THE LIVED EXPERIENCE OF FEMALE PROGRAMMERS WORKING IN THE SAN FRANCISCO BAY AREA: AN INTERPRETIVE PHENOMENOLOGICAL ANALYTIC STUDY

A dissertation submitted to
The Wright Institute Graduate School of Psychology, in partial fulfillment
of the requirements for the degree of Doctor of Psychology

by
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May 2018

CERTIFICATION OF APPROVAL

I certify that I have read THE LIVED EXPERIENCE OF FEMALE PROGRAMMERS WORKING IN THE SAN FRANCISCO BAY AREA: AN INTERPRETIVE PHENOMENOLOGICAL ANALYTIC STUDY by Paige Elizabeth O'Connell, and that in my opinion this work meets the criteria for approval of a dissertation submitted in partial fulfillment of requirements for the degree of Doctor of Psychology at the Wright Institute Graduate School of Psychology.

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Since the 1980's the percentage of women graduating college with computer science degrees has been steadily declining (Chen, 2014). Despite endorsing love for programming, the rate of attrition for female programmers in computer careers is more than double that of men (Hewlett et al., 2008). Research has shown that women face multiple barriers in studying and working in computer science, including sexism, stereotype threat, and signals of non-belonging (Cheryan et al., 2009). This current qualitative study used Interpretive Phenomenological Analysis (Smith & Osborn, 2004), to explore the journey of eight female computer programmers working full time in the San Francisco Bay Area.

Sixteen themes falling into three domains emerged from this data: early experiences, feeling like the "other," and the impact of these messages. In the first domain, themes included participants' enjoyment of the work of programming in spite of having negative and discouraging experiences in school; most tended to have a family role model as a guide. In the second domain, women encountered messages of non-belonging, inadequacy, and feeling devalued, as well as experiences of sexism and

having difficulty seeing a path forward in their careers. In the last domain, these messages created emotional distress, leading participants to feel unsafe in the larger computer science community, and to question whether they wanted to leave the field. On a positive note, most found important support in having a shared-identity group and desired to mentor other women. The results also suggest that gender identity intersected with racial and LGB identities to differentially impact their experiences.

These themes suggest that female programmers' clinical distress be treated in a culturally informed way. Clinicians should consider taking a systems approach to working with female programmers given the institutional stressors they are faced with. Psycho-education on the impact and ways to counteract experiences of sexism and stereotype threat might be incorporated into individual counseling to further buttress women programmers' self esteem and efficacy. Mentoring programs starting as early as high school and support networks that promote advocacy for women within the field are also important supports that could improve female participation and counteract attrition in programming. Future research might include research on the impact of intersectional identities and developing culturally informed therapy interventions for this population.

Dedication

This dissertation is dedicated to my wonderful husband, Miles O'Connell, who has provided inspiration, support, grounding, laughter, comfort, and good food to fuel me through this process.

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Contents

Chapter 1: Introduction

This study will examine the lived experience of female programmers working full time in the San Francisco Bay Area. A qualitative methodology will be employed using Interpretative Phenomenological Analysis (IPA) to analyze the interview data of eight to ten participants. For the purposes of this dissertation, the term *programmer* will denote those individuals employed as technical staff who write code; that is, whose job is to create computer programs or to write software code that is used to instruct a computer to perform actions. The term *lived experience* refers to the rich experience of women who are employed currently as programmers, and also includes the ways their work may impact their life beyond work. Despite the fact that occupational conditions have been shown to directly psychologically effect women who work (e.g. Lennon, 1994; Miller, Schooler, Kohn, & Miller, 1979), there is a dearth of psychological research focusing on the experiences of women employed as programmers. Thus, this study seeks to build on an existing body of literature that focuses on women's experiences in the broader field of science, technology, engineering, and mathematics (STEM).

The present study aims to expand the limited literature on female programmers from a psychological perspective. As part of this, it is important to consider programming, or computer science, as a STEM field. For the sake of brevity, and because the experiences of women in STEM are intrinsically tied to the gendered history of STEM employment, this overview will focus specifically on STEM, rather than female employment as a whole. The experience of women in STEM is influenced in large part by stereotypes and sexism that contribute to the underrepresentation of women in

this area. Once, the scarcity of women in the STEM fields was thought to be due to a difference in the innate abilities of men and women. In a 2010 report, Hill, Corbett, and St. Rose suggest that this myth was supported by the widespread belief that achievement tests such as the Standardized Achievement Test (SAT) measured innate ability. To support these arguments, proponents pointed to the huge gender disparity in scores over 700 (2 standard deviations above the mean) on the math SAT where 13 boys achieved this to every one girl. This pattern has been present since the early 1980's and was cited to confirm the idea that women were dispositionally less gifted in mathematics compared to males. However, in recent years this ratio has dropped significantly, to a ratio of approximately three to one. This rapid downward shift suggests that this score difference is not one of innate ability, but rather, is due to cultural and environmental factors (Hill, Corbett, & St Rose, 2010).

This refutation of theories that the underrepresentation of women in STEM is due to the biological differences between men and women was echoed in a 2009 meta-analysis by Ceci, Williams, and Barnett, in which they used data from over 400 papers looking at both biological and social factors contributing to this problem. The results of this analysis demonstrated that evidence suggesting that hormonal differences between genders accounted for the scarcity of female scientists was significantly weaker than data supporting other factors, such as sociocultural and environmental influences (Ceci, Williams, & Barnett, 2009).

In response to this realization direct efforts to combat some of the key sociocultural factors that have historically limited women's ability to compete with men in STEM fields have begun to be addressed. These sociocultural factors include the

impacts of sexism and stereotype threat on girls' performance and interest in quantitative fields (Cadinu, Maass, Frigerio, Impagliazzo, & Latinotti, 2003; Cheryan, Plaut, Davies, & Steele, 2009; Shapiro & Williams, 2012; Spencer, Steele, & Quinn, 1999). For example, research has shown that after women are exposed to gender stereotypic commercials, they tend to express decreased interest in quantitative education and careers (Davies, Spencer, Quinn, & Gerhardstein, 2002). Thus, efforts have been made to combat these messages with media aimed at exciting girls about science, such as the ongoing Public Broadcasting Service (PBS) cartoon series SciGirls (http://pbskids.org/scigirls). This children's show features a female main character, Izzie, who is enthusiastic about science and learning, and also acts as the host for the associated websites containing fun STEM games, and connecting girls to female STEM role models (http://scigirlsconnect.org).

Other endeavors include creating education guidelines for promoting girls in STEM (Halpern et al., 2007), as well as fun STEM summer camps for girls, such as tech trek from American Association of University Women (AAUW) (http://aauw-techtrek.org/). After attending this camp, an alumna survey revealed the impact of the experience, including boosted interest and confidence in STEM classes, and increased awareness of STEM career options (AAUW, 2014). As a result of efforts such as these, the STEM gender gap has closed significantly in recent years (Mosatche, Matloff-nieves, Kekelis, & Lawner, 2013).

Census data demonstrates that the percentage of women employed in many STEM fields, has risen since the 1990's. For example, the percentage of women in the biological sciences has risen from 42% in 1990 to 53% in 2013, and in the chemical

sciences from 27% to 39% over the same time span (Corbett & Hill, 2015). While women earned nearly the same number of science bachelor degrees, they only receive about half as many doctoral degrees in science, compared to men (National Science Foundation & National Center for Science and Engineering Statistics, 2015). Research suggests that this disparity may be due to women's diminished interest in entering STEM fields because of the anticipation that they would hold less interpersonal power than men in such male dominated fields (Chen & Moons, 2015).

Unfortunately, the disparity between men and women in STEM often gets worse after schooling. While the number of women who have obtained full professorships has more than doubled since 1993, women still hold less than a quarter of these positions (National Science Foundation, 2013). This is due in part to the perception that women with children will be distracted and therefore should not be promoted or hired for a tenure track job (Ginther & Kahn, 2006; Xu, 2008), and in part due to insufficient recruitment of qualified women. One reason for this that has been identified is that the traditional venues through which faculty positions are advertised often reach fewer women than men, due to differences in social networks (Huffman & Torres, 2002; Mencken & Winfield, 2000). One solution, therefore, is to expand the venues through which jobs are posted to target networks that would recruit women. This could significantly increase the number of female applicants and therefore increase the chances that a woman will be hired (Glass & Minnotte, 2010).

Outside of the academic realm of STEM, science and technology companies see similar problems with the impeded career advancement of women. A 2014 study by Braun and Turner revealed that while managers in science, engineering, and technology

(SET) companies were aware of the benefits of hiring women, there were also common concerns. For example, 14 of the 20 managers who participated in in-depth interviews endorsed the idea that women are harder to manage because they are emotional, or as one manager put it, "women are more sensitive and emotional; sometimes it is exhausting to manage them" (p.100). The managers cited several other disadvantages to hiring women, including that women employees were preoccupied by familial commitments, and less able to connect with their male coworkers. These types of reservations are not uncommon and have significant impacts on the hiring, career advancement, and retention of women at such companies (Braun & Turner, 2014; Diekman, Weisgram, & Belanger, 2015).

In addition to problems recruiting women, the STEM fields are known to have poor retention of qualified women. Partially as a result of the previously mentioned lack of career advancement, and partially due to sociocultural factors, such as feeling encumbered by the masculine culture of STEM companies, and lack of flexibility for family care (Servon & Visser, 2011), the attrition of women from STEM is significantly higher than for their male colleagues. This attrition is highest around the midpoint of women's careers (Hewlett et al., 2008). One important factor in women's attrition from STEM at this time is due to her taking on the burden of family responsibilities, as both companies and academic settings require long hours, and lack flexibility to attend to family matters (Heilbronner, 2013; Servon & Visser, 2011). This combined with feelings of isolation and exposure to sexist "old boys club" (Hewlett et al., 2008, p.17) cultures contribute to their decisions to leave the field.

While the advancement of women in STEM fields still has a way to go, significant progress has been made in the recruitment of women overall in the sciences in

recent years. This includes women employed in the biological and chemical sciences, as well as engineering fields (Corbett & Hill, 2015; National Science Foundation & National Center for Science and Engineering Statistics, 2015). However the computer and mathematical fields have not faired as well. In these areas, the percentage of women employed has actually decreased from 35% in 1990 to only 26% in 2013 (Corbett and Hill, 2015). This decrease in women's employment is indicative of a problem recruiting as well as a problem with sustaining women in these areas of STEM.

In the computing field, there are several subdivisions from which qualified individuals may chose. These include web developers whose job it is to create websites, computer network architects who are tasked with creating data networks, as well as computer support specialists who provide support in the use of computer software and networks, to name a few. Each specific discipline shows a similar pattern of underrepresentation of women. According to the population survey from the U.S. Bureau of Labor Statistics (BLS), women make up 34% of web developers, 12.1% of computer network architects, and 26% of computer support specialists (Department of Labor Current Population Survey, 2016).

The current study focuses on women in a specific area of computing, namely, the combined technical staff who write code, commonly referred to as programmers. The BLS divides this area into two subdivisions: computer programmers and software developers, a type of programmer who specifically develops computer programs. Thus, for the purpose of this study, the term programmer will refer the combination of these two groups. The BLS reports that women make up 21% of the 480,000 computer programmers, and 17.9% of the 1,353,000 software developers in the United States.

Taken together, this data suggests that in 2015, of the roughly 1,833,000 people employed as programmers and software developers in United States, approximately 356,500 are women (Department of Labor Current Population Survey, 2016). Gender diversity is not the only area that is lacking in the computing fields. The majority of the overall computing workforce is White, with only 3% being African-American women, 5% being Asian women, and 1% being Hispanic women (National Center for Women in Information Technology (NCWIT), 2016).

The number of programmers in America is only expected to grow in the coming decade. The BLS forecasts that employment in the larger umbrella of all computer and information technology will increase by 12 percent between 2014 and 2024, a faster rate of growth than the overall average for all occupations, suggesting that more women and people of color will be needed to help fill these jobs (Department of Labor Occupational Outlook Handbook, 2015). This work may be especially attractive to employees because the computer and programming fields pay significantly more than the 2015 national average of $36,200, with computer programmers making on average $79,530 per year, and software developers making $100,690 (Department of Labor Occupational Outlook Handbook, 2015). Despite this growth that represents a growing demand for qualified workers in a very high paying field, the number of women who have graduated with undergraduate degrees in computer science has been dropping by more than half for the past 30 years, from 37.1% in 1984 to 17.8% in 2013 (Chen, 2014). The significant drop in women who have the academic credentials to enter this growing field suggests that there is an urgent problem that needs to be addressed.

