THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Understanding Women and Asian American Disparities in Computer Science Professions

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SPRING 2022

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Computer Science
with honors in Computer Science

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ABSTRACT

This study analyzes gender and/or racial differences in reporting obstacles in the technology field and other computer science related professionals. Women are underrepresented in computer science professions, and many different theories and frameworks have been offered as an explanation for this underrepresentation. While Asian Americans may have the largest representation in computer science professions, relative to the fraction of the overall population they make up, they may contend with the intersection of the model minority myth and the forever foreigner image. This thesis compares the reporting challenges between different genders and different races to identify gendered and/or racialized challenges that might exist in the technology field. These identified gendered and/or racial challenges can provide technology companies with an insight on creating policies and programs to eliminate these challenges. With respect to the gender gap, the results indicated that men are more likely to report career transitions and financial issues as an obstacle. The results also supplied evidence that women were more likely to report work-life related conflicts than men. In contradiction of the model minority myth, Asian /Pacific Islander computer scientists were more likely to report problems with technology and interpersonal communications and their qualitative responses suggests that they received less support than their peers when facing such challenges. Asian/Pacific Islander American participants were more also likely to report issues related to financial issues than White participants and were more likely to mention interpersonal communication as a challenge in their response than any other racial groups. With the identification of such gendered and racialized challenges, companies can create policies and programs to eliminate such challenges.

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ACKNOWLEDGEMENTS

Most importantly, I would like to share my utmost appreciation for my thesis advisor, Dr. Sarah Damaske for her support and reassurance through my thesis writing process. Even though I am not a part of the Sociology department, she was still able to clearly help me through each stage of the thesis in an understandable and digestible manner; she was enthusiastic to work with me, despite being in the Computer Science and Engineering Department, and she did not let the differences in our academic backgrounds deter her. Dr. Damaske provided me with the motivation and energy to persevere through the more difficult and discouraging stages of the process to ensure that I can present this final product. I would also like to thank Dr. John Joseph Hannan for trusting me to author a thesis with honors in computer science, because he had faith that my thesis was important to the field. Though my paper may be talking through different literature than typical computer science theses, Dr. Hannan still saw the importance of such a study.

I would also like to Dr. Susan McHale, Dr. Sarah Damaske, Dr. Joshua Rosenberger, Jason Park, and Dr. Junjun Yin for providing me access to their data to use for my study. This thesis would not be possible without their carefully collected and organized data, and I greatly appreciate them entrusting me with such data to use for my own thesis.

Lastly, I would like to thank my friends and siblings for their love and support through my thesis journey. I would like to also acknowledge my parents' enthusiasm for completing the thesis as well.

Chapter 1

Introduction

With the recent worldwide COVID-19 pandemic, many existing issues and inequities in American institutions and systems were intensified. For example, the COVID-19 pandemic forced companies to implement new measures to protect workers, such as remote working. These mandates occurred in the engineering and technology fields as well. The transition to remote working highlighted that the intense work culture and expectations associated with many technology companies conflicted with at-home responsibilities and obligations; because at-home responsibilities tend to fall on women, the technology companies' environment creates an unfair burden against women. With more time spent at home as a result of STEM professionals' transitions to work-at-home, it further exacerbated the gendered work-family conflicts. According to a study done by Frize et al. (2021), women were more likely than men to be working from home, but they were still less likely to have access to an office in their homes. Moreover, women were more likely to spend three hours or more on childcare, school, household duties, and chores (Frize et al., 2021). This study clearly emphasizes how social norms continue to perpetuate the gendered roles that women are supposed to take on more of the household responsibilities.

COVID-19 also brought attention to inequities faced by a community that is often ignored in research: Asian/Pacific Islander Americans. Previously, because of the model minority myth, Asian/Pacific Islander Americans were often excluded from racial gap research, especially with research regarding racial gaps in engineering and technology fields. However,

because of former President Donald Trump's rhetoric (i.e., his referral to COVID-19 as the "Chinese virus") towards Asian Americans during the pandemic, hate crimes against Asian/Pacific Islander Americans and Xenophobia have only further increased. The organization, Stop AAPI (Asian American/Pacific Islander) Hate, found nine thousand reports of hate, violence, and discrimination against Asian Americans and Pacific Islanders in the United States during the pandemic (Knutson, 2021). However, Xenophobia and discrimination against Asian/Pacific Islander Americans is not a new phenomenon. Much like the gendered work-family conflicts, this issue and inequity appear exacerbated as a result of COVID-19 and it remains unclear if the rise in discrimination against Asian/Pacific Islander Americans may extend to the workplace, particularly workplaces like STEM fields, where Asian/Pacific Islander Americans workers are overrepresented.

With the recognition that many gendered and racialized obstacles exist in American institutions and systems, it is important to research gender disparities in prevalent fields and industries in America to address these inequities. Engineering and technology continue to have significant gender and racial gaps in occupational segregation, indicating that there are underlying challenges against certain marginalized communities. For example, women are underrepresented in earning STEM degrees, and the proportion of women in STEM career fields decreases at each stage in the pipeline (U.S. Department of Education, NCES, 2014; National Science Foundation, 2011; Xu, 2008). Women have lower entrant rates and higher dropout rates, which translates to increasing gender gaps in engineering and technology. On the other hand, "Asian Americans are the forgotten minority in the glass ceiling conversation" (Gee & Peck, 2021), indicating the extreme lack of research on Asian Americans' struggles in the technology field. According to a report based on EEOC data on Silicon Valley's management pipeline,

Asian Americans are the least likely race to receive a promotion, despite being the most likely to gain an entry-level position (Gee & Peck, 2021). This data shows that while Asian Americans may be well represented in STEM professionals overall, they are still less likely to be represented in higher and more powerful positions.

Research into gender and race/ethnic inequities in engineering and technologies is especially important in the modern day because of the exponential growth and advancement in technology in the past few decades (Rose & Ritchie, 2013). The data indicates that the number of transistors on integrated circuits doubles approximately every two years, which is an exponential growth in the number of transistors being used on integrated circuits (Rose & Ritchie, 2013). This phenomenon is called Moore's Law (Rose & Ritchie, 2013). This trend of the number of transistors on integrated circuits is directly related to the advancement of technology as well (Rose & Ritchie, 2013). The rapid advancement of technology further emphasizes the need to ensure that women and Asian Americans are properly represented in the technology field; it is important to ensure that marginalized communities do not continue to be left behind during this period of innovation. Marginalized communities being underrepresented can lead to unforeseen biases to become systemically embedded into the field because there are no voices to prevent such courses of action.

The goal of this study is to identify gendered and racialized (specifically, with respect to Asian Americans) obstacles that exist in technology and computer science related fields. The paper will use a pre-existing dataset of 3945 men and women working in Computer Science, Engineering or Mathematics related fields collected using a Qualtrics research panel for a Penn State study (CSEM 2021) for McHale et al. (2021) in April 2021-June 2021, which looked at challenges and

difficulties that individuals faced in computer science, engineering, and math. This paper will sample specifically for computer science within this data, so that it can focus on the computer science and technology field of STEM. The CSEM data included demographic, family, and work characteristics questions, as well as two open-ended questions. I qualitatively coded responses to the question, “thinking back across your CSEM career, please describe the biggest career challenge you faced and how you responded to this challenge” in order to identify if any trends exist in the reporting of challenges. For example, the results of the coding of the responses will determine whether there are any gendered and/or racialized trends in mentioning obstacles in their responses.

Chapter 2

Literature Review

This literature review will determine whether there is compelling evidence of gendered and racialized barriers for individuals in computer science.

The Gender Gap in STEM

There is longstanding evidence that a uniquely large gender gap in occupational segregation exists in STEM. According to the United States Department of Education, while undergraduate women earned 59% of degrees in biological and biomedical sciences, they only received 43% of degrees in mathematics and statistics, 18% of degrees in computer and information sciences, 19% of degrees in engineering, and 38% of degrees in the physical and technological sciences (U.S. Department of Education, NCES 2014). Women's representation in graduate level degree training is also low: women make up 30% of masters and doctorates in mathematics, 25% of masters and doctorates in computer science, 23% of masters and doctorates in engineering, and 31% of masters and doctorates in physical sciences (National Science Foundation, 2011). These statistics indicate that the gender gap seems to persist more obviously in STEM than in other fields that were previously dominated by men.

Women's underrepresentation in STEM education translates to an underrepresentation of women in STEM careers. In fact, women's representation in the STEM field declines at each stage of the pipeline (Xu, 2008). Fewer women are joining the field and more women are leaving the field. Glass et al. (2013) examined the retention of women in STEM-related occupations in comparison to other professional occupations. This study emphasizes the differences in women's

participation across different occupational fields, rather than the difference in the participation rate between men and women within the STEM occupational fields. This framing of the study helps highlight the exacerbated gender gap that exists in STEM. According to the results, women are significantly more likely to leave STEM occupational fields than other professional occupational fields (Glass et al., 2013). The trend of women leaving the STEM occupational field was most notable during women's early careers (Glass et al., 2013). Women in other professional fields exhibit similarities across a range of different characteristics (i.e. work hours, number of children, et cetera), which indicates women's home-life demands were approximately the same across different fields. However, women still left STEM at much higher rates, and the women who did leave STEM often did not drop out of the labor market entirely and searched for careers in other professions. This trend suggests that STEM has obstacles against women that do not exist in other fields.

