of historicity is the time period in which the participants entered and graduated from college. The Great Recession had a significant impact on Pia's career trajectory, despite the fact that she was aspiring for a career in law rather than STEMH when she graduated from college. However, many college students from this time period were likely stalled or completely derailed from both STEMH and non-STEMH career aspirations due to the lack of job opportunities in addition to financial and identity challenges (Aronson, Callahan, & Davis, 2015). Further, in the mid- to late 2000s, STEMH interventions on a massive scale for colleges and universities were likely only beginning to develop since significant increases in federal, state, and local investment in STEMH education policy began approximately in 2009 (Johnson, 2012). Most of the women in this study had graduated from college or were about to graduate by that time, which means that current STEMH interventions to improve pedagogy, course requirements, and advising were not yet widely being implemented.

The second contextual layer of the multilevel model considers different domains of power that contribute to inequality: organizational, representational, intersubjective, and experiential arenas where intersecting contexts of power shape opportunities. Regarding the organizational power, religion functions both as an institution as well as part of a Filipina woman's identity. The intersectionality of the participant's identities and experiences as a result

of their Catholic upbringing, with the institution of Catholicism as a byproduct of colonization, complicates and expands our understanding of intersectionality.

The representational arena "signals who is included or excluded from these opportunities" (Núñez, 2014, p. 89). As WOC in STEMH, and often being one of the few in STEMH workplace, there are constant messages and prevailing stereotypes that signal to women of color that they do not belong and/or are not valued. Leilani's experience with a man who said he didn't date engineers who are women is just one example of how these messages are embedded in everyday experiences. Pia, for example, did not find an Asian American mentor in STEMH until she enrolled in a graduate program. The lack of representation of Filipina women, or even Southeast Asian women in STEMH fields, likely impacts the opportunities for more stories that are similar to Pia's experience of being guided into STEMH.

In the intersubjective arena, family members' perceptions and beliefs have a significant influence on Filipina women. Family influence is also gendered due to patriarchal norms that persist in Filipino culture. For example, Stacy was hesitant to let her father down out of fear of negative consequences that could come from him more so than her mother. Some of the participants felt pressure to be conform to their parents' career desires for them. This is exemplified in the case of Emily's mom wanting her and her siblings to be a nurse, and Kamille's family wanting her to pursue a practical career. However, undergirding their parent's career advice was not simply a desire for their children to end up in similar careers, but to ensure their children's financial stability. Additionally, Filipina American children of immigrants often feel a level of indebtedness to their parents for sacrifices made to come to a new country and provide for their children (Chao & Kaeochinda, 2010).

In the experiential arena, it seems that the impacts of colonial mentality on STEMH career aspirations primarily exists through participants' time in school. For example, Gabriela and Stacy internalized their academic struggles rather than attributing some of the challenges to the competitive structure of their courses and universities. It is clear that hiya (shame) manifests in different ways and at different times during the career trajectory. For example, Stacy had to come to terms with the shame of being academically dismissed from her undergraduate institution. Additionally, none of the participants reported they perceived individual and structural forms of racism and sexism while in school. Related to the pervasiveness of colonial mentality, "the ideologies of your family are colonized, and even your own thoughts and actions are colonized, despite your own initial unawareness of the systematic forces at work in the simple procedures of your daily life" (Pierce, 2005, p. 32). Yet, the experiential arena is also where participants shared how they were agentic and found strategies to resist masculine and White cultures in their majors and/or workplaces (Ong, Ko, & Hodari, 2016). Thus, despite multiple axes and levels of domination operating in STEMH, there are were moments of counter-hegemony, agency, and resistance.

Implications for Future Research

Future research can focus on examining family influence on career development, particularly for students with immigrant parents and/or Asian American communities. This work will help to break stereotypes and implications of this scholarship may inform practices for career services, Asian American centers, and faculty and staff who work with Filipina/o and Asian American students may be more aware of familial and cultural pressures and help students resolve career decision conflicts. Given the lack of geographic diversity of where participants grew up in this study, future research can examine patterns and differences between Filipina

Americans who grew up in other states aside from California, including the Midwest and East coast.