The problem does not stop at the undergraduate level. A 2008 study by Hewlett et al., found that 41% of women employed in high technology fields (including programming) ended up quitting these jobs despite many voicing that they love the work, citing in part hostile work environments, isolation, and extreme stress. For example, 64% of women in technology report having been sexually harassed, and 68% of women at a de-identified U.S. based technology company recount that they feel their careers are stagnant while their male coworkers are consistently promoted (Hewlett et al., 2008). Hundreds of women who left tech echoed this finding, citing the ongoing impact of trying to negotiate discriminatory work environments, combined with lack of flexibility around child bearing and rearing, as sources of this attrition (Snyder, 2014). The high attrition rate is especially poignant when it is compared to the only 17% of men who decide to leave technology fields (Hewlett et al., 2008). Taken together, this means that there are thousands of women currently employed as computer programmers whose experience working in the field is sufficiently uncomfortable and that these same individuals, who have already survived the high undergraduate attrition rates of women deciding against degrees in the STEM fields, have made the decision to leave this high paying field. Additionally, it may be especially important to address this problem for women in the state of California, which currently employs 38,650 programmers and 123,950 software developers, the highest employment level in the country by a wide margin (Chen, 2015).

Given this situation, this study is designed to gather narrative data on the experience of female programmers to get a better understanding of their experience of their work and how this has impacted them personally and in terms of their family life. A

goal of this research is to generate data that will help mental health professionals gain a more focused understanding of these women's experiences, as well as what might help them better cope with and overcome the barriers they face. Such knowledge is especially important given that research has shown that work stressors predict common mental disorders (Stansfeld & Candy, 2006). Thus, in treating female programmers, the impacts of their work environment should not be ignored. The results of this qualitative study will not be generalizable to all female programmers due to the small sample size and semi-structured style of interview. However, the results may highlight the importance of exploring the clinical implications of female clients' employment in the field of programming and the interview themes may help to guide clinical treatment and effectiveness with this population.

Chapter 2: Literature Review

This review of the literature will begin by examining the role of sexism and stereotype threat in creating barriers for women in general and the impact that these systemic forces have on women who are employed as computer programmers. The next section will examine the key role women played historically in the development of computers and in the computer-programming field. Subsequent changes in the field that have greatly privileged males will then be discussed. The next section will examine the current literature focusing on issues of women's attrition from the field, both in undergraduate studies, and in employment. Finally, the unique factors that may contribute to women's experiences working as programmers specifically in the Bay Area of Northern California, a large technological hub, will be addressed. The chapter will end with a description of a similar study on the experience of women programmers and an analysis of the ways that this dissertation will make a unique contribution to our understanding of the lived experience of women in the Bay Area employed full time as computer programmers.

Sexism

Sexism is a system of prejudice against women, which rests on the basic belief that women are inferior to men. The likely origins of this prejudice lie in the cultures humans have built around biology: creating a gender-based allocation of duties to best suit women's biological child bearing role (Stockard, Johnson, & Stockard, 1992). While it may not have been intentional to limit women in these gender roles, and to label those

filling these essential roles as inferior, this was the result, and sexism has been the means through which this power imbalance has been justified. For example, it is for this reason that women were not permitted to vote in the United States of America until 1920, less than 100 years ago.

While much has changed since this time, and explicit forms of sexism are less acceptable now than they once were, sexism is far from gone. Rather than disappear, it has adopted a subtler form, marked by profound ambivalence towards women. In 1996, Glick and Fiske recognized and named this new evolution of sexism. Appropriately, they named it ambivalent sexism, and created a scale to measure it: the Ambivalent Sexism Inventory (ASI). This scale and the subsequent research in this area are based on the hypothesis that the ambivalence seen in modern sexism is the result of a mixture of two seemingly conflicting types of sexism: hostile and benevolent. These types, which will be described in greater detail below, can be reserved for different women at different times, or coexist within a man's reaction to a single woman in a given moment. To explain this combination, Glick and Fiske (1996) give the example of a sexy woman, whose appearance might arouse a mixture of appreciation for her beauty (benevolent), and prejudice that she would be sexually manipulative (hostile). This combination demonstrates that hostile and benevolent sexism, while distinct, are interrelated, a relationship that is supported by research demonstrating that hostile and benevolent sexism are positively correlated, in the r=0.4 to 0.5 range (Glick & Fiske, 1996, 1997).

Hostile sexism is a term coined in 1996 by Glick and Fiske to describe what most people think of when they hear the word "sexism;" that is, the blatantly negative beliefs about women as beings attempting to control men through their sexual nature and/or

feminist principles. In a study that involved men rating different types of women, Glick and Fiske found that men's scores on a hostile sexism measure uniquely predicted their expression of negative viewpoints towards women who have careers (Glick and Fiske 1997). In 2009, Krings and Facchin found that men who were high in hostile sexist beliefs and low in agreeableness were significantly more likely than those who were not, to sexually harass women when they felt unfairly treated socially (Krings & Facchin, 2009). The larger environment also plays a role in how men with high hostile sexism view themselves. For example, exposure to sexist humor can signal to men that they are in an environment that tolerates sexism; this helps them to feel better about imagining themselves behaving in a sexist way (Ford, Wentzel, & Lorion, 2001).

Unlike hostile sexism, benevolent sexism is neither explicit nor even intended to overtly keep women down. Rather, benevolent sexism refers to words and behaviors associated with the belief that women are pure or weak creatures in need of protection or coddling. This tends to be a more socially acceptable facet of sexism in traditional western cultures, fitting nicely with the traditional aspirations of men as being the chivalrous protectors of women, who are referred to at times as "the weaker sex." Thus, benevolent sexism is perceived by the perpetrator, and sometimes by the target as well, as being positive despite operating on the basic detrimental assumption that women are inferior (Glick & Fiske, 1996, 1997, 2001).

Benevolent sexism has also been shown to break into three distinct subtypes: "protective paternalism" (e.g. women should be helped first), "complementary gender differentiation" (e.g. women are more innocent or angelic than men), and "heterosexual intimacy" (e.g. every man should have a woman to love) (Glick and Fiske, 1996). Each

of these subtypes serves to reinforce traditional gender roles, making the messages they send especially problematic for women who have chosen careers in traditionally male-dominated fields, such as computer programming.

Both hostile and benevolent sexism are present across many cultures, and in fact, are more accepted by women as well in cultures that endorse higher levels of sexist beliefs. Glick and Fiske hypothesized that the rewards of benevolent sexism involve a combination of "reward and punishment," (p. 116) in which the seeming benefits of benevolent sexism (such as being called angelic) are the rewards, while the explicit degradation of hostile sexism acts as punishment. Some of these benefits are combined with the explicit (hostile) punishment of breaking the gender expectations. This creates an environment in which sexism seems natural (Glick and Fiske, 2001). In exploring the ways in which women endorse sexist beliefs, Becker (2010) found that women in Germany were more likely to endorse hostile sexist attitudes when they think about other women, such as career women, who do not fulfill traditional stereotypes. In contrast, when women thought of those in traditional roles, such as homemakers, they were more likely to endorse benevolent sexist beliefs. This is consistent with the perception of career-oriented women being more threatening to the expectations of the male-dominated society than those inhabiting more traditional roles (Becker, 2010). Additionally, women's endorsement of benevolently sexist views may contribute to later endorsement of hostilely sexist beliefs when they're exposed to authoritarian rule that is driven by the perception that those outside that rule are a threat (Sibley, Overall, & Duckitt, 2007). This is consistent with another problematic feature of benevolent sexism; its tendency to

undermine any momentum for action involved in changing the culture of hostile sexism (Becker & Wright, 2011).

While one might expect the hostile sexism, which is more explicit and derogatory, to have a larger impact, research has demonstrated that it is benevolent sexism that is more problematic for women pursuing a career (Barreto, Ellemers, Piebinga, & Moya, 2010; Dardenne, Dumont, & Bollier, 2007; Dumont, Sarlet, & Dardenne, 2010). Barreto and Moya (2010) found that women who are exposed to benevolent sexism tend to define themselves in relational instead of task-related language when working with the (male) source of the sexism. This had the impact of women being more likely to forego taking a leadership role when engaging with male colleagues and instead playing a more "collaborative" role with these colleagues. On the other hand, women exposed to hostile sexism were not so quick to collaborate, but were more able to take charge in a work situation (Barreto and Moya, 2010).

Another study looked at two groups of women in a workplace environment, one where the manager acted in a hostile sexist manner and one where the manager acted in a benevolent sexist manner. The performance of the second group of women was most significantly impaired. These women exposed to benevolent sexism were more likely to experience mental doubts about their own competence whereas women in the hostile condition were well aware that they were being stereotyped and could therefore protect themselves from it (Dardenne, Dumont, and Bollier, 2007). Further, women's autobiographical memory shifted towards a view of themselves as more incompetent after they were exposed to benevolent, but not hostile, sexism (Dumont, Sarlet, and Dardenne, 2010). In other words exposure to benevolent sexism made women more

likely to question their motives and less likely to trust their instincts; in this way benevolent sexism has proven to be more insidious in undermining women than hostile sexism in these situations.

In addition to being harmful to the victim, sexist behavior can actually further the perpetrator's career. Men and women who act in subtly, but not overtly, sexist ways are more likely to rely on men for advice, and this reliance on men is positively correlated with being promoted (Watkins et al., 2006). This sets up a self-reinforcing system in the workplace, where those who have more power are more likely to hold subtly sexist beliefs and behaviors. Furthermore, whether women are hired in the first place may be influenced by this type of sexism, specifically revolving around the disparity in the level of respect men and women receive. Jackson, Esses, and Burris (2001) found that a manager's higher respect for male candidates than female ones reliably accounted for hiring discrimination, and especially in hiring for high-status jobs (Jackson, Esses, & Burris, 2001). However, hostile sexism also plays a large role in hiring. It is associated with more negative appraisals of female candidates compared to males, and for managers making more positive recommendations about prospective male candidates over female candidates who are applying for managerial roles (Masser & Abrams, 2004).

There is one more type of sexism that should be addressed. This is referred to as ambient sexism. Unlike the previous forms of sexism where there is a person perpetrating the sexist remark, ambient sexism refers to environmental cues creating an atmosphere that sends a sexist message. For example, if the walls of a technology company's office are covered in posters of male innovators, or stereotypically male interests, it creates a tone implying that women do not fit in. The preponderance of these cues alone can be

enough to implicitly dissuade female undergraduate students from becoming interested in computer programming (Cheryan et al., 2009). The term, ambient sexism, has also been used to describe indirect exposure to sexist remarks, such as overhearing a conversation targeting other women. Such ambient exposure to hostile sexism is enough to decrease women's self-esteem related to their performance, and lower their career aspirations (Bradley-Geist, Rivera, & Geringer, 2015).

Such ambient messages, both hostile and benevolent, can have a significant emotional impact. For example, in a study of 40 college students who were asked to keep daily diaries of impactful sexist interactions they witnessed for two weeks, the reported incidents were found to be a mixture of "traditional gender-role" prejudices, "demeaning or derogatory comments or behaviors," and "sexual objectification;" (p.38) essentially, both benevolent and hostile forms of sexism. The participants reported that these experiences impacted them in a variety of ways: by generating anger, making them feel anxious, and affecting their level of comfort and self-esteem (Swim, Hyers, Cohen, & Ferguson, 2001). This suggests that the emotional impact of ambient sexist messages may negatively impact women's abilities to perform their jobs successfully, and take a large psychological toll.

There is a unifying message that connects each sub-type of sexism: that women are lesser than men. In reflecting on this, one might call to mind the heteronormative stereotypes about what makes a good wife (such as beauty, kindness, and proficiency in housework), as opposed to what makes a good husband (such as a good job, and intelligence). These stereotypes are evident to children from a young age, combined with messages that this means that girls may be more suited to the arts than the sciences, for

example. Being consistently exposed to such stereotypes can be especially taxing when performing tasks that go against the stereotype, such as a woman doing math. The process through which this struggle against a stereotype impacts people is referred to as *stereotype threat.*

Stereotype Threat

The term stereotype threat was coined in a 1995 article by Steele and Aronson, in which they define the term as "being at risk of confirming, as self-characteristic, a negative stereotype about one's group" (p.797). In this article, they go on to describe the negative impact that this threat has on the test-taking performance of African American students, due in part to the distracting nature of contending with the intrinsic fear associated with being identified as that stereotype (Steele & Aronson, 1995). Since this time, research has demonstrated that presenting a task as a test of cognitive ability alone is enough to create a significant disparity in scores between those who belong to a group stereotyped as having lower intelligence and those who do not. One explanation for this is that this is due to increased mental load as measured by heart-rate variability (Croizet et al., 2004).