Mathematical Abilities

Despite the fact that the STEM field demands a wide array of skills, individuals' mathematical abilities have been used as a longstanding measure of their potential in the STEM field (Hyde, 2014). Historically, there have been claims from individuals as powerful as a former President of Harvard that a gender gap persists in STEM as a result of women lagging behind men with respect to mathematical abilities (Dillon, 2005). There is a longstanding belief that men perform better in mathematics and thus would perform better in STEM. These expectations likely stem from the implicit and explicit biases that men are better at math and hard sciences and women better at arts and soft sciences. However, in recent decades, studies have proven that this supposed gap in performance in mathematics does not exist; men's and women's

mathematical abilities “have reached parity” (Hyde, 2014). The evidence from such a study indicates that there is no significant difference in performance within mathematics to serve as a gendered obstacle between men and women in STEM.

However, there may be gendered differences in how they perceive their own abilities in mathematics. According to Penner and Willer (2019), men are significantly more likely than women to retake a math course if they did not pass the course. Men generally have more faith in their mathematical performance and abilities than women (Penner & Willer, 2019). In fact, even when women achieve higher scores and grades in STEM, they are still significantly less likely to consider STEM as a viable option for their future (Miller et al., 2006). These differences in self-assessments can impact individuals’ decisions to continue their education or career in STEM. The expectancy-value model, coined by Eccles (2011), predicts that individuals make decisions about their careers and futures based on their expectations of future success in the field and the value (i.e., the prosperity, the recognition, the social impact, et cetera) the individual places on the field. These values are shaped by the way they are socialized as individuals. Therefore, those who have greater confidence in their mathematical abilities are significantly more likely to continue pursuing an education within the STEM field (Eccles 2011). These expectations and values can differ based on gender as a result of the gendered ways in men and women are socialized. Since men are generally more likely to be pushed towards STEM-oriented activities, they are significantly more likely to have higher expectations for themselves and values associated with STEM than women. These differences in expectations and values can explain why women are less likely to enter or remain in the STEM field.

Moreover, stereotypically, people consider that success in STEM is associated with innate intelligence or brilliance, while the same belief is not held with non-STEM fields (Meyer

et al., 2015). This assumption about innate intelligence can be a hindrance when coupled with a fixed mindset, a perspective that believes one's intelligence is a predisposed trait and not one that can be improved through "effort, practice, and persistence" (Wang & Degol, 2016). Women are more likely to exhibit a fixed mindset and are, thus, more likely to be deterred by difficulties they face in mathematics because they view mathematics as an innate ability (Dweck, 2007). This vulnerability may cause women to prematurely or inaccurately perceive themselves as not capable of a career in STEM.

While there is no evidence of discrepancies in the absolute mathematical performance between men and women, there is evidence that there may be differences in men's and women's strength relative to their other strengths. When individuals perform better in mathematics than humanities, they will likely pursue a career in STEM; however, when individuals have relatively similar abilities in both math and humanities, they will likely pursue a career that is not in STEM (Wang et al., 2013). There is evidence of gendered differences in these relative cognitive strengths, with men typically having higher math abilities than verbal abilities while women's skills in mathematics and humanities are comparable (Wang et al., 2013). These differences in relative cognitive strength can serve as gendered opportunities for women to pursue careers outside of the STEM field. Valla and Ceci (2014) described how having comparable abilities across a wide array of disciplines, rather than specific talent in one domain, can lead individuals to be more open to various possibilities for their career goals.

Personal Preferences and Goals

However, while there is no evidence of differences in abilities between men and women, there is well-documented evidence for discrepancies in personal preferences and goals. An

analysis by Su et al. (2009) indicated that men preferred careers that work with material goods and objects while women preferred human-centered careers. Women often prefer careers based on the positions' contributions to communal goals; women tend to choose careers where they can help others and the greater good. Stereotypically, STEM contradicts these goals, for STEM is often portrayed as a cold and mechanical discipline. The study conducted by Diekman et al. (2010) found two important results to back these claims. A significant fraction of the individuals in the study believed that communal goals and the STEM field are not aligned, and, thus, those with the personal value of working with and helping people have significantly less interest in STEM professional occupations (Diekman et al., 2010). Moreover, individuals' prioritization of communal goals in their careers choices acts as a mediator between the gendered differences in interest for pursuing a career in STEM (Diekman et al., 2010). The study by Freund et al. (2012) found that women tend towards socially oriented careers because they are more motivated by altruism than men. There is evidence of such tendencies within the STEM field itself, with women pursuing more careers in more human-centered subfields, such as biomedical and environmental engineering, than other more technical and math-heavy subfields (Ceci & Williams, 2011). Another study by Canney and Bielefeldt (2015) also found that women tend towards engineering subfields that focus more on human, such as biomedical, environmental, and civil engineering. The results indicate that personal goals and preferences may serve as a gendered obstacle in STEM professional occupations; women may feel more inclined to leave their positions because, compared to men, women may be more likely to perceive a misalignment between their own values and STEM occupation goals.

This trend can be especially seen in the computer science field. Stereotypically, professionals in technology companies are "coding-obsessed geek[s]" and are cisgender men that

"embody a masculine or 'frat like' culture" (Wynn & Correll, 2017). These wide-shared beliefs of the model computer scientist directly conflict with the social role of women: community-focused nurturers who enjoy more social and human-centered work (Eagly & Steffen, 1984). Because of the conflicts in the socialization of women and the stereotypes of the successful software engineer, women reported having lower cultural and skill alignment of a professional in a technology company than men (Wynn & Correll, 2017). The work culture and the environmental factors found in technology companies can deter individuals with more feminine characteristics from joining the workforce (Sassler et al., 2017). This misalignment, whether it is perceived or real, creates feelings of exclusion and disidentification in their work among women (Wynn & Correll, 2017). The manifestation of such self-doubt and imposter syndrome-related symptoms can lead to difficulties to join or remain in the technology workforce. The misalignment can manifest even among women's networks. Women are significantly less likely to have individuals who are pursuing a STEM career in their social network; women will adjust their interests and goals to align with those in their social network in order to avoid exclusion (Raabe et al., 2019).

Work-life Balance with Respect to Family and Self

Gender roles are defined and maintained by how hegemonic cultural beliefs about gender interact with and impact the social context of individuals (Ridgeway et al., 2004). This model can explain why stereotypically women are assumed to be the caretaker, the homemaker, the housewife, et cetera (Ridgeway et al., 2004). Therefore, there is an expectation that the woman in a relationship between a man and woman should leave their full-time STEM position – rather than the man – to become a full-time parent. According to empirical data, households are

significantly more likely to relocate for husbands' careers at the expense of the wives' career. An eight-year longitudinal study, conducted by Cech & Blair (2019) examined the career trajectories of new parents, who are STEM professionals. The study found that "43% of women leave full-time STEM employment after their first child" and that "new mothers are more likely like than new fathers to leave STEM, to switch to part-time work, and to exit the labor force" (Cech & Blair, 2019). However, the study did find that new parents, regardless of gender, are significantly more likely to leave their full-time STEM positions than their non-parent counterparts. Therefore, some may argue that this trend of women leaving the workforce for their families as a result of the aforementioned socialization of women may be found in all disciplines and is not unique to STEM. But, when considering the results of this study with the conclusions of the study done by Glass et al. (2013), there are clearly barriers that are specific for new parents in STEM and that women are more susceptible to these barriers. It is reasonable to conclude that new mothers with a career in STEM are more likely to choose to leave their full-time position rather than new mothers in another profession. This indicates that these barriers are both field-specific and gendered.

In fact, according to interviews of successful women in engineering, persistent women engineers were significantly less likely to be married and had fewer children, suggesting that a successful career in STEM conflicts with typical women's family goals (Buse et al., 2013).

Implicit and Explicit Bias

While gendered discrepancies in preferences, abilities, and expectations may explain some of the supply-side barriers that women face in the STEM field, implicit and explicit biases of their coworkers and higher-level executives play a role in gendered demand-side barriers.

There are deep-rooted "beliefs and stereotypes that associate men, more than women, with science, math, leadership, or careers" (Charlesworth & Banaji, 2019). Charlesworth & Banaji (2019) further noted that these explicit and implicit biases have evidence to be "prevalent across the lifespan, across gender, across nations, and across time." These biases can lead to hiring managers having an incorrectly held belief that men are more suitable contenders for STEM positions and promotions (Charlesworth & Banaji, 2019). Women are forced to strive for excellence beyond the standards of their counterparts of the other gender in order to get the same position or promotion. Reilly et al. (2016) conducted an experiment to evaluate the competence of STEM interns; the results of this study indicate that women were viewed as less competent with various challenges significantly more likely than men. Women who struggled or ran into challenges were viewed as "confirmation of stereotypes about their ill-suitedness for STEM fields."

Studies have also shown that these biases play an important role in work culture. Moss-Racusin et al. (2018) examined the impact of these gender biases on STEM engagement between men and women. The experiment concluded that gender bias does create a hostile environment for women, such that women have a significantly lower "sense of belonging, positivity towards, and aspirations to participate in STEM" than men (Moss-Racusin et al., 2018). Women are forced to contend and reconcile with this unwelcoming setting, simply as a result of their gender.