Future research on Filipina American in STEMH, as well as other career fields, can contribute to expanding women of color feminisms. For example, Pinayism, coined by scholar Allyson Tintiangco-Cubales (2005), and its expansion into Pinayist pedagogy (Tintiangco-Cubales & Sarmiento, 2009) can examine Filipina women in STEMH from a lens that focuses on praxis and transformation. Pinayism and Pinayist pedagogy aim to "uncover challenges that Pinays face, while creating plans of action that pursue social change for the betterment of their lives" (p. 180). Examining how Pinays in STEMH and other careers work to transform their workplace environments for the betterment of their lives and their communities is alignment with aims of intersectionality research to "critique structures of power and domination, produce transformative knowledges, inform praxis, and work toward social justice" (Harris & Patton, 2019, p. 354).

Lastly, while scholarship on WOC in STEMH is often focused on examining the interlocking effects of racism and sexism, we can also use intersectionality to study underrepresented groups in STEMH by analyzing the influence of additional social identities such as generational status and family income. Particularly when thinking of intersectionality research and examining how racism is gendered and how sexism is raced, this type of analysis poses a challenge for understanding the experiences of Filipina American women since they are rarely, if at all, able to acknowledge intersectional experiences of discrimination until they enter the workforce. However, understanding the legacy of colonization and nuanced understandings of Filipina/o culture can help reveal individual and systemic racism and sexism as these women moved through their education and careers. Thus, research on WOC in STEMH might need to

explore additional methods that allow researchers to understand how marginalized groups are uniquely impacted larger social contexts, higher education, and the STEMH work environment. Too often, studies in STEMH focus on immediate academic environments when the portrait of WOC experiences is much more complex and women, like Fe Del Mundo, must find success in the midst of interlocking oppressions based on multiple contextual layers that influence their pathways toward a STEMH career.

Appendix A

Demographic Screening Survey

Please provide a pseudonym: _____

What is your age? _____

What city and state do you live in? _____

What is your current occupation? _____

In what STEM field would you classify your occupation? _____

What degree is your highest level of education? _____

What college did you attend for your undergraduate degree? _____

What was your undergraduate major? _____

How do you identify?

Race: _____

Ethnicity: _____

Gender: _____

How would you define your socioeconomic class?

When you were growing up: _____

Now: _____

Appendix B

Interview Protocol

As this is a semi-structured interview these are guiding questions; not all question may be asked, and question may not be asked in this exact order. Follow-up question may also emerge during the conversation.

Thank you for agreeing to participate within this study and share your experiences with me. Please know that you participating is voluntary and you reserved to stop the interview or withdraw from the study at any time.

IV. BACKGROUND & EDUCATION HISTORY

1. Please state your name and current role/occupation for the recording.
2. What careers in STEMH did you aspire to in college?
    a. Probe: How was your career aspiration supported in college?
        1. Probe: Were there any influential people or events that sparked or reinforced this interest?
    b. What was your major? How did you decide to major in (insert major here)?

V. INTERSECTIONALITY IN COLLEGE AND STEMH WORKPLACE

10. In thinking about your race/ethnicity, gender, socioeconomic status, or other parts of your identity, what identity or identities were you most aware of in college?
    a. Probe: Have you ever experienced discrimination because of your (sex, gender, race, class) identity while in college?
        i. Probe: What was the nature of the discrimination?
        ii. How do you think your college experiences are similar or different compared to students who differed from you in either their race/ethnicity, gender, or socioeconomic class?
11. What curricular, co-curricular, interaction with peers or interaction with faculty were you involved in and how did they contribute or deter you from your STEMH career goals? (Probe for any specific programs, people, or courses).
12. What college experiences, academic or social, were most critical to the reason why you are in a STEMH-related career today?
    a. Probe: how did confidence impacted your experience in your major and/or in your career trajectory.
    b. Probe: how did faculty supported or guided your experience in your major and/in your career trajectory.
13. In thinking about your race/ethnicity, gender, socioeconomic status, or other parts of your identity, what identity or identities were you most aware of now in your field of work?
    a. Probe: Have you ever experienced discrimination because of your (sex, gender, race, class) identity in the workplace?
        i. Probe: What was the nature of the discrimination?

14. What resources, training, or support do you find most critical to the reason why you are in a STEMH-related career today?

VI. REFLECTION

15. What are your thoughts on underrepresentation in the STEMH workforce?
    a. Probe: What is it like for minority women in particular?
    b. Probe: What does it mean to you to work in a STEMH-related career?
    c. Probe: What lessons have you learned from your experiences in college and since college about working in the STEMH field?
    d. Probe: What advice would you give to college students aspiring for a STEMH-related career who share a background and upbringing similar to yours?
16. Is there anything else that you would like to share that I have not asked you?

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