Since the identification of stereotype threat as a major factor contributing to performance disparities between groups, it has become a much-studied topic related to women's performance in mathematics, a subject that is highly linked with computer science. In 1999, a study on this subject demonstrated the common knowledge that women underperform on difficult math exams in comparison to men. This difference was eliminated when the researchers directly combatted stereotype threat by explaining that

the test had not historically generated gender differences (Spencer et al., 1999). Expectations of one's performance may also intersect with stereotype threat in impacting performance. A 2003 study found that receiving negative messages stating that women are worse than men at mathematical tests both lowered the women's predictions of how well they expected to do on the subsequent test, and significantly lowered their actual scores ($p<0.05$) compared to groups that received positive or neutral messages. Moreover, those who rated mathematical ability as personally important to them showed a greater decrease in expectancy from the positive to the negative message condition (marginally significant, at $p<0.052$) compared to those who did not identify with mathematical ability (no significant decrease) (Cadinu et al., 2003). In this way women who were more invested in being good at math were more negatively impacted in their performance when exposed to the stereotype. This impact on performance may also discourage women from choosing to pursue careers in fields related to math.

A meta-analysis by Voyer and Voyer (2014) looked at gender differences in academic success in the classroom from elementary school through graduate school, using data from 369 different samples representing a combined sample size of 538,710 males and 595,332 females. The results were surprising, in that females overall had significantly higher grades ($p<0.05$) compared to males, with the largest difference between groups being in language. While the difference between scores was smallest in the area of mathematics, females still out-scored their male counterparts (Voyer & Voyer, 2014). This finding is especially interesting given the contrast it represents to the well-documented gender disparity in the Standardized Achievement Test (SAT), with males consistently outperforming females on the math SAT since 1972 (College Board, 2013).

Stereotype type threat is most salient in formal testing with standardized tests, as compared to the classroom setting. Indeed, this disparity in gender performance in the classroom setting compared to performance on the SAT is a clear illustration of the negative impact of stereotype threat on females' performance.

In understanding the power of stereotype threat, it is important to note that introducing stereotype threat in a population that does not typically experience it is sufficient to negatively impact performance. A 1999 study by Aronson et al., found that introducing stereotype threat against White men in mathematics, by drawing intentional comparisons to Asian men as superior mathematicians, was effective in decreasing performance of the White males on a math test when compared to a control group. This effect would likely be far greater in a population exposed to constant messages stereotyping them as less proficient and competent (Aronson et al., 1999).

The multiple ramifications of stereotype threat on individuals' psychological wellbeing, as well as effects on other areas of life have been well documented. Being subjected to the stress caused by stereotype threat increases anxiety (Spencer et al., 1999), and increases the blood pressure of those under threat (Blascovich, Spencer, Quinn, & Steele, 2001). In fact, stereotype threat has been shown to impact the threatened individual in multiple domains, a phenomenon known as *stereotype threat spillover*. Effected areas include both working memory (Beilock, Rydell, & McConnell, 2007) and emotion regulation (Johns, Inzlicht, & Schmader, 2008). These are both important abilities for sound work performance. A 2008 study by Schmader, Johns, and Forbes found that those under threat performed less well on tasks requiring two distinct types of processing. Cognitive or social tasks, which function through the use of controlled

processing, are disrupted by both the negative impact of stress on prefrontal processing and by the additional cognitive load that occurs from active attempts to suppress automatic negative cognitive and emotional reactions to the stress. In contrast, performance on sensorimotor tasks, which rely on automatic processing, are impaired by the individuals' efforts to actively monitor their process as they perform the task (Schmader, Johns, & Forbes, 2008). In this way both controlled cognitive processing and more implicit processing were interrupted by stereotype threat causing individuals to underperform.

In a series of four studies published in a 2010 paper by Inzlicht and Kang, the researchers examined the effect of spillover from the stress of coping with stereotype threat. In the first study, they taught half of the participants a coping strategy to use cognitive reappraisal to combat stereotype threats. The remaining participants were not given any strategies. They found that those who were not taught to cope scored significantly lower on a set of math questions taken from a graduate requisite exam (GRE) than those who were taught to reappraise the situation. Further, those who were not taught to cope behaved significantly more aggressively on a subsequent game task. The researchers were able to rule out frustration over poor results as the cause of this aggression, and suggest that instead this reaction was due to depleted internal resources in the women without coping skills (Inzlicht & Kang, 2010).

In the second study, Inzlicht and Kang found a similar effect in those who were more sensitive to stigma. Those who reported that a math test would be more threatening, were more likely to over-eat when presented with ice cream. The data did not correlate with increased negative affect or frustration, again leading the researchers to suggest a

depletion of resources was to blame. The third study found that those who felt more threatened displayed riskier behavior in a lottery situation. The final study showed that women who were threatened later displayed poorer attentional control on a Stroop task, a task of executive control and function, compared to men or women who were taught to cope in these situations (Inzlict & Kang, 2010). These results are important in several ways. First they demonstrate the real impact of living under stereotype threat, leaving these women more at risk for losing their jobs due to disregulated behavior or making more errors in their work due to diminished attentional control. Additionally and very importantly for the mental health treatment of women living under constant stereotype threat, such as female programmers, these results demonstrated that the negative impact of stereotype threat on performance could be significantly reduced by teaching coping skills that are less resource intensive.

More studies provide evidence of the benefit of training people to cope with stereotype threat. This was functionally demonstrated in a 2005 study by Johns, Schmader, and Martens that looked at 75 female and 42 male undergraduate participants taking a math test using problems taken from the GRE. In one condition, the participants were told that this test was for a "study of gender differences in mathematics performance" (p.176). A second group was told the same thing, but also educated about stereotype threat, and reminded that any anxiety may be the result of these stereotypes rather than reflecting their ability. As is expected, female participants in the first condition scored significantly lower than their male counterparts ($p<0.01$), however, those in the second (teaching) condition, performed equally as well as their male counterparts (Johns, Schmader, & Martens, 2005). A 2004 dissertation reported a similar

finding in looking at the impact of stereotype threat on standardized test performance in African Americans. The results demonstrated that those who were alerted to the concept and potential experience of stereotype threat outperformed both those who were only warned about general anxiety as well as the control group (Aronson, & Williams, 2004). This suggests that similar forewarning about the impact of stereotype threat given to female programmers and students might help to mediate the potential negative effects of stereotype threat on their careers.

Other interventions may also reduce the impact of stereotype threat. For example, women who read about women succeeding in math related fields, such as architecture or invention, prior to taking a math test performed significantly better than those who were not given such priming ($p=0.008$). Further, women in the control group performed significantly worse than men ($p=0.006$), but the difference between men and women's scores was not significant for those in the intervention condition ($p=0.448$) (McIntyre, Paulson, & Lord, 2003). McIntyre et al. repeated these studies, yielding similar results in 2005, with the additional finding that reading more biographies of successful women increased performance. Indeed those women who read no essays performed significantly worse than men ($p=0.006$), whereas the difference between men and women who read one essay was no longer significant. Women who read two essays about successful women did better than those who read one, and those who read three or four essays had the best performance by a small margin. This suggests that the not only may exposure to successful female role models or mentors help to diminish the impact of stereotype threat on women in Science Technology Engineering and Mathematics (STEM) fields

(McIntyre, Paulson, and Lord, 2003), but having access to multiple positive role models may lead to even greater protection from stereotype threat (McIntyre et al., 2005).

The importance of role models in combatting stereotype threat to bolster women's math performance is echoed in additional research. In 2002, Marx and Roman conducted a study of undergraduate males and females manipulating gender and reported level of math competency of the examiner as a variable. They found that women performed as well as men when the experimenter, also said to have created the test, was female ($p=0.59$), but significantly worse if the experimenter was male ($p<0.01$). The exposure to a competent female role model provided protection even if the participants only read about competent female role models where the person was not in the room (Marx & Roman, 2002). Taken together, the importance of role models makes the huge attrition of women from the field of computer science even more problematic, as it results in a scarcity of role models for upcoming generations of female programmers. This leaves these cohorts vulnerable to the impact of stereotype threat in a manner similar to their female predecessors in the field.

However, the research also provides hope that if stereotype threat can be identified as a problem for women in math-related fields and women can receive proactive training and exposure to positive competent female role models. This provides both mental health professionals and places of employment a new fruitful area of intervention to help counter the effects of stereotype threat for women entering the field of computer programming and other math related fields. The importance of role models in helping future generations of women to overcome stereotype threat is especially interesting when looking at the history of the field of programming, in which the

important contributions of women have gone largely unacknowledged. As a result, historical hostile sexism may still be impacting young female programmers through the resulting dearth of role models.

The History of Women as Programmers

In order to understand the current job imbalance in terms of numbers of women employed as computer programmers, it is helpful to trace a brief history of women in the field of computer science. When one imagines programmers, a cliché image likely jumps to mind: a socially awkward geeky White man. What many people, including those employed in the field, do not know is that the pioneers of computer programming were female. Even before the existence of programmable computers, Ada Lovelace, the daughter of the renowned poet Lord Byron, worked with her friend Charles Babbage to create a description of the first *analytic engine*. While the machine was never built, it is often considered the predecessor of modern computers. In fact, Babbage and Lovelace's notes were used a century later by the people who constructed the first computer (Isaacson, 2014).

While Babbage's notes suggest that he considered the invention to be a calculator capable of complex calculations, Lovelace envisioned much more for the machine, hypothesizing that it might handle "pieces of music of any degree of complexity or extent" (Lovelace, 1843, p.694). Walter Isaacson, author of the 2014 book entitled *The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution*, referenced notes of Lovelace in an interview with Laura Sydell on National Public Radio (NPR): "[Ada] understands how you take an instruction set and load it into

the machine, and she even does an example, which is programming Bernoulli numbers, an incredibly complicated sequence of numbers" (Sydell, 2014). This acknowledgement of the early role of women in computers is unusual in that this history is not well known to the general public.

When the world's first electronic computer, the Electronic Numerical Integrator and Computer (ENIAC), was invented in 1945, men believed, as Babbage had, that the hardware of these machines was the exciting work (Isaacson, 2014). Thus, the programming work fell to a group of six female mathematicians. Jean Bartik, a member of this group, recalls in a 2008 interview with Linda O'Bryon at the Computer History Museum (CHM), that the job was not prestigious. In fact, these women were neither acknowledged at the unveiling of the computer to the public, nor invited to the celebratory dinner. Although the women were pictured with the computer, they went unnamed by the media. "People never recognized us," Bartik explains, "They never acted as though we knew what we were doing" (Bartik & O'Bryon, 2008). In fact, in another for CHM, Bartik recalls that after ENIAC was a success, Herman Goldstein, a man in charge of these women, "claimed that he and Adele programmed it; can you believe that? That was a boldface lie" (Bartik & Hendrie, 2008, p.31).

This team of female programmers later began to work on commercial computers, and joined forces with Grace Hopper, a math professor and member of the Navy Reserve. Hopper believed that programming could be done more effectively using language rather than numbers. In 1952, she led a team to create the first compiler, a program for turning language into code that is read by computers. An important development from this vision came to fruition in 1959, when she became a key member of the committee that

developed Common Business Oriented Language (COBOL). This ability to program computers and compile the code for whatever hardware one was using changed the face of computer science (Beyer, 2009). As Isaacson said in his 2014 interview at NPR, this "made programming more important than hardware, 'cause you could use it on any piece of hardware" (Sydell, 2014).

Even in the 1960's, programming was considered to be a good fit for women. *Cosmopolitan Magazine* published an article in 1967 called "Computer Girls" encouraging women to pursue computer programming as a career. However, by this time, the tides of the field were already changing. Male computer programmers strove to make their field more prestigious by transforming it from a female career to a male one. In order to accomplish this, they created professional associations and discouraged the hiring of women through negative advertisements. "What has sixteen legs, eight waggly tongues and costs you at least $40,000 a year?" asks one such advertisement, for the Optical Scanning Corporation (1960's, seen in Frink, 2011), showed prominent pictures of female legs and mouths. "Our optical reader can do anything your keypunch operators do," reads a 1967 advertisement for Recognition Equipment that features a picture of a pregnant woman. The ad continues to say, "(Well, almost.) It can't take maternity leave. Or suffer from morning sickness. Or complain about being tired all the time" (Ensmenger, 2010, p.30). These negative messages served to discourage the hiring of women in programming along with using hiring algorithms that involved mathematical puzzles, the answers of which were circulated through male fraternities. Finally personality tests were used as a basis for hiring programmers and profiles were favored that championed today's idea of an "anti-social computer geek" (Frink, 2011, para. 10).

All this increased the numbers of males going into programming and served to discourage women who might be interested in careers in computer programming.

History has shown us that these tactics worked. The new practices and stereotypes have become self-perpetuating, as men fitting the "computer geek" mold seek out employment in the field, and employers search for the men fitting the stereotype (N. L. Ensmenger, 2012). This message that women do not fit in the field may explain part of the persistent decline in women obtaining undergraduate degrees in computer science, from 37.1% in 1983-84 down to 17.8% in 2012-13 (Chen, 2014).