According to a report by Ganley et al. (2018), women cited their belief that they would face more discrimination in STEM professional occupations for avoiding and leaving the STEM field. Another study conducted by Buse et al. (2013) found that women persisted in their STEM careers when they had higher self-efficacy and identified with the engineer image. These results

indicate the importance of belonging with regards to persistence in STEM careers. These responses clearly indicate there are both gendered and occupation-specific obstacles in STEM. These biases do not only come from external sources. Women internalize many of these biases as well. Cech et al. (2011) conducted a study to determine how familial obligations, low self-assessments, and low professional role confidence all could contribute to the attrition of women in STEM. Professional role confidence captures "individuals' confidence in their ability to successfully fulfill the roles, competencies, and identity features of a profession" (Cech et al., 2011). The study found that neither family plans nor low self-assessments served as a determinant for attrition in STEM; however, low professional role confidence did have a causal relationship with persistence in the STEM field. Specifically, the likelihood of pursuing a STEM career and career-fit confidence have a positive relationship. Thus, since the expected discrimination (Ganley et al., 2018) and lower sense of belonging (Moss-Racusin et al., 2018) decrease women's career-fit confidence, women are significantly more likely to not pursue a STEM career. In fact, previous reports have found that women's decision to remain in the STEM field had a strong casual relationship with their environment (Corbett & Hill, 2015).

There are also more explicit forms of bias, such as the pollution theory of discrimination (Goldin, 2014). This theory posits that allowing individuals from underrepresented groups to join the field will tarnish the prestige of the field. Individuals with this mindset believe that the standards are being lowered for underrepresented groups to join the field. In the case of STEM, a field stereotypically associated with men, individuals would believe that the standard is being lowered for women to enter the field, which would tarnish the image of STEM.

To understand the consequences of these implicit and explicit biases, it is important to consider the impact of the social-psychological phenomena, stereotype threat, on women's

interests and abilities in STEM. Shapiro & Williams (2011) define stereotype threat as a "concern or anxiety that one's performance or actions can be seen through the lens of a negative stereotype." Spencer et al. (1999) showed that stereotype threat does have a causal relationship with performance in mathematical abilities. In their study, when women were informed that there are gender differences in performance on a test they performed significantly worse than they were not informed of such gender differences (Spencer et al., 1999). Stereotype threat has led to poor performance on assessments involving other STEM and leadership aspects as well (Shapiro & Williams, 2011). Therefore, the aforementioned sense of not belonging and disidentifying with the STEM field can lead to gendered underperformance due to the stereotype threat that women may perceive.

Asian Americans' Experience in STEM

Model Minority Myth

The model minority myth describes Asian Americans as a "particularly successful" marginalized community "across academic, economic, and cultural domains" that other less successful racial groups should look towards as a model (Profession, 2019). The stereotype plays on the idea that Asian Americans typically hold more "perceived achievements" in comparison to other racial groups in the country (Profession, 2019). While these stereotypes may not seem harmful on the surface level, any stereotype – whether positive or negative – may be a divisive force and may create unintended obstacles and issues.

Asian Americans have been excluded from much of the STEM research due to the perceived achievements they have earned as a minority group. In fact, according to the United

States Census (1968 to 2018), Asian Americans earned a higher real median income than non-Hispanic White Americans, even as non-Hispanic White Americans earned a higher real median income in comparison with all other remaining racial groups. Not only do Asian Americans have the highest real median income, but Asian Americans also make up the largest fraction of managerial positions (Kern, 1988). With respect to STEM, Asian Americans hold 5.5% of STEM occupations. With respect to the fraction of the total United States population that each racial group makes up, Asian Americans have the highest rate of STEM employment among any racial group, even though they make up the lowest fraction (5.5%) of overall STEM professionals than any other racial group (Landivar, 2013; U.S. Census Bureau, 2021). Such data creates the narrative that Asian Americans should not be studied as a minority group because, on the surface level, they seem to not be facing the same disadvantages as other racial groups.

Moreover, the model minority myth can create unreasonable expectations for Asian Americans to be high achieving among their peers. Lee & Zhou (2015) used the "success frame" as a model to describe the strict and overbearing pressures from family and the Asian American community to receive degrees from Ivy League universities and pursue skill-intensive fields, such as STEM, medicine, and law. In order to meet these expectations of the model minority myth, Asian Americans may overwork themselves and those who fail to reach these expectations may be outcasted and rejected from their Asian American community.

Forever Foreigner

However, despite being portrayed as the quote-unquote successful minority group in contrast to other racial minority groups in the model minority myth, Asian Americans are still considered "forever foreigners" (Tuan, 1999). Tuan (1999) described "forever foreigners" as a

racial minority group that will never be seen as an American from the white, western perspective that is prevalent in modern society. Asian Americans are consistently "exotified, objectified, and marginalized" as a result of the "White gaze" (McGee et al., 2017). Asian Americans are constantly seen as separate from White Americans. However, because Asian Americans are often viewed through the lens of the model minority myth, the true nature of their experiences are not properly researched and understood.

This exclusion from being a White American is especially prevalent for South Asian Americans. Despite the fact that eighty percent of South Asian Americans have degrees or jobs in STEM or the social sciences and South Asian Americans have a higher rate of graduate-level degrees than the general United States population (Bhattacharjee, 2021), they still face an extensive amount of Islamphobic and racist discrimination. These prejudices escalated after the 9/11 attack and Former President Donald Trump's executive order of the "Muslim Ban." As a result of these racist stereotypes and prejudices, South Asian Americans appear to face increasing bias and this study will ask whether such bias reaches inside the workplace.

The Intersection of the Model Minority Myth and the Forever Foreigner

The double burden of the model minority myth and the forever foreign alienate Asian Americans from both White Americans and other racial minority groups. With respect to White Americans, because Asian Americans are always seen as foreigners, they can never enjoy the full privilege that White Americans do. According to the study done by Huynh et al. (2011), the constant reminder of not being a White American significantly lowered Asian Americans' sense of belonging in their surrounding culture and created identity conflicts. The perpetual foreign stereotype also acts as a predictor for "lower hope and life satisfaction for Asian Americans"

(Huynh et al., 2011). This can demotivate Asian Americans from pursuing careers where White American culture is prevalent, such as technology companies. Shams (2019) reported that South Asian Americans' do not have the luxury of the same sense of security that their White counterparts enjoy; even with academic and financial achievements, South Asian Americans are hindered because of their racialized identity. This conclusion was based on observations that South Asian Americans reported fears of their identity, specifically related to race and religion, undermining their achievements (Shams, 2019). Such anxiety can manifest as obstacles in both their education, career preferences, job-changes, and upward mobility (Shams, 2019).

However, because of their seemingly higher achievements (i.e. higher real median income, higher rate of STEM professionals with respect to their overall population in America) in comparison to other racial minority groups, it also drives hostility between Asian Americans and other racial groups. Asian Americans are often viewed as too privileged among other racial groups and are excluded from the solidarity of being a racial minority in a White society. Chen & Buell (2017) argue that the model minority myth is a tool that is used to perpetuate the "neoliberal racial project" because the model minority myth takes advantage of both the prestige of STEM and the racialization of Asian American. For example, the neoliberal racial project has a pillar revolving around the idea that it is only an individual's sheer will that determines their social and economic mobility, disregarding the circumstantial obstacles that may exist for marginalized communities. The model minority myth supports these claims, which only further uplifts the neoliberal racial project, and was used by White Americans to contrast and undermine the Black activism working to highlight the injustices in America's institutional systems. Essentially, the model minority myth helps to reinforce the American dream that "whoever is at the top, so to speak, deserves to be there, and whoever is at the bottom must not have worked

hard enough" (Chen & Buell, 2017). The model minority myth not only marginalizes Asian Americans from White Americans, but it also serves as a divisive force between Asian Americans and other racial minorities. This may serve to isolate Asian American/Pacific Islander workers in STEM fields from both white workers and from Black or Latino workers who might otherwise be potential allies in the workplace.

Chapter 3

Methodology

Participants

The data used for this thesis was drawn from a larger dataset studying the career program of women and men in computer science, engineering, and math (CSEM). McHale et al. (2021) utilized the Qualitrics research panel to recruit individuals who currently hd a career in CSEM. The Qualitrics research panel allowed the recruitment of populations who are typically underrepresented in research and assured that participants met the eligibility requirements ("over 18 years of age, living in the U.S. and in a CSEM occupation") through its prescreening feature (McHale et al., 2021). The complete dataset consisted 3,945 participants surveyed from March 2021 to June 2021. Approximately one-third of the sample were women and two-thirds were men. One-third of the sample identified themselves as White participants, 12% of the sample identified themselves as Black participants, 11% of the sample identified themselves as Latinx participants, 9% of the sample identified themselves as Asian/Pacific Islander participants, and 2% of the sample identified themselves as Native American participants. Black and Latinx participants were overrepresented in this sample, relative to Black and Latinx representation in CSEM careers in the general population, and Asian/Pacific Islander and Native American participants were underrepresented in this sample, relative to their representation in CSEM careers in the general population (McHale et al., 2021).