The Leaky Pipeline: Undergraduate Years

In recent years there had been a growing body of literature looking at the *leaky pipeline* of women in Science, Technology, Engineering, and Mathematics (STEM). This refers to women who are excited by technology and demonstrate a real competence and interest in it while in high school but come to abandon these dreams while in college. Often these women become demoralized and end up giving up on their career goals only to end up in alternate fields that pay less money. Through research in this area and subsequent changes in policy and programs, which will be discussed in a later section, progress has been made in helping women to succeed in many STEM fields. However, the problem is far from resolved.

It appears that the problem actually begins before students reach college. Scragg and Smith (1998) studies their affiliated university, State University of New York (SUNY) Geneseo, and found that in addition to problems with retention, low entry rates of women into computer science were a significant factor in the lower number of

graduates in the field (Scragg & Smith, 1998). This message is echoed by Chute (2009), who suggests that high school women and minorities who did not have a family member in a technology field were far less likely than men to take classes in math or computer science (Chute, 2009). In line with this suggestion, in a 2010 paper, Buzzetto-More, Ukoha and Rustagi looked at both race and gender found that females were less prepared for success in computer science (CS) classes than males, and had also received less counseling about, and less exposure to, the CS field (Buzzetto-more, Ukoha, & Rustagi, 2010). This finding may be explained in part by male and female stereotypes, where young boys are encouraged to tinker with toys and computers while girls are urged to play with dolls. This problem in differing levels of support and encouragement continues in college, where there are significantly fewer female and minority faculty in STEM available to be mentors for these underrepresented students.

While other STEM fields have been recruiting a growing number of women, as previously mentioned, computer programming has experienced a decline in the number of women achieving college degrees in Computer Science, from 37.1% in 1983-84 down to 17.8% in 2012-13 (Chen, 2014). Despite the fact that the field of computer science is only growing, with the U.S. Department of Labor projecting an increase to 1.4 million jobs by 2018, fewer women are completing degrees (Ashcraft & Blithe, 2010). One might argue that this is due in part to many women not fitting the presumed ideal personality of being unsocial and geeky that pervaded hiring tests in the past, and continues as a stereotype today. If it were the case that this personality type did indeed predict better performance in CS, then might this explain the decline in the numbers of women attempting the degree? Unfortunately for proponents of this argument, new research has

shown that personality factors do not predict performance in computer science classes. In fact, while intelligence and critical thinking improved performance on the psychology exam, the factors that best predicted performance were ability to be patient and concentrate on the task (Aamodt, 1982).

So if the old hiring stereotypes have been disproven, then why has the leaky pipeline been getting leakier? While the idea of the ideal programmer is baseless, multiple studies over a span of decades have shown that the impact of the resulting stereotype continues to deter women from pursuing careers in CS. One such study from 2013 found that the perception that men were better suited to CS was a major barrier to women's participation in the field (Bock, Taylor, Phillips, & Wenying, 2013). This is not a new finding. In 1997, Margolis and Fisher interviewed 120 undergraduate students, including CS majors and non-majors, about their experiences and thoughts around CS. Among their findings, they identified the "geek mythology" (stereotypes of the ideal computer scientist) as "especially pernicious for discouraging and repelling women students" (Margolis & Fisher, 1997, p.138). Other themes this study identified were problems in the academic climate, as well as female's lower self-esteem and self-appraisal in CS, and differing motivation for men and women entering the field: with men citing computers as "the ultimate toy," (p.139) whereas women spoke of pulls such as the betterment of the world and computers as the future.

This difference in motivation may sound irrelevant, but in fact, it speaks both to the added pressure and high bar for success that women may set for themselves, and to a key difference in what one might focus on in school. This is consistent with findings in a 2007 study by Varma and Hahn, in which over half of the women interviewed had a

negative perception of computer science classes, a much higher percentage than in male students. The chief concern of the female students was that the classes did not seem pertinent to "real-world" concerns, a complaint very much in line with the differing impetuses for women to enter the field (Varma & Hahn, 2007).

Additionally, CS courses may be taught in a way that caters to male students in other ways as well. Research has found gender differences in preferred learning styles between male and female students, which have been attributed to different cultural emphases for men and women (Milgram, 2007). A study of performance in men and women taking CS courses in Bahrain found that men were performing significantly better than women in the class despite similar capabilities. Analysis revealed that class assignments were limited to the bare essentials. As a result, the female students, who tended to follow the syllabus closely were less well prepared for quizzes, whereas male students were more likely to explore material outside the course, resulting in better performance (Alkhalifa, 2008). This difference is likely a result of the way that men and women are socialized differently in Bahrain, with men being encouraged to be independent while women are discouraged from such behavior (Markus & Conner, 2013).

This difference in learning needs is not limited to other countries. A 2007 dissertation by Stoilescu found that many introductory courses were taught with the assumption of significant prior experience in computer science, something that many male students had, but many female students did not. This put the female students at a significant disadvantage, and led to increased anxiety and decreased confidence for these women. The researcher further elucidates that, in part because of this disparity, the

female students were less likely to focus on the "practical values" needed for employment after graduation, putting them at a disadvantage as they moved beyond college (Stoilescu et al., 2007).

In addition to these issues, a 2009 paper by Cheryan, Plaut, Davies, and Steele found that ambient messages in the academic environment that signaled belonging, or lack thereof, was key to this loss of women. They show that changing objects in a computer science classroom from those representing the constructed stereotype of a computer scientist as male and geeky, such as Star Trek posters, to nonstereotypical items such as nature posters, increased females' interest in the subject to the level of their male peers. Furthermore, these ambient stereotypically male environments frequently undermined women's interest in computer science degrees, even when the academic environment was entirely populated by other women (Cheryan et al., 2009). Therefore, these pervasive stereotypes of how a programmer should look may act as gatekeepers for women, driving many away from the field (Cheryan, Master, & Meltzoff, 2015).

Recently, qualitative studies have aimed to gain a deeper view of these issues. A mixed methods dissertation by Ragsdale (2013) analyzed data from 160 survey respondents who identified as female and who had completed CS degrees. The author also completed six in-depth interviews. He found that while previous experience with programming before college was not necessary for the completion of a degree, as only 57% of the respondents had such experience, a high level of confidence in math ability and enjoyment of mathematics appears to be important. This is extremely relevant to the recruitment and retention of women in CS, as pervasive societal stereotypes suggesting that women are inferior at math may be a major force in deterring their pursuit of CS

degrees. Another key finding in this study was the importance of the women's confidence that they will succeed in the field. This reinforces the message that positive mentorship and support is key in helping women to persevere through an undergraduate degree (Ragsdale, 2013).

This also supports the findings of a qualitative study by Frieze (2007), who examined the impact of deliberately moving to change culture and environment on the decision of women to pursue an undergraduate degree in programming. Specifically, this study observed the effects of positive changes to the computer science curriculum implemented at Carnegie Mellon in an effort to improve the retention of female majors. The study argues that the shift to a more gender balanced and supportive environment was the likely driving force behind the resulting improved retention rates of female Computer Science graduates, and has in turn drawn more women to programming, creating a positive cycle (Frieze, 2007). This suggests that a similar shift in the culture of companies might engender a similar improvement in the numbers and experiences of female programmers employed there.

The Leaky Pipeline: Employment

Research has shown that the pipeline does not stop leaking after women graduate from college. In fact, a study by the National Center for Women and Information Technology (NCWIT) found that while 74% of women employed in technology jobs state that they "love their work," 56% of women in technical positions leave within ten years (Ashcraft & Blithe, 2010). They attribute this in part to the absence of female mentors, and general isolation in a male dominated culture. This lack of mentorship may

also negatively impact the potential for women's career advancement, and job satisfaction (Hewlett, 2008).

The problem may begin before a woman even finds employment, as the language of recruiting has been a persistent problem in inadvertently discouraging qualified women from applying to positions as programmers. The Anita Borg Institute, an organization promoting women in technology, published recruiting guidelines in 2012 (Simard & Gammal, 2012). In these, they encourage companies to stop advertising for jobs using stereotypical terms, such as "rock star hacker," or "code ninja," (p.14) as these are more likely to attract male applicants who have been socialized to think of themselves as independent and outstanding. Similarly, research from law firms has shown that qualifiers that have strong masculine connotations, such as assertive or outspoken, may deter female applicants and make it more likely for men to be hired (Gorman, 2005). Additionally, in hiring, the qualifier of goodness of fit is often used to rationalize the hiring, and promoting, of men over women (Lyness & Heilman, 2006). This is especially problematic in an established culture that is very masculine, where the supposed lack of fit of women is an established problem, essentially creating a self-propagating culture where those who fit the mold are hired over those who would bring diversity.

In 2014, Braun and Turner did a study in which they interviewed managers in Science, Engineering, and Technology (SET) companies. Their results are in line with the suggestion that it may be more difficult for women to be hired to a SET job. They found that while managers advocated the benefits of hiring women, including increasing diversity and improving teamwork, they were also aware of the ways that negative stereotypes about women impeded hiring and promoting women in SET. Common

stereotypes these managers mentioned included women being more emotional, more challenging to manage, more sensitive, and more likely to have their attention diverted by family responsibilities (Braun & Turner, 2014).

These attitudes create work environments that can result in women workers experiencing explicit sexism, both from managers as well as work colleagues. And even when there is an awareness of sexism, paternalistic attitudes about women in SET can be prevalent. This second type of attitude engenders a more insidious type of sexism, called benevolent sexism, which implies that women are incompetent and in need of support or protection (Glick & Fiske, 2001). While often well intentioned, this attitude can be even more damaging, as gender identification protects against hostile, but not benevolent, sexism. This would explain the results of a 2011 dissertation, in which Trevor-Smith found that feelings of technology self-efficacy was higher for women with technology education than those without, but was actually lower for women with technology jobs than those with non-technology jobs (Trevor-smith, 2011). This suggests that the problematic work environment may significantly lower women's self-concept and ability to perform in their technical jobs.

Women in the field of computer science face a multitude of barriers to professional success. In addition to the aforementioned messages from the managerial perspective that women are more emotional and therefore more difficult to work with then men, interactions with environments that favor men and with men who harbor sexist attitudes have had detrimental effects on women workers' self esteem. In an engineering environment, both factors have been shown to trigger stereotype messages in women that, in turn, negatively impacted the quality of their work in engineering (Logel et al., 2009).

As a result, women are placed at a functional disadvantage compared to men in their ability to excel at their jobs. This combination of an adverse environment and being met with sexist attitudes in male coworkers can create a self-fulfilling prophecy where women's success in programming is systematically undermined. This occurs as a result of women's tendency to experience pervasive doubts about their competence at work. When this is combined with the overall lack of mentorship offered to women, both in academia and technical work environments and the dearth of female role models, this can create an internal experience where women come to believe that the problem lies in them as individuals, rather than in a system that consistently undermines them.

These messages are reinforced by the culture that many companies foster, and may play a significant role in the aforementioned attrition of female programmers. In 2014, Kieran Snyder wrote an article for Fortune.com speaking to the results of interviewing 716 "women who left tech" (para. 1). Of these, 484 left due in part to becoming a mother, and an additional 85 primarily for this reason. These women spoke to the challenges of returning from maternity leave, having no place to pump breast milk, lack of flexibility around taking leave, unsupportive environments, and inability to pay for childcare based on their salary. As one of the interviewees clarifies, "Motherhood was just the amplifier. It made all the problems that I'd been putting up with forever actually intolerable" (para.10). An additional 192 women cited the discriminatory environment alone as the primary reason for their decision to leave the field. Unfortunately, these culture problems often drive the women away permanently. Of the women interviewed in this study, 625 out of the 716 stated that they do not plan to return to working in technology, though many mentioned loving the actual programming (Snyder, 2014).

Aside from the psychological impacts of the environment, recent research has shown that bias in the work environment results, on a practical basis, in a shutting out of women's ideas. A 2016 by Terrell et al., found that the acceptance of submissions to an open-source software community, Github, varied significantly if the gender of the author was identifiable. Specifically, submissions from female programmers were accepted at a higher rate than those of their male colleagues only if the gender of the submitter was unknown. When female contributors were identified as being female, the rate of acceptance fell below that of the male identified programmers (Terrell et al., 2016). This demonstrates two very important points. The first is that gender of the programmer colors the way peers view that person's code, a problem that puts women at a functional disadvantage regardless of skill. Secondly, this study makes it clear that female programmers are able to make important contributions to the field, thereby combatting the argument that any discrepancies in the numbers of male and female programmers could be due to inferior ability on the part of the women.

Additionally, very real consequences have fallen upon female programmers who speak out against sexist treatment, or stand out from the crowd. For example, in 2013 CBS San Francisco reported that a woman was fired for tweeting about men harassing her at a programming conference (CBS, 2013). Such incidents reinforce a silencing message to women, and may lead to greater attrition from the field. Even appearing in public, or attempting to contribute to the field, can be a dangerous exercise for female programmers. In 2015, female programmer Jessie Frazelle wrote a blog post decrying the treatment she had received. She writes:

> Ever since I started speaking at conferences and contributing to open source projects I have been endlessly harassed. I've gotten hundreds of private messages on IRC and emails about sex, rape, and death threats. People emailing me saying they jerked off to my conference talk video... is mild in comparison to sending photoshopped pictures of me covered in blood. I wish I could do my job, something I very obviously love doing, without any of this bullshit. However that seems impossible at this point (Frazelle, 2015, p.1).