For the focus of this thesis, 281 respondents were selected from the general data set. All of the respondents must have selected "Technical" in the occupational role field. This criteria ensured the subsample was focusing on individuals with a computer science and/or technology

background. To select the respondents, I first randomly selected ten respondents for every fifty respondents. Then, to ensure I had a comparable representation of Asian/Pacific Islander participants in the subsample, I oversampled for participants who selected "Asian/Pacific Islander" in the "ethnic" field. The subsample consisted of 153 men (71 Asian/Pacific Islander participants, 24 Black, Latinx, Native American, Other participants, and 58 White participants) and 124 women (62 Asian/Pacific Islander participants, 26 Black, Latinx, Native American, Other participants, and 36 White participants).

Measures

McHale et al. (2021) developed two open-ended questions to ask the participants of the Qualtrics research panel:

1. What have been the main factors (e.g., your personal characteristics and situation; family; education; career prospects; financial prospects; work characteristics and experiences, etc.) responsible for your pursuing a career in Computer Science Engineering and/or Math (CSEM)?
2. And, thinking back across your CSEM career, please describe the biggest career challenge you faced and how you responded to this challenge.

The participants also reported on their family and job characteristics. This information was used to collect background and other explanatory characteristics.

Analytic Approach

To code the responses to the second open-ended question, I first identified a list of themes that are commonly reported as barriers among individuals with careers related to

computer science. Within each theme, participants' responses can be coded into different variations of the theme. If a participants' response is not related to the theme, then it would be coded as "None." I identified 7 themes: technological challenges, COVID, financial issues, career transitions, work culture, interpersonal relations, and personal issues. To code each response, I read and analyzed the participant's response to the second open-ended question and identified which themes were most relevant. If more than one qualitative variation under a specific theme seemed relevant to a response, we chose the qualitative reporting that was most relevant to the response.

Strengths and Limitations

This study is critical in this day and age, for technological advancements have been growing at exponential rates in recent decades (Rose & Ritchie, 2013). Moore's Law tracks this exponential progress through "the observation that the number of transistors on integrated circuits doubles approximately every two years" (Rose & Ritchie, 2013). The rapid expansion in the number of transistors on integrated is related to the complexity and capabilities of modern technology (Rose & Ritchie, 2013). Because of the ever-growing prevalence of technology, it is important to not let certain groups and marginalized communities to be underrepresented in this field. It can only further exacerbate inequities in the field if marginalized communities' voices continue to be undermined. Thus, research on the struggles and obstacles women and Asian

Americans face in computer science and the technology field is critical to ensure that their voices are not diminished in technology.

Since this thesis will be focusing on a relatively small sample of women and Asian Americans, qualitative responses can be used to get a more in depth understanding of the struggles and conflicts marginalized communities face. Interview-based research can be used to discover "hidden patterns and dynamics that take place within institutions, social contexts, relationships, and individual experiences" (Gerson & Damaske, 2020).

However, because this thesis utilizes preexisting data that was intended to research CSEM in general and not specifically computer science, there are some limitations to this study. For example, the subsample used for this study was pulled using the occupation role field; however, there was no procedure to ensure that participants had similar understanding of this field. Therefore, there may be some misreporting of whether an individual is in the technical and computer science field. Moreover, the second question was open to interpretation: it simply asked for the "biggest career challenge" that the participant faced in their career. Participants were not informed that this survey is being used to study gender or racial gaps that may exist in their work environment. Since "biggest career challenge" can be interpreted in many ways, just because a participant did not report a particular an issue as their most prevalent challenge, it does not mean they do not contend with such conflicts.

Chapter 4

Findings

Gender Gap Results

Technological Challenges

Technological challenges were one of the most reported challenge; more than 25% of the individuals in the subsample mentioned technological challenges in their responses. In the analysis, technological challenges were broken down into five components; the breakdown by gender of technological challenges is illustrated in Table 1 below.

Table 1: Gender Differences in Reporting Technological Challenges

		Men	Women
Technological Challenges			
	A lot of difficult technologies	*7*	*10*
	Finishing Education	*16*	*5*
	Mathematical and/or Programming Concepts	*10*	*8*
	Pace of modern technology advancement	*11*	*10*
	Total Technical Challenges	***44 (28.8%)***	***33 (26.6%)***
	None	***109 (71.2%)***	***91 (73.4%)***

Based on the coding of the responses in the subsample, approximately 29% of men reported technological challenges and approximately 27% of women reported technological challenges. Moreover, men overwhelmingly reported challenges with formal education and

mathematical and programming concepts, while women reported more challenges with the industry technology itself.

For example, one woman described the obstacle of the sheer number of technologies she had to learn initially:

> *"The biggest challenge I faced was starting out, [for] I [did not] know much about how computer systems worked. Getting a foothold was a considerable challenge."*

Another woman described how *"nothing was easy, it was hard to keep on trying when nothing made sense and I was tired."* Since women's responses indicated more concern about unfamiliarity with the technologies used for their professions, it indicated that there may be gendered differences that may cause these barriers. These barriers may arise for a variety of reasons, such as the way women are socialized differently from men as discussed in the literature review. Women also more often reported struggles related to the pace of modern technology advancement, with *"the biggest challenge in this career [being] the consistent acquisition of the required skilled."* The differences in the rate of reporting such technological challenges suggests that women may be less prepared for the industry's technology than men are when entering the technology field.

On the other hand, men were more likely to report issues with more rudimentary mathematical and programming concepts, which counters the long-standing argument that the gender gap is a result of women having poorer performance in mathematical abilities. For example, one man detailed his struggles with math:

> *"I was not the best at math growing up, so I had to work hard to study and overcome that obstacle. It was not easy."*

These differences in responses can help pinpoint what stages in the pipeline to the STEM career that may be causing these gendered differences in technological challenges. By adding additional on-the-job training in new technology and concepts at these stages, it can counter some of the reported gender disparities.

COVID

Because this study was conducted in the past two years, it is unsurprising that COVID-19 and the related changes to the work environment were also reported as challenges in participants' responses. Fourteen of the 277 participants in the subsample reported COVID-19 as their largest obstacle, as indicated by Table 2.

Table 2: Gender Differences in Reporting COVID Challenges

		Men	Women
COVID			
	Reported COVID as an issue	***8 (5.2%)***	***6 (4.8%)***
	None	***145 (94.8%)***	***118 (95.2%)***

With respect to COVID and the impact it had on the work's day-to-day responsibilities, men and women had a similar likelihood to report the transition being difficult. However, the difference was only half a percent; therefore, further studies would be required to see whether the difference is significant. Both men and women reported issues with the remote environment that resulted from companies' response to COVID-19 safety protocol. One respondent described how these changes have impacted him:

"The biggest challenge I have faced is having to deal with the large effects of the [COVID]-19 pandemic on my organization. Given my position most of the workload was placed on my role."

Another respondent discussed the impact the remote work had on his physical health:

"At times being at a desk for extended periods has taken a toll on my posture and caused back pain. Overall I enjoy working in a CSEM office environment."

Responses such as these indicate both men and women benefit from the face-to-face interactions they experience at the offices. For other respondents, COVID-19 created more barriers for obtaining a position:

"The pandemic hit right as I was starting to look for a career, and that made a good job difficult to find. I overcame this by using some connections and also my skills to land a fully remote position in a technology solutions company."

This quote suggests that COVID-19 related issues could be further exacerbated if participants do not have other advantages (such as connections). Such advantages could be gendered and will be explored in later sections.

Financial Issues

For the analysis, financial issues were broken down into two components: financial issues related to education-related debt (i.e., student loans) and financial issues related to income. The gendered breakdown of these financial issues is defined in Table 3.

Table 3: Gender Differences in Reporting Financial Issues

		Men	Women
Financial Issues			
	Education-related debt	*3*	*3*
	Income-related issues	*6*	*3*
	Total Financial Issues	***9 (5.9%)***	***6 (4.8%)***
	None	***144 (94.1%)***	***118 (95.2%)***

Similar to COVID, there was not a significant difference in reporting of financial issues between men and women. However, it is notable that men were more likely to report income-related issues with regards to financial issues while women are more likely to report education-related debt (i.e., paying off student loans).

One woman reported about her frustration with student loans:

> *"The biggest challenge I faced was paying for college. It atrocious how much these schools charge and they barely offer education anymore. It's all liberal [propaganda] being taught now."*

Another woman discussed how she *"had work at McDonald's"* because she was struggling to get a job in the STEM career field initially. Since she was *"paying off [her] student debt,"* she could not afford to be unemployed while looking for a STEM professional position. This obligation for STEM professionals to hold two jobs in order to afford their basic necessities.

On the other hand, men responses included more reports with challenges related to "[his] income" and "finding a job with good benefits." One respondent described why this income-related issue was especially pertinent:

"The biggest career challenge in [CSEM] … was my money [problem], … in that time I [did] not [have] enough money to increase myself in that career."

The participant was indicating that for the time commitment that their career demands, their income was not satisfactory. The time-wage tradeoff was more costly than beneficial.