This post further speaks to a catch 22 female programmers may face: to attempt to advance their career and make contributions under threat of such sexist treatment, or to try to lay low and survive. Either avenue could easily contribute to women's increased attrition from the field. Thus, the well-documented problematic and sexist messages that contribute to undergraduate women leaving the field may not disappear upon graduation and may be present or even more salient in these tech work environments.

Employment in Technology in The San Francisco Bay Area

The Bay Area is a central hub for technology companies in the United States, being home to technology giants including Google, Facebook, Apple, Paypal and Twitter as well as myriad other large and small companies. As such, the Bay Area has become a prominent location for programmers to come for work, or to look for work. Both big and new companies continue to fuel the demand for new programming talent, creating a self-reinforcing demand.

Technology advertisements litter the billboards along the freeways, advertising companies' services as well as recruiting new programming talent. One such advertisement, by recruiting platform Dice.com, displays black and white images of the stereotypical programmer: scrawny, nerdy looking men, posed dramatically in their underwear. "Find the hottest tech talent," the 2015 billboards read. The diversity in the

ads sends a clear message: the "hottest tech talent" is mostly nerdy White men, with a light sprinkling of Asian and Indian men. Women don't fit the image.

This message is unfortunately continued by the shockingly low diversity at many of the Bay Area companies. Google, for example, published diversity data in January 2015 that states that while women make up 30% of their employees, only 18% of their technical staff is female (www.google.com/diversity). Other Bay Area companies report similar numbers of women on their technical staff, with LinkedIn having 17% (Wadors, 2014), and Yahoo having 15% (Reses, 2014), for example. In 2014, Twitter published diversity data showing that only 10% of their technical staff is female (Van Huysse, 2014). Many companies remain unwilling to publish such diversity data, likely because it is similarly skewed. The companies in question often point out that this low employment rate is likely a due to a combination of the shortage of women with computer science degrees, and the high attrition from the field. However, these companies could be more active in targeting female programmers in their recruitment efforts as well as providing internships for women and other training opportunities in programing. In addition these companies could actively recruit women as well as addressing issues in the culture to make it more women and family friendly. With changes that could contribute to creating a culture in which women felt more comfortable staying in the field, one would expect that these numbers could climb dramatically.

The problem does not stop with the low numbers of female employees; technology companies are not immune from pay inequality. The Bay Area is one of the most expensive places to live in the United States, with San Francisco now rivaling New York City for the highest rent, according to the August 2014 rent report on Zumper, an

online real estate marketplace (Le Louarn, 2014). This means that pay disparities in the Bay Area may be even more damaging to a family's or individual's quality of life, and their ability to stay in the area compared with other parts of the country. This makes the vast pay differences between genders reported in the analysis of census data from the 2014 Silicon Valley Index all the more shocking. The report found that for those employed in Silicon Valley, which is largely composed of technology companies, men with Bachelor's Degrees are paid 40% more than women with the same degree, and that the difference widens to an astounding 73% pay gap between men and women holding Graduate Degrees (Hancock & Carson, 2014).

Women working in technology companies are slowly becoming more vocal about the discrimination against them. For example, on March 16th, 2015, Chia Hong, a technology partner who worked at Facebook from 2010 until she was fired in 2013, sued the Silicon Valley based company for discriminating against her on the basis of her gender and race. In the suit, she specifies that the harassment she faced and her wrongful termination caused her "severe emotional distress" (Hong v. Facebook, 2015, p.12). Three days later, on March 19th, Tina Huang filed a lawsuit against her employer; San Francisco-based Twitter, for discriminatory promotion practices against women. Part of her complaint revealed that she had detailed her concerns to the CEO prior to taking legal action; the result was not the conversation and change she had hoped for, but rather, she found herself placed on leave while the company investigated her concerns. After three months of this leave, without updates on the investigation or a timeframe for her return, she felt she had no choice but to resign (Huang v. Twitter, 2015). These lawsuits give

voice to another potential facet of the question of women's attrition from technology fields: that those who attempt to speak out and change the culture may be forced out.

Fortunately, as awareness around this issue grows, so does the amount of support. In recent years, several organizations have opened in the Bay Area and nationally, with the aim of increasing the number of female programmers, and supporting those already employed in the field. These include intensive programming courses, such as the San Francisco based Hackbright Academy, a ten week long programming curriculum for women that also introduces their students to Silicon Valley companies looking for programmers (https://hackbrightacademy.com). Other organizations, such as She's Geeky, offer peer support from other women in STEM and self-identified female geeks (http://shesgeeky.org). Support for entrepreneurial women, and female technology professionals, is also available in the form of conferences for women programmers in addition to other additional resources geared to providing support for women in tech (http://women2.com). These are just a few examples of the growing support for women in technology. While these organizations cannot change the culture of the companies in which female programmers work, they can help these women find much needed support in the face of a problematic system.

Summary

Women studying to be, and employed as, programmers face a variety of cultural barriers as a result of widespread sexism and stereotype threat. Research has shown that these factors can have serious ramifications, both personally and professionally, ranging from decreased sense of competence and self-esteem to significantly impacted

performance and difficulty regulating emotions. Taken together, this can further limit women's success through both internal and external means. This may contribute to the high attrition rates of women from the field of programming, both in their undergraduate studies and in employment.

While the quantitative research in this area demonstrates that there is a problem both in recruitment and attrition of women in the field of computer science, thus far there have been few research studies to date that aim to gain a deeper understanding of the lived experience of female programmers. Such research is especially important to individuals living in the San Francisco Bay Area, as it is currently one of the most expensive areas in the country. This makes both the gendered pay gap reported in Silicon Valley, and the high attrition of women from one of the highest paid jobs available, significant problems for female programmers' potential quality of life.

A recent dissertation by Amanda O'Conner (2014) presented the results of a five-year longitudinal study aiming to identify the factors contributing to women's perseverance in obtaining a computer science degree and continuing employment in the field. In this study she interviewed fifteen women at a university: first in their final year of college, and then again between four and five years later. As might be expected based on previous literature, themes that arose included the prevalence of stereotype threat throughout the women's experience, as well as lowered self-confidence in both their studies and work lives. Surprisingly, however, the women interviewed stated that the stereotype threat was not a disincentive to them, and could even be used as motivation to succeed. This may speak to a self-selection of women who are able to persist in the field of programming and who were able to reframe such negative messages to combat

stereotype threat. Consistent with this theory, the interviewed women also cited personal motivation as a driving force behind their perseverance (O'Connor, 2014).

While this study provides helpful insight similar to the goals of this dissertation, the current study differs from O'Connor's in three important ways: The current study is a phenomenological study that intends to look more deeply at the experiences of women who work in computer programming, from their selection of their first job to their ongoing career experience in programming. The overall exploratory question that this study will address is what is the lived experience of Bay Area women who work full time in computer programming? A second way this study differs from the O'Connor study is that it focuses solely on the experiences of women currently working in the field rather than on their experience of college. Finally, the current study will interview women from a variety of work places who attended a variety of colleges (as opposed to all coming from the same cohort in a single school). As such, this study will expand on the existing literature by gathering more disparate voices and going deeper into their experience as programmers in the work force.

The results of this study will ideally contribute to the field by raising awareness around the issues faced by women in computer programming. Through this research, key challenges that full time women programmers face will be documented, including how they negotiate work environments and work-life balance. This dissertation may also reveal recommendations that provide an impetus for the development of better supports and mentoring services for young women interested in working in the field of programming. Lastly, this study may identify potential directions for clinical treatment

that could more effectively support the well-being and function of this growing population of working women.

Chapter 3: Methodology

Overview

This study aims to better understand the lived experience of women working as computer programmers in the San Francisco Bay Area, exploring the highpoints and the nature of the barriers these women may have faced as programmers both personally and professionally. Because the field of computer science (CS) is currently one of the highest paid industries, and is actively hiring, the great disparity between the number of men and women in the field has been the focus of significant research. Many of these studies focus on undergraduate attrition rates of women majoring in computer science, and of those that do look at women who have made it to the workforce as programmers, few of them seek to understand their experience in depth. Because the barriers these women face, and the impacts on them, are likely complex and multifaceted, a qualitative approach is appropriate to begin to explore this experience. In this qualitative study, eight female participants currently working as computer programmers full-time were interviewed in a semi-structured style, about their experiences as a computer programmer. The researcher then analyzed the resulting transcripts to identify themes endorsed by a majority of at least five of the participants; these themes were then used to construct a holistic picture of these participants' experience. The results of this study will hopefully inform the development of hypotheses that can subsequently be tested in future quantitative research on female computer programmers.

Participants

In order to qualify for this study, all participants needed to be 18 years of age or older, cis-gender female-identified, programmers who were currently employed as full-time programmers as employees of a company (not working as a consultant). They must have been employed as programmers at Bay Area companies for at least one full year leading up to their participation in the study. These women must do the majority of their work from a company office, as opposed to working remotely, as this would likely be a very different experience. Additionally, because the interviews were conducted in English, and language is important to the success of the coding, all participants were required to be able to speak English fluently. The study was limited to women in the San Francisco Bay Area, a growing technological hub, in order to facilitate in-person interviews and to better understand the experience in this particular location.

Recruitment and Screening

Recruiting was done through the snowball method. The researcher began by reaching out to acquaintances in the field of programming, and asking them to spread the word to their friends and coworkers. These initial contacts were provided with brochure about the study that included contact information for the researcher, to be passed out to potential participants (Appendix B). The brochure described the study, including the process as an interview aimed at understanding their experience, and included the criterion for participation in the study.

In order to qualify for the study, potential participants needed to contact the researcher via the phone number or email address provided in the brochure. Individuals

who responded to the brochure were then screened by phone to ensure that they meet the inclusion criterion, described under the participants heading, above (Appendix C). In addition, the participants' rights as research participants, including the right to withdraw from the study at any time, were explained to each participant. Respondents who met the full criteria and who wished to participate were scheduled for a full in-person interview with the researcher. Participants who complete the interview were compensated with a $25.00 gift card for amazon.com, which was physically handed to them by the researcher at the end of the interview.

Procedure

Immediately after the interview had been scheduled, a package was emailed to each of the eight participants including a letter of introduction describing the study in greater detail, explaining informed consent, reminding participants of their rights, as well as a formal informed consent form that will include consent to audio recording (Appendix D). The study description included information on the researcher and dissertation chair. Accompanying these forms, there was a brief demographic questionnaire for participants to fill out as well (Appendix E). The questionnaire asked about key demographic information including educational and cultural background, type of programming performed, employment history (including company type and size), history of support (or lack thereof) in family and intimate relationships, history of family involvement with STEM fields, as well as future career and family goals. The participant brought these completed forms, including the demographic questionnaire and signed informed consent, to the interview. In order to protect the confidentiality of the

participants, following the interview these forms were stored in a locked file cabinet in the researcher's office, to be kept for seven years.

The format of the interviews was a series of semi-structured questions based on a protocol created by the researcher (Appendix F). This protocol consisted of open-ended questions that worked to gather information on aspects of each participant's individual experience. Prior to the interview, the researcher verbally explained the informed consent and participant's rights to ensure that each participant fully understood the process. Interviews were conducted in person, and done in a mutually agreed upon quiet setting with an approximate duration of one hour. As part of informed consent all participants consented to have their interviews taped, and all interviews were audio recorded and later transcribed in a de-identified way to facilitate accurate data analysis. Audio recordings were stored in a safe in the researcher's residence, and deleted immediately following transcription.

Interview Protocol

Interviews were designed to be semi-structured; they consisted of open-ended questions and prompts to facilitate each participant's deeper exploration of their own experience. Questions were designed to explore multiple aspects of each person's narrative regarding their employment in the computer programming industry and impacts on their larger life and emotional experience. The interview began by exploring what drew them to computer programming, what sustained this interest, and what their education leading up to employment as programmers was like. The next part of the interview explored the contours of their experience as professional programmers: the

hiring process, what it was like to get acclimated to the workplace as programmers. The interview also explored the contours of their experience at work: the highpoints, the low points, what potential barriers each woman may have faced, how they coped with these barriers, and what supports they found most helpful for coping. The last part of the interview examined the impact this experience has had on their lives and self-concept, as well as any "ah ha" moments these women have experienced. The interviews ended by asking what these participants would want to tell other women entering the workforce as computer programmers. In line with the principles of Interpretive Phenomenological Analysis, as outlined by Smith (2004), these interview questions were not designed to be rigidly adhered to but rather served as a starting point for a larger and deeper exploration of the participant's experience.

Bracketing of Potential Bias

The researcher attempted to reduce the impact of personal bias on the results by working to maintain awareness of her assumptions around this subject, and staying aware of her motivations for the study (Appendix G). As a woman with a background in STEM, having a bachelor's degree in Biology and several years of research experience, the researcher may have implicit assumptions about the types of barriers faced by females in a STEM profession. These assumptions may also be influence by the experience of the researcher's mother, a Biologist, who has faced her own significant challenges as a female scientist who grew her career during a time when explicit sexism was more socially accepted.

Further, being married to a male computer programmer, his views about the experiences of his female colleges, as well as his assumptions about the culture of the field, may have influenced the researcher's opinions and expectations about the study results. However, as a male ingrained in the culture of computer programming, and therefore someone in a position of higher power, his views cannot be expected to fully or accurately reflect the experiences of his female colleagues, who are most often on the down side of this power differential. His views may also reflect societally expected blind spots. Thus, the researcher maintained his narratives, and her own resulting views, as separate from the experiences of the study participants.

In order to help the experiences of the participants to be unmarred by these notions, the researcher worked to remain aware of her preconceived assumptions, and to be open to experiences that were not congruent with her own. As a further step, the researcher documented her experiences and assumptions, and frequently compared them to the themes that arose during the data analysis, and actively searched for themes that differed.

Data Analysis

After the data collection, each interview was transcribed verbatim. The resulting transcripts were then coded for common themes, using the framework of Interpretive Phenomenological Analysis (IPA), as outlined by Smith (2004). IPA is an approach that is both idiographic and iterative in nature, in that it both turns the specific words used into more general themes, and constantly cycles back to compare the themes that have been generated to the original interview.

Analysis took place in three phases. The first phase consisted of the researcher re-reading each transcribed interview several times, and making notes in the margins of immediate reactions to parts of the interview that appear significant. When this was completed, the researcher returned to the beginning of the transcript and used the annotations she made to identify emerging themes. These themes were then listed and reorganized, so that they were no longer arranged based on when in the interview they emerged, but rather so that they were grouped by commonalities. The resulting clusters of themes were then labeled in a more abstract way, to capture the overarching idea of the group, and to facilitate connection between transcripts, should similar themes arise. Each of these larger themes were assigned a numerical identifier for ease of documentation as repeated themes become apparent. Each interview was independently analyzed using this method.

When this thematic analysis was completed for each transcript, a comprehensive table of themes was generated. This was checked against the researchers bracket of potential bias, as well as to the original transcripts, to ensure that all themes accurately reflect the individual data. The list of themes were then refined and trimmed down based on the frequency of each theme's appearance across interviews, as well as the depth in which it was spoken about. Only themes that are consistent across at least five of the interviews were included in the master table.

In order to maximize the validity of the analysis, and minimize the potential impact of researcher bias, a second coder was utilized. This coder was a graduate student in clinical psychology who had no personal or professional experience in this specific area of study. They were provided with transcripts of the interviews, the table of themes

compiled by the researcher, and the researcher's bracketing of potential bias. This coder was charged with noting any potential themes that the researcher may have missed, as well as articulating any alternate interpretations of the data, and documenting any areas in which the researcher's bias may have influenced the analysis. This coder then met with the researcher, and the two discussed any differences, and finalized the master table of themes together.

Chapter 4: Results

Participants

The participants in this study were eight cis-gender women who are currently employed as programmers in the San Francisco Bay Area. All participants were living in the San Francisco bay area at the time of the study. Their ages ranged from 23-37 years old. Five of the participants identified as White, and three identified as people of color (one as Black, one as East Asian, and one as South Asian). Three participants identified as members of the LGB community (one identified as gay, and two as bisexual). These participants are each described below, in chronological order of interview date. In order to protect the anonymity of these participants, pseudonyms are being used, and identifying details are kept vague.

"Anne" was a 23-year-old woman who identifies as White and heterosexual. Her father was a software engineer, and encouraged her to pursue a degree in computer science. Anne majored in humanities in college while taking computer science classes, after she felt unfairly treated by a professor in the computer science major in a way that impacted her ability to pursue a computer science degree. Despite this, she found employment as a programmer, and has now been working professionally for approximately a year and a half.

"Bette" was a 31-year-old woman who identifies as Black and heterosexual. She began playing with computers at a young age, and taught herself some coding as a teenager. In college, she majored in humanities, and worked a job creating websites for departments at her school. She initially entered the profession of programming by taking

freelance jobs in order to save money for continued schooling in another field. She has now been working as a programmer for over nine years.

"Caroline" was a 37-year-old woman who identifies as East Asian and heterosexual. Her father is an electrical engineer, but has not been a strong source of support for her career. She majored in an unrelated STEM field at a prestigious university, and also had a non-STEM career before being inspired by her software engineering friends, and deciding to become a programmer. She attended a programming boot camp, after which she found a job and has been working as a programmer for four years. She is engaged to a male programmer.

"Diane" was a 24-year-old woman who identifies as White and heterosexual. Her father was a software engineer, and provided support and mentorship through her undergraduate studies in computer science. She majored in computer science, and since graduating, has been working as a programmer for approximately three years. She is currently married to a male programmer.

"Emma" was a 32-year-old woman who identifies as White and homosexual. She began programming in high school, but majored in an unrelated STEM field in college. She briefly pursued graduate school and then a non-STEM career before deciding to pursue programming as a career. She attended a programming boot camp, and she has now been working as a programming in the San Francisco Bay Area for approximately three years. She is married, and her wife is not in any STEM field.

"Francis" was a 30-year-old woman who identifies as White and bisexual. Her father is a software engineer, and she began coding at an early age, but did not identify what she was doing as programming. She majored in a non-STEM field in college, then

worked for a start-up doing work that was not programming, and realized that she wanted to become a programmer. She pursued a Masters degree in Information Management, and then found work as a front-end programmer. She has now been working as a programmer for over 5 years. She has a young child, and is married to a male programmer.

"Gretta" was a 30-year-old woman who identifies as White and bisexual. She reports having "many aunts and uncle in STEM," and has an undergraduate degree and a PhD in Electrical and Computer Engineering. She has been working as a programmer in the San Francisco Bay Area for approximately 4 years. She has a male partner who is not in any STEM field.

"Holly" was a 26-year-old woman who identifies as South Asian and heterosexual. Both of her parents are software engineers, and encouraged her to study computer science. She began to study programming in high school, and majored in computer science in college. She has been working as a professional programmer for over 3.5 years.

Themes

Through Analysis of the data, sixteen key themes emerged. These have been grouped into related domains (Table 1), and each theme is discussed below.

Table 1

Themes Grouped into Domains

Domains and Theme	Endorsed by number of participants:
Early experiences	
1. Family role model/mentor	5
2. Did not envision herself as a programmer as a child	6
3. Negative experiences in school/non-traditional education	8
4. Experiencing programming as fun	7
Feeling like the "other"	
5. Messages of non-belonging	7
6. Messages of inadequacy	6
7. Messages of not being valued	6
8. Exposure to sexism	8
9. Lack of seeing a path forward in career	6
10. Intersectionality impacts feeling of "otherness"	
a. Otherness heightened by racial identity	3*
b. LGB identity or gender expression as a mitigating factor	3*
Impacts of these messages	
11. Emotionally affected by experiences at work	7
12. Feeling of un-safety in the larger community	5
13. Importance of community with shared identity group	7
14. Thoughts of leaving programming	5
15. Seeing the damage of homogeneity	5
16. Giving back, becoming a sponsor/mentor/role model	6

* Indicates that while these were not endorsed by five or more participants, they were endorsed by all of the participants who identified within this intersectional identity group

Domain 1: Early Experiences

This domain includes experiences that preceded the participants' work as professional programmers.

Theme 1: Family role model or mentor. Five of the participants reported having a parent or close relative in computer science. These caregivers provided them with encouragement and mentorship in their studies.

Gretta recounted that her brother is a software engineer, and her family involvement in multiple STEM fields encouraged her to pursue STEM degrees, and provided "smart, strong women and all of the right models you would want." This also protected her from realizing the biases against women in STEM. She explains, "when I was in fourth grade or so, I was chatting with my mom in the hallway at home and she said, 'Did you know that people used to think that women weren't as good at math and science?' I thought that was just dumb."

Anna explained that having a family role model introduced her to the idea that she could become a programmer, because "dad… was a software engineer, so I always knew it was a possibility." Similarly, Francis described the way her father taught her basic programming as a child, and enrolled her in classes to help her learn the skill. She recounted that "I didn't think of that as programming, even though it totally was," but that it prepared her to explore programming as a career option later in life. She further explained that exposure to her father's work and stories prepared her to understand the culture and style of interaction in programming:

> I grew up in a programming household. Even before I could program, I could speak the language. My dad came home and at the dinner table would be talking about a stupid bug or a stupid manager that he had been dealing with all day. It

> was like even when I don't know… what the words mean in whatever story he's telling, I still got the cadence of what a problem in programming sounds like.

Holly echoed the importance of family role models in deciding to try programming. She recalled the ways that growing up with two parents as software engineers was what led her to try programming as a high school student, and then encouraged her interest from there:

> Everybody had to pick between doing an economics class and a computer science class [in high school]. It was a 30-person class and basically everyone in the class, and all of the girls, picked an economics class…. Both of my parents wanted me to try the computer science class. I've always been really into math and I always liked puzzles growing up and solving problems. My parents told me that they thought I would like it and wanted me to try it…. So, I ended up doing the computer science class and was actually pretty good at it. So, that's how I got into it. After that, I thought it was kind of fun.

When asked about her experience of undergraduate education, Diane described her father's key role in helping her to persevere in achieving a Bachelor's degree in computer science:

> I don't think I would have stayed in the program had he not been there because it was really hard for the first semester and part of the second semester of the program. But, the light at the end of the tunnel was that eventually I was going to end up in high level enough classes that weren't so programming heavy but more like conceptual and abstract and algorithms based. He was confident I would kick all their asses in those classes. The guys that end up in the program, who had been programming in their basements since they were 12, are nerdy in that they love to program and that's their box. Once they end up out of their box, they end up being really uncomfortable. He'd noticed that when he was teaching so he thought that was where I was just not going to have any problems and it would be better once I got to that point. He was totally right.

Theme 2: Did not envision herself as a programmer as a child. Six of the participants expressed that they did not envision themselves choosing a career as a programmer until high school or later. Of these six, only Holly decided to pursue programming before college, despite many of the participants having similar family role

models. Even she recalled that before taking a class in high school, she was disinterested in programming as a career; "I have memories growing up about not wanting to sit in front of a computer all day. I wasn't going to do that, I wanted to do something more fun."

Francis echoed this, and laughed as she said, "I grew up around computers from a very young age. You'd think that I would be one of those people who thought 'of course I'm going to do computers' from the very beginning. But, it actually took me a while." Diane expressed feeling surprised to find she enjoyed computer science in college, because seeing her father's work growing up "I thought it sounded like the most boring stuff ever. I legitimately never wanted to do this." Caroline recalled that she was drawn more to the hard sciences as a child, possibly related to her father's occupation as an electrical engineer, and did not think of computer science as an option for a career until after college and several years of working.

Gretta found herself drawn to programming early on, but also did not think that it could be a career for her due to a misconception about the field. She remembered, "I wanted to do computer science, but I had somehow heard that all of the jobs were being outsourced to India. So, I liked computer science but couldn't study it, so I had to find something else." Similarly, Bette became interested in computers and programming early, but never considered that she could pursue it as a career. When asked how she entered the field, she recalled:

> It was an accident. I had kind of like been fiddling with computers from a young age, but never really knowing how they worked. It was just like playing games as a teen. I started reading source code and teaching myself. I worked a job in college making websites for other departments. But, I always liked the things you could make, it always felt really alive to me. I was like 'Oh, this is cool'…I didn't think I was going to be a professional computer programmer.

Theme 3: Negative experiences in school/non-traditional education. Five of the participants reported having negative experiences in school while studying computer science. It is important to note that this included all of the four women interviewed who completed a degree related to computer science (either undergraduate or graduate), and one participant who took classes in computer science but did not pursue the major. The three participants who did not endorse negative experiences did not study computer science in school, but rather did boot camps or entered the industry through freelance experience.

Anna reported that she intended to major in computer science until she felt chased out of the major after struggling academically due to distracting issues in her personal life. Even after persisting in taking relevant classes, she felt unwelcome:

> In college it was awful… I ended up switching to a philosophy major and I just took computer science classes as needed. But, those computer science classes that I was in, I still had a really unpleasant experience. I had a professor condescend to me. I had weird comments about the fact that I was a philosophy major in a computer science class. I just constantly felt that I needed to explain to people why I was where I was, and it was frustrating because my work and my commitment showed that I was invested.