Career Transitions

Responses containing challenges related to career transitions was analyzed in the context of three components. This study looked at the transitions for individuals first entering the STEM field/company with a STEM background, individuals who are looking for promotions and/or better positions within the company they are already employed at, and individuals entering the STEM field/company with no STEM background. This analysis is broken down in Table 4.

Table 4: Gender Differences in Reporting Career Transitions Challenges

		Men	Women
Career Transitions			
	Entering the STEM field and/or a new company	*18*	*15*
	Moving up within the STEM field and/or obtaining promotions	*9*	*3*
	Transition from a non-STEM related career to a STEM career	*7*	*4*
	Total Career Transitions	***34 (22.2%)***	***22 (17.7%)***
	None	***119 (77.8%)***	***102 (82.3%)***

The results of career transitions indicate that men were more likely to report issues regarding career transitions than women. However, interestingly, within the sample of men (n=34) who reported career transitions as a challenge, they were equally likely to report challenges with entering the STEM field and issues with obtaining promotions and/or transitioning from non-STEM related careers to STEM-related careers. On the other hand, among the women (n=22) who mentioned career transitions challenges in their response, an overwhelming majority reported entering the STEM field as their biggest challenge.

Work Culture

Work culture was the most reported challenge among all the participants in the subsample. In this thesis's analysis, work culture included both the work environment and its expectations and work-life balance that workers had to manage. The gendered breakdown of work culture challenges is reported in Table 5.

Table 5: Gender Differences in Reporting Work Culture Challenges

		Men	**Women**
Work Culture			
	Work-life balance related to family/self	*9*	*11*
	Work-life balance related to education	*1*	*7*
	Unrealistic expectations	*11*	*9*
	Assimilating to the STEM work environment	*18*	*9*
	Administrative and/or housekeeping issues at work	*5*	*1*
	Total Work Culture	***44 (28.8%)***	***37 (29.8%)***
	None	***109 (71.2%)***	***87 (70.2%)***

Work culture encapsulated both the general expectations and work environment as well as work-life balance. Women were more likely to report work-life balance issues than men; approximately 15% of the women in the subsample reported experiencing work-life balance conflicts while only approximately 7% of the men reported similar issues. Surprisingly, approximately 22% of the men reported issues related to the work environment, while only 15% of the women reported such issues.

For example, one woman described in her response how *"[her] biggest challenge is looking after [her] family while pursing [her] career."* Many women responded with similar struggles with work-life balance related to family. In fact, there are expectations that individuals in technological professionals continue working over the weekend. These pressures further reduced the time women were able to spend with their family, and they had to set explicit boundaries in order to ensure some form of work-life balance:

> *"It was hard to balance my home life and my kids so I have decided to take the weekends off to spend time with my kids."*

Other women talked about how their career seemed to block their own personal growth: *"The time [was my biggest challenge]. Always I feel that I need more time … to be better."* Another woman similarly talked about the expectations of constantly working impacted her, *"My biggest challenge is having limiting time to myself."* These reporting all indicate that women are more likely to indicate a conflict with work-life balance than men.

On the other hand, in the subsample of men, one respondent described his conflicting struggles between the unwelcoming work environment and financial restraints:

> *"My biggest career challenge was when I was [not] comfortable in the work environment I was put in. I had a choice: to continue to suffer in conditions I was [not] [okay] with or quit a [well-paying] job and go back on the search."*

Other respondents talked how they struggled with *"adjusting to people and situations"* and the demanding *"hard work that [is] involved."* For example, one man gave a specific example of the typical expectations he may have on a day-to-day basis:

> *"The biggest challenge I faced was working through an upgrade that took down, for [three] days, a system responsible for $4 [billion] in annual revenue. Persistence and teamwork were the two things that got me through the challenge."*

Interpersonal Communication

Interpersonal communication was another common challenge that was reported among the responses in this study's subsample. Interpersonal communication included issues related to communication between coworkers as well as communication between upper/top levels. The gendered breakdown of the reporting of interpersonal communication is indicated in Table 6.

Table 6: Gender Differences in Interpersonal Communication Challenges

		Men	Women
Interpersonal communication			
	Connections and/or network	*4*	*3*
	Interpersonal communication between coworkers	*8*	*6*
	Restricted guidance with work	*2*	*3*
	Communication with upper/top levels	*6*	*2*
	Disrespectful communication related to identity	*9*	*11*
	Total Interpersonal Communication	***29 (19.0%)***	***25 (20.2%)***
	None	***124 (81.0%)***	***99 (79.8%)***

The results indicated that women were slightly more likely to report interpersonal communication as an issue than men; however, very marginal differences between the likelihood of a man reporting interpersonal communications as a challenge and a woman reporting it as a challenge is surprising. Based on the literature review and its associated predictions, this thesis would have expected women to be much more likely to report this issue. It is notable that men were much more likely to report communication with upper/top levels than women.

Personal Issues

Personal issues were reported less frequently than technological challenges, career transitions, or interpersonal communications. The literature review would have predicted participants who identified as woman would have reported imposter syndrome and/or self-

consciousness related to their identity more often; however, Table 7 indicates that this study's results proved otherwise.

Table 7: Gender Differences in Reporting Personal Issues

Personal issues		Men	Women
	Burnout	*1*	*3*
	Self-conscious of identity	*9*	*6*
	Imposter syndrome	*7*	*2*
	Personal motivations	*3*	*7*
	Total Personal Issues	***20 (13.1%)***	***18 (14.5%)***
	None	***133 (86.9%)***	***106 (85.5%)***

Women were marginally more likely to report personal issues than men. These results are surprising, for the literature review and this thesis predicted that women would more likely report such issues. Moreover, even within the sample of people who reported personal issues (n=38), men were more likely to report issues related to imposter syndrome and self-consciousness of identity and women were more likely to include burnout and personal motivations in their responses. It is important to remember that the individuals in this study were only asked to report their largest challenge, which makes it much more subjective for participants to interpret in various manners. For example, some participants took a more straight-forward interpretation of the question and described projects that were more challenging, and other participants had a more introspective interpretation of the question Therefore, it is not possible to conclude that women do not experience these challenges as well.

Racial Gap Results

Technological Challenges

Similar analysis to the gender gap was done with racial discrepancies as well. Table 8 reports the racial breakdown of participants in the subsample who indicated technological challenges in their responses.

Table 8: Racial Differences in Reporting Technological Challenges

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Technological Challenges				
	A lot of difficult technologies	*4*	*8*	*5*
	Finishing Education	*5*	*14*	*2*
	Mathematical and/or Programming Concepts	*6*	*10*	*2*
	Pace of modern technology advancement	*7*	*9*	*5*
	Total Technical Challenges	***22 (23.4%)***	***41 (30.8%)***	***14 (28.0%)***
	None	***72 (76.6%)***	***92 (69.2%)***	***36 (72.0%)***

In terms of racial breakdown, Asian/Pacific Islander participants were most likely to report technological challenges, while white participants are the least likely. Within technological challenges, White participants roughly evenly reported across the different subproblems. On the other hand, Asian participants were more likely to include finishing education as their technical challenge. Such results refutes the assumptions proposed by the model minority myth, which predicts that Asian/Pacific Islander Americans excel more in technological concept than other racial minorities. A possible explanation for these seemingly contradictory results is that, given the model minority myth, Asian/Pacific Islander professionals

may not receive the same level of support or training than other groups. Because of this undermining of support for Asian/Pacific Islander professionals, it could lead to poorer performances in technological concepts among this minority group.

COVID

As described in the introduction, COVID-19 has exacerbated anti-Asian/Pacific Islander American hate and discrimination. Furthermore, COVID-19 intensified preexisting institutional and systemic inequities. Therefore, it was important to study the likelihood different races were to report COVID-19 as a challenge in their career. Table 9 indicate such results.

Table 9: Racial Differences in Reporting COVID Challenges

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
COVID				
	Reported COVID as an issue	***4 (4.3%)***	***8 (6.0%)***	***2 (4.0%)***
	None	***90 (95.7%)***	***125 (94.0%)***	***48 (96.0%)***

Asian/Pacific Islander participants were most likely to report issues related to COVID-19 and its associated impact on the work environment (e.g., remote working). White, Black, Hispanic, and Native American participants reported COVID-19 as an issue at similar rates; the difference was less than a percent (0.3%) and, thus, negligent. This finding could be related to the increase in reporting of hate, violence, and discrimination during the pandemic. Perhaps, COVID-19 caused Asian/Pacific Islander participants to face more hostility due to the negative narrative perpetuated by Former President Donald Trump. Another explanation could be that the increase in reporting of hate, violence, and discrimination during the pandemic emboldened Asian/Pacific Islander participants to speak up about other inequities they face as a result of their race. To be

able to determine whether there is a casual relationship and the direction of the relationship between these two factors, a controlled study would have to be conducted.

Financial Issues

Financial issues breakdown by race is important, for it provides concrete measures and proof of whether there is an existing implicit bias and/or discrimination that causes some races to be more likely to report financial issues than other races. Table 10 does indicate that people of color were more likely than White participants to report financial issues, which suggests there may be some implicit bias, a lack of wealth, or other underlying forces that cause people of color to be more likely to face these obstacles.