Francis recalls that she did not pursue programming until after college, when she joined the workforce, began to self-teach, and then went to graduate school in Information Management. When reflecting on this, she noted that "my worst grade in college was [in CS] and I took that as a sign that programming really wasn't for me." Diane also recalled feeling discouraged in school, and attributed her father's support as key to her decision to stay in the major. She explained that without an early interest in, and experience with, programming, she felt behind her peers:

> I think if you have programmed a lot, or even slightly more than your neighbor, it gives you a really huge advantage because there's all these preliminary silly mistakes that you inevitably end up doing that the person next to you doesn't have to go through because they've already done them in something else beforehand. So, I was doing all of those mistakes on top of attempting to finish an assignment within a reasonable period of time, whereas they would just crank it out and I still had 10 hours to pour into the assignment…When you see that, it's super discouraging.

This discouragement was also evident in Holly's story, "there are not a lot of girls in the program obviously and there were a lot of points where I felt I really sucked at it, but I just had to keep going. I knew I felt I wasn't very good at it but felt I should just keep going." She attributed her persistence to an internship experience that showed her that school would not be representative of her real abilities in the work force. Likewise, Gretta recalled that her transition to graduate school was challenging, and made her question her intelligence and abilities for "the first year or two, I felt so stupid and not sure I should be there. Did they let me in only because they needed more women?" This worry also reflects another implicit message facing women: that computer science is "lowering the bar" to include diversity, which was expressed by three of the participants.

Theme 4: Experiencing programming as fun. Seven of the eight participants endorsed that in spite of discouragement, they found programming to be a fun and exciting exercise, which they enjoyed. Each of these participants expressed that this enjoyment of the work itself has persisted in their professional lives.

Bette recalled her excitement when she began learning to program "I always liked the things you could make, it always felt really alive to me. I was like 'Oh, this is cool.'" When asked what led her from an initial interest to a professional career, Gretta reflected, "Sustained my interest? It remains fun. I like the creative aspect. I like the very logical aspect, and I like that those two combined. I like that I can play around at home and

make the computer do my bidding." Francis shared that her enjoyment of programming led her to change career paths despite getting into law school. "I found that I really liked building web applications; I liked building stuff, at least as much, if not more so than arguing about it. So yeah, I almost went and then turned back at the last moment and decided I was going to be a web dev."

Holly beamed with excitement as she explained, "You just build cool sh*t. You build cool things that so many people use. It's really empowering to put something on a screen and make it work." Emma was also enthusiastic when speaking of the process and the idea of her work being used by people:

> It's really fun. I mean, it really is just fun. Not every moment of it, it can be really frustrating and really tedious, but being able to throw some lines of code together and actually see something, build something that other people can use and interact with. That's really fun. Solving problems is really fun.

Caroline expressed a similar enjoyment. After being inspired to try programming by friends in the industry, Caroline found that programming was a rewarding and exciting field for her. When talking about a recent project she completed, she explained:

> It's something incredibly satisfying to say that now, not only have I improved the working lives of so many people, but I now understand the system, I know the ins and outs of it, and if I had to do it again I could do it much faster. So, it's using the things that I've learned to build new things, and also at the same time, increase my own skill level and understanding. It's incredibly rewarding day to day to be constantly learning in that way

Diane recalls how quickly she realized she enjoyed programming after beginning a class, "Two weeks in, I loved it, it was so cool!" and notes that depending on the project, that same feeling persists into her career today:

> Sometimes I legitimately love what I'm working on at work, and this whole thing that I'm building out. There were so many nights that I'd come home and make dinner, eat dinner, and then kept working on it. While my husband is working on his side projects, I'll be working on work stuff because I have fun doing it.

Domain 2: Feeling Like the "Other"

This domain encompasses feelings that the participant described, and messages they have received, that they are different from their male counterparts in negative ways.

Theme 5: Messages of non-belonging. Seven of the eight participants described receiving various messages that they do not belong in the field of programming. Anne lamented that despite her best efforts to fit in with the culture of programming, even at the expense of being honest with herself about her personal interests, she does not really fit:

> I've been told, or suggested, at different parts of my life, or experience in tech, that I'm not quite what tech is. And, at a certain point, I got kind of tired of trying to assume whatever it was that was expected of a software engineer and decided to hone in on my personal interests.

Additionally, Bette points out that those who do not have the time, culture fit, or wish to socialize after work may be left out of decisions and even promotions:

> [Promotions are] based on things like do you go out drinking with the engineering team or what have you. I was offered a promotion at a bar once… I don't want that. That shouldn't be the avenue to secure career advancement, especially if you want a family. So, people get locked out of the decision-making process because they're not engaging socially with their team. I don't have anything against engaging with your team, but you can do it during the work day, right?... I remember that I've been on projects where it's like 'We're doing this in this direction', then like the next day, 'where are we moving, what was the last decision?' 'Don't worry about it'. There's always some discussion after work that I wasn't there for, so I couldn't be in on the idea, or what have you.

Seven of the participants referenced receiving or internalizing messages that they are different, and worse, than male programmers for prioritizing work/life balance, rather than working on programming all the time. Diane explained that, "I just have a really hard time working on a thing that isn't work or school," while comparing herself to her

husband, who is also a programmer, and spends the majority of his time at home programming side-projects. Bette conveyed the discouragement of this comparison:

> I keep a regular schedule, I go to bed at night, I wake up in the morning, and I come into the office. At one of the places I worked, I would wake up to these notifications about people submitting code at 4 in the morning. I can't compete with that. I'm not going to be that person.

Holly expressed a similar discouragement, saying, "It feels like the people who are working really hard are the people who are coding all day at work and then they go home and do side projects, learn a bunch of stuff and then they come back to work and know all of this stuff. That's not me at all." Emma echoed this, emphasizing that she puts effort into stepping away from work, even if it limits her contributions outside of work, saying, "I try not to work all the time, so, while I have been involved in a little bit of open source, I don't find that I have a ton of time or energy to dedicate to that." As a mother, Francis has felt the necessity of work/life balance strongly:

> Making sure that I have the downtime in the rest of my life to make work that feels like work be fun. Making sure I just have the capacity to bring my brain to work, which with a baby in the house and so forth, you have to be more deliberate about getting enough sleep.

Caroline described that this idea that programmers should be using all of their time for coding is rooted in the myth of the "real" programmer:

> When you talk to people about what a real programmer is like, there's this idea of someone who sits in a dark room and programs for 60 hours a week and has no social life and they are incredibly technical, they read technical papers, they work on these incredible projects and it's a solo person who is this lone genius and that's our vision of what a real programmer is like.

Holly added that she has noticed that these messages not only hurt women, but also make it more difficult for companies to hire women because of this message:

> I think those types of companies have more trouble hiring women who aren't into working that late and have other interests. Also, I've noticed, and I don't think I

> can generalize this, but of the women I've worked with, a lot of us enjoy computer science but it's not necessarily what we want to be doing with all of our time.

These messages were often emphasized by the traditional interview process used by most technology companies, referred to as white board interviewing, as the interviewee is expected to solve a problem on a white board (often with little relation to the actual work they are interviewing to do). Five of the participants expressed that this process was discouraging and signaled non-belonging to them. When asked about her experienced with hiring, Holly explained the discouragement she experiences in these interviews:

> Oh my God. It is the most stressful thing ever. Where do I even begin? How much time do you have? It sucks. So, the technical interview sucks. It's just the most stressful thing ever. You sit down, and someone asks you a problem and you solve it in front of them, either on a white board or on a computer. But, that's not representative at all of how you would actually work in a situation. Normally, you work with people and collaborate a bunch but none of that gets really tested in the technical interview, which I think is a huge bummer because I actually am not very good at the current technical interview, but I think that I am a good engineer.

Bette echoed this feeling of discouragement and feeling that the interview is not representative of her work or abilities:

> It's not true to how you would actually program. I don't write code on a whiteboard without any reference materials. I think a lot of people have reference materials when they're thinking about how to solve a problem.... I feel like that wasn't representative of the work that I can do.... It's weird, because if you have a track record, I have had a job programming that seems like, and it's for everybody not just me. It's like you may have worked at [big company 1] for however long, or you many have worked at [big company 2], but we don't believe that you can actually code, so we're going to need to confirm that.

Anne emphasized that this interview style assumes a traditional computer science education, which she does not have. She remarked that the hiring process "was really difficult for me because a lot of their interviews assumed a computer science education

and theoretical knowledge that I don't have." Francis also recalled her disappointment when she was sent materials for an interview, and saw that it was not testing anything relevant to her experience or the actual job she was interviewing for:

> I studied for a week, you know, like the toy problems that you do on whiteboard, because I decided to take my best shot at it… I got very little read on what any of the people who were interviewing me did. I could have been an axe murderer for all they knew, and they never really asked.

Holly has also had experiences interviewing others, and in this situation as well has been given messages that she does not fit the mold of a programmer:

> I conducted a lot of interviews. I was interviewing someone, and it was going to be a technical interview, and he was like 'Oh' … he said it in a way that would be offensive. He said 'Oh, so you're a designer here?' He may have even asked if I was a recruiter or something. He assumed that I wasn't an engineer.

Theme 6: Messages of inadequacy. Six of the participants referenced having received messages that they were inadequate as programmers, which often reinforced feelings of being an imposter. One of the most common methods of delivering this message is though feedback that they are "not technical enough," which Francis explained, "being non-technical was like a dis." Bette elaborated:

> I've been told a lot that I'm not technical enough, which is funny because I write code for a living. I've talked to a bunch of people, and only women get that feedback. So, someone told me they think it's a gender insult for caring about problems holistically.

Diane felt that this message has held her career back, when her manager had promised her a promotion but then changed his mind and told her, "from the leadership perspective, I was hitting it out of the park, but he felt like he had to pad the technical section." Caroline echoed this frustration, remarking, "in terms of conversations I have with women day after day, I don't even really blink anymore when I hear another person tell me that they can't get a promotion in this business because they are just not technical

enough." Anne built on this by bringing up that this message has become internalized, and is present even at conferences targeted at women:

> I've been to Grace Hopper, which I was very excited about. When I went, a lot of the content got watered down and a lot of the workshops were more on soft skills, which made me very angry. There was this implicit suggestion that the content for women was not technical and shouldn't be technical. It felt so counter to what I felt that experience would represent.

As a result of these messages, many of the participants described feeling like an imposter. Anne shared that this feeling was so profound that it made her hesitate to participate in this study:

> I think when I even got your message and the description for what kind of candidates you wanted to participate in your study, I kind of even second-guessed if I was legitimate in a way and whether my experience was, I guess, true to software engineer enough to warrant us having this conversation. So, I'm always kind of second-guessing whether I am a software engineer, even though I am.

Holly expressed feeling similarly to the other participants, resonating both with hearing the messages, and with the internalization of that message. She shared:

> People who are minorities in tech feel like they need to prove more of themselves, and they do, honestly, at times which is just stupid. When it comes to technical ability, there is a bias that we ourselves believe, which is that we are less able-technically able. Also, there's a whole thing at companies that they don't want to lower the bar to hire more diverse candidates. You hear that all the time. So, a part of it is also messes with your head in the whole process.

Bette added to this by sharing the impact of these messages on her, which have often driven her to leave a job:

> For me, it was that I was going to regular, I'm going to be reliable, I'm going to be in the office at certain times, and I'm going to finish the projects I say I'm going to finish. But, to feel undermined by people who are more senior to me, submitting code patches or whatever. It was like 'Oh, I can't succeed here.' But, if this is the paradigm, I can't succeed here, so I ended up quitting.

Theme 7: Messages of not being valued. Six of the participants endorsed feeling that their skills and contributions were not valued as programmers. This largely

came in the form of being underpaid or offered low pay, and feeling held back from promotions (some of which is demonstrated in overlapping messages with theme 6, above). Bette described the frustration of not feeling that her hard work yielded any concrete recognition. She explained, "work really hard, people will see that work, and you will get rewarded, right? That does not happen as much at work for me. Every promotion I've gotten has been by moving my job."

Diane emphasized the impact of this when she reflected that a "low point was definitely the point where I found out I was the lowest paid engineer at that job. That was a rough time," in part because of the unjustness, and in part because of the implication that this had about her value to the company. In fact, she noted that despite multiple promises to remedy her pay, it was not until she spoke to the CEO directly that she was given a raise. Emma was candid as she shared that she carries awareness that "relative to other techies, I don't make that much but I do okay."

Francis's story resonated with these as she described an experience with hiring, where a large company that typically provides high salaries offered her a job:

> The offer was for a lower salary than what I made at my 20-25-person at the time start-up… I was like, you're a name company! Are you serious?… There's been an article that's been going around about the lawsuit of where they are suing for inequality of men and women at the company. Looking at those articles and stats they provided, I realized the offer they gave me was long those lines. I had been industry for years at that point. Like seriously?