Table 10: Racial Differences in Reporting Financial Issues

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Financial Issues				
	Education-related debt	*2*	*2*	*2*
	Income-related issues	*2*	*`6*	*1*
	Total Financial Issues	***4 (4.3%)***	***8 (6.0%)***	***3 (6.0%)***
	None	***90 (95.7%)***	***125 (94.0%)***	***47 (94.0%)***

Participants who identified as Asian/Pacific Islander and participants who identified as Black, Hispanic, Native American, and/or Other were both equally the most likely to indicate that financial issues were their biggest challenge. However, Asian/Pacific Islander participants who reported financial issues (n=8) were overwhelmingly more likely to respond with income-related issues, while Black, Hispanic, Native American and/or Other participants who reported

financial issues (n=3) were more likely to have financial issues related to education debts and loans. White participants who reported financial issues (n=4) were evenly split between education-related debt and income-related issues.

Career Transitions

Similar to financial issues, the rate at which career transitions are reported by race can provide further evidence for the existence of an implicit bias. If one racial group is more likely to report difficulties with obtaining a job and/or promotion, it could be an indication of a possible prejudice against the racial group. Table 11 has the racial breakdown for the reporting of career transition issues in the study's subsample.

Table 11: Racial Differences in Reporting Career Transitions Challenges

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Career Transitions				
	Entering the STEM field and/or a new company	*12*	*15*	*6*
	Moving up within the STEM field and/or obtaining promotions	*5*	*7*	*0*
	Transition from a non-STEM related career to a STEM career	*4*	*3*	*4*
	Total Career Transitions	***21 (22.3%)***	***25 (18.8%)***	***10 (20.0%)***
	None	***73 (77.7%)***	***108 (81.2%)***	***40 (80.0%)***

In terms of career transitions, White participants were the most likely to report such issues in their responses while Asian/Pacific islander participants were the least likely. However,

across all races, among the individuals who reported career transitions, they all indicated that entering the STEM field and/or a new company was the most difficult obstacle.

Work Culture

The analysis for the racial breakdown of issues related to work culture is reported in Table 12. This reporting helps pinpoint institutional and systemic issues that some racial groups may be facing (i.e., institutional inequities that may exacerbate work-life balance).

Table 12: Racial Differences in Reporting Work Culture Challenges

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Work Culture				
	Work-life balance related to family/self	*8*	*6*	*6*
	Work-life balance related to education	*2*	*5*	*1*
	Unrealistic expectations	*6*	*8*	*6*
	Assimilating to the STEM work environment	*8*	*12*	*7*
	Administrative and/or housekeeping issues at work	*4*	*0*	*2*
	Total Work Culture	***28 (29.8%)***	***31 (23.3%)***	***22 (44.0%)***
	None	***66 (70.2%)***	***102 (76.7%)***	***28 (56.0%)***

Participants who identified as Black, Hispanic, Native American, or Other were the most likely to mention work culture as their biggest challenge; in fact, almost half of the participants who identified as Black, Hispanic, Native American, or Other reported such challenges.

Asian/Pacific Islander participants were the least likely to report work culture in their response. Assimilating to the STEM work environment was the component of work culture that was most likely to be reported across all participants who reported work culture as an issue. Work-life balance related to family and/or self and unrealistic were other common components of work culture that individuals indicated were obstacles in their careers.

Interpersonal Communication

Interpersonal communication issues broken down by race can provide some evidence for whether some racial groups face more hostility in their communication than other racial groups. Such attitudes could be a result of implicit biases towards racial groups. Table 13 indicate the racial breakdown of interpersonal communication challenges.

Table 13: Racial Differences in Interpersonal Communication Challenges

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Interpersonal communication				
	Connections and/or network	*2*	*4*	*1*
	Interpersonal communication between coworkers	*2*	*7*	*5*
	Restricted guidance with work	*2*	*2*	*1*
	Communication with upper/top levels	*2*	*5*	*1*
	Disrespectful communication related to identity	*8*	*10*	*2*
	Total Interpersonal Communications	***16 (17.0%)***	***28 (21.1%)***	***10 (20.0%)***
	None	***78 (83.0%)***	***105 (78.9%)***	***40 (80.0%)***

With interpersonal communication, Asian/Pacific Islander participants were the most likely to report the issue and White participants were the least likely. Among White participants who reported such issues (n=16), half of them indicated that disrespectful communication related to identity as the component of interpersonal communication that became an obstacle. Asian/Pacific Islander participants who mentioned interpersonal communication issues in their responses were likely to include disrespectful communication related to identity and/or interpersonal communication between coworkers as the component of interpersonal communication that was a challenge.

For example, one Asian/Pacific Islander participant described how one of their mentors "*did [not] [want to] write [his] recommendations so [the participant] had to persuade [the mentor] to."* This participant's experience indicates how they struggle to be treated respectfully and fairly by their upper levels/bosses.

Another participant described one of their interpersonal communication challenges:

> *"The biggest career challenge was that there was no one to assist me when I [fell] into any difficulty. I did [not] expect to solve those problems by my own attempts."*

This participant's response can be connected back to the model minority myth: Asian/Pacific Islander participants may be more likely to report restricted guidance, because if their coworkers and bosses act under the assumption of the model minority myth, they may not provide as much assistance to Asian/Pacific Islander coworkers. Such assumptions and biases can create racialized obstacles.

Personal Issues

White participants were the most likely to indicate personal issues in their responses while Black, Hispanic, Native American, and/or Other participants were the least likely. Among the White participants (n=18) and Black, Hispanic, Native American, and/or Other participants (n=5) who indicated such issues, respectively, self-consciousness related to their identity was the most likely component of personal issues to be reported. On the other hand, Asian/Pacific Islander participants who reported personal issues were more likely to indicate that personal motivations were their largest obstacle within personal issues. The specific racial breakdown of personal issues is reported in Table 14.

Table 14: Racial Differences in Reporting Personal Issues

		White	Asian/Pacific Islander	Black, Hispanic, Native American, Other
Personal issues				
	Burnout	*2*	*2*	*0*
	Self-conscious of identity	*8*	*4*	*3*
	Imposter syndrome	*4*	*4*	*1*
	Personal motivations	*4*	*5*	*1*
	Total Personal Issues	***18 (19.1%)***	***15 (11.3%)***	***5 (10.0%)***
	None	***76 (80.9%)***	***118 (88.7%)***	***45 (90.0%)***

These results are surprising with respect to the literature review. The previous literature on such work would have predicted that people of color would report higher rates of imposter syndrome and self-consciousness with their identity than White participants. Nonetheless, it is once again important to note that participants only indicated their largest obstacle in their career.

Even if they did not mention personal issues in their response, it does not mean they did not have personal issues. Moreover, ethnicity was often misreported which could further skew this data.

Chapter 5

Discussion

With respect to the gender gap, the results indicate that there are gendered obstacles in terms of work culture. Within this issue, the results supplied evidence that women were overwhelmingly more likely to report work-life conflicts than men. The gendering of such obstacles can be explained by the gendered roles of men and women in terms of family and household responsibilities. Since women are socialized to be the primary caretaker of homes, they would often hold more responsibilities to tend to at home than men. To eliminate such gendered obstacles, technology companies can take measures to encourage better balance between individuals' work and family and stressing the importance of both.

The results also indicated that women are less likely to report career transitions and financial issues as an obstacle and are less likely to report issues related to interpersonal communication with upper levels/bosses. These results contradict what majority of the literature review may have predicted. Because of the implicit and explicit biases that individuals may hold, this study would expect women to have less advantages for receiving promotions and respectable communication with their upper levels/bosses. However, it is important to note that men and women may also have gendered perceptions of unfairness and challenges. Studies have shown that women are less likely to object to inequities because of differences in the socialization of women and men and the environment they are in (Wang et al., 2021). Wang et al. (2021) specifically realized that women were less likely to report issues with unfairness when there is a power imbalance and when they are not properly informed about the rights they hold in

the environment. These results reflect such tendencies, which is why men may have higher rates of reporting such issues. In order to determine whether career transitions and financial issues and interpersonal communication are a gendered obstacles, future studies would have to create measures to precisely define career transition and financial issues and interpersonal communication challenges across all participants.

The results regarding the interpersonal communication in racial analysis section may point to the intersection of the model minority myth and forever foreigner that often alienate Asian/Pacific Islander Americans from both White people and people of color. This isolation can lead to frictions with communication with other individuals in their careers. Results such as these provide evidence for underlying prejudices that may exist in many technology companies. To eliminate such inequities, it is important for technology to bring attention to these issues and create organizations and policies to help feel Asian/Pacific Islander workers to feel more comfortable and welcomed among their coworkers. Moreover, the results also indicated that Asian/Pacific Islander professionals in technology fields were actually more likely to report technological challenges than their other racial counterparts. These results directly contradict the model minority myth that is perpetuated in society about Asian Americans. An explanation behind these results could be the fact that Asian/Pacific Islander coworkers are also more likely to report interpersonal communication, so they do not have as accessible support and resources as other races.

Asian /Pacific Islander American participants were more likely to report issues related to financial issues than White participants and were more likely to mention interpersonal communication as a challenge in their response than any other racial groups. The fact that Asian/Pacific Islander American participants were reporting more financial issues may point to

the fact that, though Asian/Pacific Islander Americans may have a large representation in the technology field, they are less likely to receive promotions and/or better wages than their White counterparts. Another notable result is that Asian/Pacific Islander Americans were more likely to report COVID-19 issues, which connects back to the predictions made by previous literature. Perhaps Asian/Pacific Islander Americans were more likely to report COVID-19 issues, because of the prejudiced connection made between COVID-19 and Chinese Americans.

As mentioned in the strengths and limitation sections, this study was based on responses and preexisting data from a study done by McHale et al. (2021). The study however only used a small sample of the data and not all the participants were included in this data. Therefore, if our sample is not representative of the entire group, there could be improper reporting of results. Future studies could analyze the entire data set for gendered differences in reporting obstacles.

Appendix A

Sample

Table 15: Background Characteristics of the Entire Sample (McHale et al., 2021)

		Women	**Men**	**Transgender**	**Total**
Age: Mean (*SD*)		32.46 (10.71)	37.01 (9.67)	27.41 (8.65)	35.35 (10.31)
Ethnicity Frequency (%)	*White*	719 (52.75%)	1,936 (75.18%)	18 (39.13%)	2,673 (67.09%)
	Black	176 (12.91%)	187 (7.26%)	3 (6.52%)	366 (9.19%)
	Hispanic	152 (11.15%)	139 (5.40%)	7 (15.22%)	298 (7.48%)
	Asian/Pacific Islander	161 (11.81%)	173 (6.72%)	6 (13.04%)	340 (8.53%)
	Native American	12 (0.88%)	13 (0.50%)	2 (4.35%)	27 (0.68%)
	Multi-ethnic	143 (10.49%)	127 (4.93%)	10 (21.74%)	280 (7.03%)
Couple Relationship Status Frequency (%)	*Single*	565 (41.36%)	634 (24.52%)	19 (41.30%)	1,218 (30.47%)
	Married	601 (44.00%)	1,773 (68.56%)	10 (21.74%)	2,384 (59.63%)
	Cohabiting	147 (10.76%)	115 (4.45%)	13 (28.26%)	275 (6.80%)
	Divorced	38 (2.78%)	47 (1.82%)	0 (0.00%)	85 (2.13%)
	Other	15 (1.10%)	17 (0.66%)	4 (8.70%)	36 (0.90%)
Parenthood Status Frequency (%)		713 (52.20%)	1,818 (70.30%)	46 (100.00%)	2,542 (63.58%)
U.S. Born Frequency (%)		1,264 (92.53%)	2,472 (95.59%)	42 (91.30%)	3,778 (94.50%)
Engineering Degree Frequency (%)		1,015 (74.30%)	2,058 (79.58%)	33 (71.74%)	3,106 (77.69%)

Table 16: Job Characteristics of the Entire Sample (McHale et al., 2021)

		Women	**Men**	**Transgender**	**Total**
Work Hours Mean (*SD*)		36.09 (15.60)	35.52 (13.60)	34.44 (14.76)	35.71 (14.32)
Years Worked Mean (*SD*)		7.89 (9.08)	9.73 (9.63)	6.00 (8.71)	9.06 (9.48)
Median Number Jobs		3	3	2	3
Job Sector Frequency (%)	*Academia*	185 (13.54%)	214 (8.28%)	10 (21.74%)	409 (10.23%)
	Industry	828 (60.61%)	1,821 (70.42%)	24 (52.17%)	2,673 (66.86%)
	Government	259 (18.96%)	319 (12.34%)	9 (19.57%)	587 (14.68%)
	Other	94 (6.88%)	232 (8.97%)	3 (6.52%)	329 (8.23%)
Work Role Frequency (%)	*Education Role*	199 (14.57%)	218 (8.43%)	9 (19.57%)	426 (10.66%)
	Research Role	344 (25.18%)	462 (17.87%)	11 (23.91%)	817 (20.44%)
	Management Role	509 (37.26%)	1,046 (40.45%)	11 (23.91%)	1,566 (39.17%)
	Technical Role	776 (56.81%)	1,554 (60.09%)	32 (69.57%)	2,362 (59.08%)
	Other Role	46 (3.37%)	152 (5.88%)	2 (4.35%)	200 (5.00%)

References

Bhattacharjee, Y. (2021, May 3). *How South Asian Americans Are Building a New American Dream*. Magazine. https://www.nationalgeographic.com/magazine/article/south-asian-american-stereotype-kondabolu-simpsons

Buse, K., Bilimoria, D., & Perelli, S. (2013). Why they stay: women persisting in US engineering careers. Career Development International, 18(2), 139–154. https://doi.org/10.1108/cdi-11-2012-0108

Canney, Nathan E., and Angela R. Bielefeldt. 2015. Gender differences in the social responsibility attitudes of engineering students and how they change over time. Journal of Women Minorities in Science and Engineering 21: 215–37.

Cech, E. A., & Blair-Loy, M. (2019). The changing career trajectories of new parents in STEM. *Proceedings of the National Academy of Sciences*, *116*(10), 4182–4187. https://doi.org/10.1073/pnas.1810862116

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional Role Confidence and Gendered Persistence in Engineering. *American Sociological Review*, *76*(5), 641–666. https://doi.org/10.1177/0003122411420815

Ceci, S. J., & Williams, W. M. (2011). Understanding current causes of women's underrepresentation in science. PNAS, 108, 3157–3162. doi:10.1073/pnas.1014871108.

Charlesworth, T. E., & Banaji, M. R. (2019). Gender in Science, Technology, Engineering, and Mathematics: Issues, Causes, Solutions. The Journal of Neuroscience, 39(37), 7228–7243. https://doi.org/10.1523/jneurosci.0475-18.2019

Chen, G. A., & Buell, J. Y. (2017). Of models and myths: Asian(Americans) in STEM and the

neoliberal racial project. Race Ethnicity and Education, 21(5), 607–625. https://doi.org/10.1080/13613324.2017.1377170

Corbett, Christianne, and Catherine Hill. 2015. Solving the Equation. Washington: American Association of Women, Available online: http://www.aauw.org/aauw_check/pdf_download/show_pdf.php?file=solving-the-equation (accessed on 1 March 2022).

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking Congruity Between Goals and Roles: A New Look at Why Women Opt Out of Science, Technology, Engineering, and Mathematics Careers. *Psychological Science*, *21*(8), 1051–1057. http://www.jstor.org/stable/41062332

Dweck, C. (2007). Is math a gift? Beliefs that put females at risk. In S. J. Ceci & W. M. Williams (Eds.), Why aren't more women in 1460 science? Top researchers debate the evidence (pp. 47–55). Washington: APA Press. doi:10.1037/11546-004.

Eccles, J. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. International Journal of Behavioral Development, 35(3), 195–201. https://doi.org/10.1177/0165025411398185

Freund, A. M., Weiss, D., & Wiese, B. S. (2013). Graduating from high school: The role of gender-related attitudes, self-concept and goal clarity in a major transition in late adolescence. European Journal of Developmental Psychology, 10(5), 580–596. https://doi.org/10.1080/17405629.2013.772508

Frize, M., Lhotska, L., Marcu, L. G., Stoeva, M., Barabino, G., Ibrahim, F., Lim, S., Kaldoudi, E., Marques Da Silva, A. M., Tan, P. H., Tsapaki, V., & Bezak, E. (2021). The impact of COVID-19 pandemic on gender-related work from home in STEM fields—Report of the

WiMPBME Task Group. *Gender, Work & Organization*, *28*(S2), 378–396. https://doi.org/10.1111/gwao.12690

Ganley, C. M., George, C. E., Cimpian, J. R., & Makowski, M. B. (2017). Gender Equity in College Majors: Looking Beyond the STEM/Non-STEM Dichotomy for Answers Regarding Female Participation. *American Educational Research Journal*, *55*(3), 453–487. https://doi.org/10.3102/0002831217740221

Gee, B., & Peck, D. (2021, August 31). *Asian Americans Are the Least Likely Group in the U.S. to Be Promoted to Management*. Harvard Business Review. https://hbr.org/2018/05/asian-americans-are-the-least-likely-group-in-the-u-s-to-be-promoted-to-management

Gerson, K., & Damaske, S. (2020). *The Science and Art of Interviewing*. Oxford University Press.

Glass, J. L., Sassler, S., Levitte, Y., & Michelmore, K. M. (2013). What's So Special about STEM? A Comparison of Women's Retention in STEM and Professional Occupations. *Social Forces*, *92*(2), 723–756. https://doi.org/10.1093/sf/sot092

Goldin, Claudia. 2014. A pollution theory of discrimination: Male and female differences in occupations and earnings. In Human Capital Theory: The American Record. Edited by Leah P. Boustan, Carola Frydman and Robert A. Margo. Chicago: University of Chicago Press, pp. 313–48.

Huynh, Q. L., Devos, T., & Smalarz, L. (2011). Perpetual Foreigner in One's Own Land: Potential Implications for Identity and Psychological Adjustment. Journal of Social and Clinical Psychology, 30(2), 133–162. https://doi.org/10.1521/jscp.2011.30.2.133

Hyde, J. S. (2014). Gender Similarities and Differences. *Annual Review of Psychology*, *65*(1),

373–398. https://doi.org/10.1146/annurev-psych-010213-115057

Kern, Richard (1988). "The Asian Market: Too Good to Be True?" Sales & Marketing Management, 141 (May), 38-40.

Knutson, K. (2021, November 3). *Racism against Asian Americans another danger of pandemic*. University of Wisconsin-Madison News. https://news.wisc.edu/racism-against-asians-another-danger-of-pandemic/

Landivar, L. (2013). *Disparities in STEM Employment by Sex, Race, and Hispanic Origin*. https://www2.census.gov/library/publications/2013/acs/acs-24.pdf

Lee, J., & Zhou, M. (2015). *The Asian American Achievement Paradox* (Illustrated ed.). Russell Sage Foundation.

McGee, E. O., Thakore, B. K., & LaBlance, S. S. (2017). The burden of being "model": Racialized experiences of Asian STEM college students. Journal of Diversity in Higher Education, 10(3), 253–270. https://doi.org/10.1037/dhe0000022

McHale, S., Damaske, S., Rosenberger, J., Park, J., & Yin, J. (2021). Education, Work, and Family Pathways of Women and Men in Computer Science, Engineering and Math (CSEM). *CISCO*.

Meyer, M., Cimpian, A., & Leslie, S. J. (2015). Women are underrepresented in fields where success is believed to require brilliance. Frontiers in Psychology, 6, 1–12. doi:10.3389/fpsyg.2015.00235.

Miller, P. H., Slawinski Blessing, J., & Schwartz, S. (2006). Gender Differences in High School Students' Views about Science. *International Journal of Science Education*, *28*(4), 363–381. https://doi.org/10.1080/09500690500277664

Moss-Racusin, C. A., Sanzari, C., Caluori, N., & Rabasco, H. (2018). Gender Bias Produces

Gender Gaps in STEM Engagement. Sex Roles, 79(11–12), 651–670. https://doi.org/10.1007/s11199-018-0902-z

National Science Foundation (2011). Women, minorities, and persons with disabilities in science and engineering: 2011. Arlington, VA.: National Science Foundation.

Penner, A. M., & Willer, R. (2019). Men's Overpersistence and the Gender Gap in Science and Mathematics. *Socius: Sociological Research for a Dynamic World*, *5*, 237802311882183. https://doi.org/10.1177/2378023118821836

The Model Minority Myth. (2018, December). The Practice, 5(1). https://thepractice.law.harvard.edu/article/the-model-minority-myth/

Raabe, I. J., Boda, Z., & Stadtfeld, C. (2019). The Social Pipeline: How Friend Influence and Peer Exposure Widen the STEM Gender Gap. *Sociology of Education*, *92*(2), 105–123. https://doi.org/10.1177/0038040718824095

Ridgeway, Cecilia L., and Shelley J. Correll. 2004. "Unpacking the Gender System: A Theoretical Perspective on Gender Beliefs and Social Relations." Gender & Society 18(4):510–31. doi: 10.1177/0891243204265269.

Roser, M., & Ritchie, H. (2013). Technological Progress. *Our World in Data*. https://ourworldindata.org/technological-progress

Sassler, S., Michelmore, K., & Smith, K. (2017). A Tale of Two Majors: Explaining the Gender Gap in STEM Employment among Computer Science and Engineering Degree Holders. *Social Sciences*, *6*(3), 69. https://doi.org/10.3390/socsci6030069

Shams, T. (2019). Successful yet Precarious: South Asian Muslim Americans, Islamophobia, and the Model Minority Myth. *Sociological Perspectives*, *63*(4), 653–669. https://doi.org/10.1177/0731121419895006

Shapiro, J. R., & Williams, A. M. (2011). The Role of Stereotype Threats in Undermining Girls' and Women's Performance and Interest in STEM Fields. Sex Roles, 66(3–4), 175–183. https://doi.org/10.1007/s11199-011-0051-0

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. Journal of Experimental Social Psychology, 35, 4–28. doi:10.1006/jesp.1998.1373.

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: a meta-analysis of sex differences in interests. Psychological Bulletin, 135, 859–884. doi:10.1037/a0017364.

Thébaud, S., & Charles, M. (2018). Segregation, Stereotypes, and STEM. *Social Sciences*, *7*(7), 111. https://doi.org/10.3390/socsci7070111

Tuan, M. (1999). Forever foreigners or honorary Whites? The Asian ethnic experience today. New Brunswick, NJ: Rutgers University Press.

U.S. Census Bureau, Current Population Survey, 1968 to 2018 Annual Social and Economic Supplements.

U.S. Census Bureau. (2021). *Population Estimates (QuickFacts)*. https://www.census.gov/quickfacts/fact/table/US#.

U.S. Department of Education, National Center for Education Statistics (NCES). (2014). Digest of education statistics. Retrieved from https://nces.ed.gov/programs/digest/2014menu_tables.asp

Valla, J. M., & Ceci, S. J. (2014). Breadth-based models of women's underrepresentation in STEM fields: an integrative commentary on Schmidt (2011) and Nye et al. (2012). Perspectives on Psychological Science, 9, 219–224. doi:10.1177/1745691614522067.

Wang, M. T., Eccles, J. S., & Kenny, S. (2013). Not lack of ability but more choice: individual and gender differences in STEM career choice. Psychological Science, 24, 770–775. doi:10.1177/0956797612458937

Wang, M. T., & Degol, J. L. (2016). Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions. Educational Psychology Review, 29(1), 119–140. https://doi.org/10.1007/s10648-015-9355-x

Wang, X., Chui, W. H., & Wang, Y. (2021). Perception of Gender Equality Matters: Targets' Responses to Workplace Sexual Harassment in Chinese Metropolises. *Journal of Interpersonal Violence*, 088626052199745. https://doi.org/10.1177/0886260521997452

Wynn, A., & Correll, S. (2017). Gendered Perceptions of Cultural and Skill Alignment in Technology Companies. *Social Sciences*, *6*(2), 45. https://doi.org/10.3390/socsci6020045

Xu, Y. J. (2008). Gender Disparity in STEM Disciplines: A Study of Faculty Attrition and Turnover Intentions. Research in Higher Education, 49(7), 607–624. https://doi.org/10.1007/s11162-008-9097-4

ACADEMIC VITA

EDUCATION

Schreyer Honors College – The Pennsylvania State University University Park, PA
College of Engineering May 2022
Bachelor of Science in Computer Science

- **Software/Hardware Language Experience: Python, Java, C++, Verilog**
- Achievements: The President's Freshman Award, Attended Liberty Mutual Women in Technology Summit, Grace Hopper Convention 2021 Sponsorship, Thesis in Computer Science Area of Honors

EXPERIENCE

Capital One Mclean, VA
Software Engineer TIP and TDP May 2021 – August 2021
Certification: Certified Secure Software Engineer – Associate

- Reduced the Run-Time-Equivalent (RTE) of the team that handles credit card referral bonuses by automating the error handling process that software engineers have been doing manually
- Applied **S3, SNS, SQS, & Postgres DB to** parse & handle errors with a daily Cron job on **AWS Lambda**
- Designed and programmed a **React** console application for Capital One's business teams to visualize each application's status and information as it goes through the automated error handling process

Dow Chemical Company Collegeville, PA
Software Engineer – Summer Intern June 2019 – August 2019; July 2020 – August 2020

- Assisted with creating a program using **Python** and the **Pandas** library that would create a uniform spread sheet for the results from Dow's experiments on paint composition
- Initiated the project to create a GUI using the **PyQt** library for researchers to use for their experiments by working with **event handling** from the external experimental equipment that are used for measuring viscosity
- Used data from **external databases** to assimilate this GUI program with two preexisting programs at Dow

ACTIVITIES

Days for Girls University Park, PA
Finance Team Co-Leader September 2020 – Present

- Ideate, plan, organize, promote and execute a fundraiser project involving selling handmade scrunchies to earn money to support menstrual health care and education for menstruators from underprivileged backgrounds
- Raised over $200 in one month by organizing a holiday social media challenge; designed over ten graphics to help support and promote the fundraiser on Instagram
- Bring awareness about sustainable and safe menstrual sanitary care by actively participating in discussions

Schreyer Honors College Student Council University Park, PA

Social Director September 2019 – Present

- Plan and promote Winter and Spring Schreyer formal by contacting venues, organizing decorations and entertainment for the formal's theme, and creating social media/on-campus promotions
- Create a social and welcoming environment for incoming and existing members in order to foster a community of networking and meaningful connections

Association of Women in Computing University Park, PA

Technical Director (Fall Season) September 2019 – Present

- Plan and conduct Technical Workshops for members to get hands on experience working with computer science concepts they may not have access to in classes, such as GitHub and technical interviews
- Present Tech Talks to expose members to technologies not within the computer science curriculum at Penn State, but are important to the computer science industry, such as databases and AWC
- Create a collaborative environment that fosters a community of learning about new and revolutionary technology

RELEVANT PROJECTS

- **DATA STRUCTURE** – Programmed an infix calculator using Linked List, Stack, and Queue data structures
- **SYSTEM PROGRAMMING** – Programmed a device driver that sits between a virtual application and virtualized hardware devices that will perform basic file system functions.
- **VERILOG** – Implemented a basic pipelined, five-stage CPU that can handle structural & data hazards.