Caroline was clear that "I have to work harder to stay at my current level than some of my peers do to get promoted. To literally be given feedback on all of the things I'm doing right and be told 'well, you still have to do these'." In addition, she spoke about the significant contributions she was making to the team and being penalized for not fitting with the model of a programmer being purely technical:

> I had even gotten feedback from other people that sort of 'we know that you're good at communication and these types of big picture views', 'we know that you are good at mentorship', 'we know that you can manage teaching dynamics; therefore, because we know you're good at them, we don't need you to demonstrate them or do them. We need you to prove that you can do the other stuff'. So, it felt like instead of leveraging that and rewarding that, I was being penalized by them saying what else can't you do. Whereas, there was no flip side to that where people who are focused on only the technical aspect were rarely asked to demonstrate that they had those leadership and communication skills, and to tamp down one in favor of the other

Other messages that they are not valued as much as their male counterparts come in the form of extra emotional labor that is not valued in the same way that technical performance is. Caroline felt this strongly, stating:

> They don't see that there's a lot of work that exists sort of below sea level that is helping to maintain the structure so it's helping to smooth away all of the rifts that are being created by this high performing person who is damaging to morale. They don't value that work. They don't see that it's actually a lot of other things that is enabling this person to continue to progress in that way.

Anne explained both carrying the burden of both needing to turn her attention away from work to participate in inclusion meetings, and of then being asked to teach those who chose not to attend:

> [I'm] always feeling like I need to apologize or explain why I'm stepping away from my desk to go to a diversity inclusion meeting. I remember one day I got really angry because the two men on my team did not go to the diversity inclusion meeting that was open to everyone. When I got back to my desk they asked me to explain it to them and it's hard because I don't want to say 'Well you should have gone if you want to know' but at the same time they chose not to take the time to work on it because they're working on code and they're far along in their careers so it seems like whatever they are doing is working well and it's what gets recognized and they don't talk about social issues really.

This lack of value assigned to aspects of the job that are disproportionately filled by women, and other minorities in technology fields, was echoed by four of the participants. Bette spoke of the lack of visibility for acting as a mentor to other women:

> It's not going to be like 'Oh, you successfully mentored a young woman. Promotion!' Like that's not going to happen. That's not what my company promotes. My company promotes completing a highly visible project that looked hard. So, it's us completing something when we said we would complete it, and also her getting this experience it was like 'Oh yeah, that was good', but it's not like the kinds of things that are valued from the company perspective.

Caroline also referenced struggling with this personally and ethically, when she described making a difficult choice between striving for her own career advancement by focusing only on technical work, or helping the team as a whole:

> It made me realize that advancement needed to be focused on what they were grading me on whether or not that was fair. It was kind of a dark moment for me because, in that subsequent week, there were multiple times when I had to make that decision of someone was struggling with a problem and that is holding back the entire team and if I followed the advice that would get me promoted I would ignore that issue, not reach out and just keep my head down and work on my project and that would help me. But, if I helped them and unblocked them and made things better, that is implicitly damaging myself, and it was always this choice of which one is actually more important to me. I ultimately made the choice to unblock the team because that helped all 10 people get more done. It was a very bittersweet thing recognizing that these were the patterns that were putting me in this position.

Diane expressed frustration at seeing a "real programmer" type of coworker be promoted quickly while she was promised promotions but then told that she was not technical enough. She recalled the feeling of injustice that the explicit messages of the company valuing both technical and team skills were not matching her experience:

> Even though this kid is sometimes an asshole, he's done some really great things technically, even though he blatantly refuses to go to meetings and has been called out multiple times for being too harsh with principle engineers, literally the top of the ladder and you cannot get higher than that, and just calling them out on things like this is a horrible design. I've talked to him and he's told me he's gotten reprimanded for this. And, he's still being promoted! You have different priorities. The whole time that I was there, from October to early June, I was told that they value leadership and technical ability about the same, and I needed to fit a certain bar across all these criteria to be put up for promotion.

Bette was in full agreement with this sentiment. She went on to explain that these messages feel gendered and disheartening:

> And like, heroics too. It's not seen as good that you released something stable and there were no issues with it. It's like if you release it, and there are problems, and you fix it, then I'm great. There's that piece to it, which I feel is very masculine, whereas I think some of the best programmers I know are women, and that's because they're very considerate about the things they do and think, and they plot and plan whatever they do. They release stable code and there [are] no hiccups, which is like it didn't happen, which is so weird. One of the women I know at work is like 'Yeah of course, I work really hard to make it stable' 'Why would I want to release something that isn't stable?' But you know, I think the squeaky wheel gets the grease.

Theme 8: Exposure to sexism. All of the eight participants acknowledged seeing and feeling sexism in their workplaces. This largely took the form of ambient sexism, with jokes and other subtler signs, or benevolent sexism. Anne explained that this made it harder for her to defend herself, feel her experience is valid, and find support:

> It's hard when nothing clearly bad has happened. I was in a group interview recently with other women in tech and a lot of them had horrible stories about blatant insult or sexual assault and I had just this weird, vague, fuzzy, microaggressiony type stuff that maybe if I didn't have the vocabulary I have I'd be able to even ignore it. But, it's difficult to talk about when there's nothing obviously wrong.

Caroline expressed that she was aware of sexism in technology fields even before entering the field herself, noting, "coming from academia, there are a lot of undertones of sexism in there, whether or not you belong there, but I was already aware coming into it that somehow it was different in technology, and I didn't know why." Since becoming a programmer, she has felt that the tones of sexism are pervasive and impactful:

> It just affects so many aspects of how you live your life, and how you present yourself, and what you talk about. Meanwhile, in sort of pseudo-anonymous spaces, you see the pure volume of how much actual contempt people have for people like me. There are forums and websites that exist basically for people in technology to post anonymously under some sort of pseudonym about stuff, and if you look in there, there are really huge amounts of complaining of political

> correctness gone wrong, about identity politics taking over, about lowering the bar in order to bring people in. It's always the assumption that when diversity is increased, the bar has been lowered.

Holly's experience also resonated with this idea of "lowering the bar," as part of the sexist messages she struggles with at work. She adds, "In one sense, I'm like 'Of course we're not lowering our bar hiring candidates that deserve to be there' but, as someone who has been hired by a company, I also wonder if I might just be filling a quota." Bette referred to this process as "death by paper cuts, because no one is going to come out and say they don't want you, but they are going to discourage you through their actions." Diane expressed reluctance to name her experiences as sexism "because it falls into the category of something I can't fix." She explained that the ambient sexism at work is difficult to deal with "I don't think it's going to stop me. It would definitely stop other people, I think, which sucks." Emma echoed the other participant's experiences of subtle sexism, and witnessing hostile sexism, but said she feels protected by her more androgynous gender expression:

> I've been lucky so far in terms of actually experiencing out-and-out explicit sexism now, this is not sub-text. But, I've seen it. I've seen it a lot actually. I've definitely noticed too, when I've seen it, that it tends to be directed at women who present a lot more femininely than I do. So, I can't help but think that that probably plays a role.

Gretta has noticed the sexism around her, but stated that she is unperturbed by it, noting, "I think I already have a bit of a thick skin and I'm not very averse to dirty jokes and the other things that seem to put people off." Francis similarly described limiting the impact of sexism on her, by taking steps to protect herself from sexism online, but notes that you cannot avoid hearing what is happening to other women working in technology:

> My trolling on social media is non-existent. It exists but it's very low. I heard about the Block Together block bot early and joined so maybe there are people

> sending me hate messages right now, but I'll never see them because I already have that set up. You develop a shell reading about other people's bullsh*t. Reading about the CEO of the week who had a sexual harassment lawsuit and may or may not get fired. And, it keeps happening.

Caroline added how stuck she feels in responding to sexism in her environment. She described an experience in which she was unsure how to act:

> I remember during a meeting where someone made a comment about a person who is taking notes as being the secretary in a really demeaning way. I remember someone making a joke about women belonging in the kitchen. It happened, and I just froze and stared. Because it's awkward to push back. It was clearly meant as a joke, but obviously the basis of that was incredibly harmful, and knowing that pushing back on that would make me look humorless and also affect our interpersonal relationship and our working relationship but not saying anything allows that to continue. I was just sort of frozen in that moment on which path to take because neither one was a good path for me. One makes me someone who is not fun to work with and in a lot of ways, not a good teammate because I can't take a joke, I'm humorless, all of those make angry feminist tropes, and the other one just allows it to exist.

Theme 9: Lack of seeing a path forward in their career. Six of the participants referenced feeling discouraged looking toward the future, as they do not see many women in high positions. Holly described this struggle, and why seeing that representation is important, saying:

> There are just not a lot of women in senior positions. I think the biggest thing that keeps people at a job it to see someone in their line of sight, I guess, that represents something that they want to be, or they want to grow into. A lot of women don't get that.

Bette added that this discouragement of a way forward is both internal and external, as "another thing people do is pattern match. Like all of the very successful CEOs in the tech space aren't women, so people are like 'Well, you don't actually pattern so what could you know', which is very frustrating." She also noted that the process of creating your own path forward takes extra effort at drive:

> You can't do what you can't see. So, they… look around to see, like, 'Is there someone who looks like me in the leadership role?' Right? So, I think about that a lot. Is there anybody doing the job I want? No. Ok, I guess it's going to be me. Cool! I'll build on it, but it can be very frustrating.

Caroline felt similarly, and added that this is especially true for programmers with intersectional identities as women and, "couple that with being a person of color, it's even more so of the level of representation for people like me disappears at higher levels. So, it's just harder to see yourself there." She reflected that she often sees female peers encouraged to leave technical work, and that this is a common path that leads out of technology rather then up to senior and leadership positions. She remarked:

> Women who go into technology get seen as almost like the janitors or the team mom where you're picking up stuff that other people are reluctant to do or haven't done, and it's not glamorous work. It's essential work, work that allows the team to progress faster and smoother, but it's not seen as valuable, and so they're not promoted and aren't given stretch goals that allow them to demonstrate the full breadth of their capabilities. In some cases, I've heard of at least 3 people who were told that they should consider becoming project managers because they were so good at that big picture view, but in a way that shuffles them out of technology when they are actually incredibly capable of that and having that allowed the team to go out further.

Diane built on this message of a limited path when she included that even in a company with an unusually high percentage of women, she was unable to see a path upward towards senior or leadership roles:

> My internship was very atypical, it was one other intern and me, we were both women… I think the percentage of female programmers there was almost 30%, which is unheard of. There are problems with that. They are all super junior and not getting promoted, and everyone I worked with last year are still there and have not gotten promoted.

Emma gave a similar message, and expressed anger that this is commonly attributed to lack of ability on the part of the women:

> there's a huge risk of women achieving mid-level and not going any further, even though they have incredible experience and skill set. It's not a meritocracy. That's a lie. That's just a lie. It's a myth that's perpetuated a lot, it's not, it's not a meritocracy.

Francis echoed this awareness of women being held back, and added that many women leave programming before advancing to mid, or advanced, careers. She commented:

> there are a lot fewer mid-career or late career women than there are junior programmer women and it's because there's a drop-off. They don't all get kicked out by gamer gate trolls, so that's the thing. Some women just decide there are better uses of their time and less microaggressions. They don't find a safe place to do their work.

Theme 10: Intersectionality impacts feeling of "otherness"

a. Otherness heightened by racial identity. All three of the participants who identify as women of color, expressed feelings that this intersection of identities enhanced their sense of being the "other," and compounded the challenges they face. Bette was candid that, "I don't fit anyway. The racism is so real, like I'm not ever going to be a White engineer." She added that this makes it even more difficult to find a mentor, remarking that, "people tend to mentor people who remind them of themselves. I don't remind anybody of themselves. I'm a woman, Black, and for the most part, I've been the only Black person in the company, let alone in an engineering group." Bette further expressed discouragement at feeling a lack of visibility even in talks related to diversity in technology. She remarked:

> There's so much focus on women in technology, which becomes more of a wetland issue in technology. So, all the inner-city focus has tended to let more white women into this sector than more women of color. So, a lot of times people would say 'women of color' and I hear 'white women and people of color', and I'm in the people of color bucket

Caroline echoed this sense of isolation and not fitting, and added that this mix of identities also limits how she feels able to behave. She explained:

> It's just been a very isolating experience in general to be a person of color in tech. It's almost like a multiplying factor of whatever else you're experiencing. I've seen this happen a lot where you're on the receiving end of more of the negative side effects of discrimination in the industry, but you're more restricted in how you can push back and talk about it. There's already this feeling that we talk about it too much, we put politics and identity into it too much, and the sense that being open and honest about all of the things that you've experienced is being political and bringing it into a sphere that doesn't exist. The limits for acceptable behavior, in terms of speaking out, are even more narrow for people of color, and that multiplies what it is for women… As a woman, I'm expected to be more considerate, more caring, speak less, be less pushy, be less assertive, and if I violate that, I'm bossy. It's always negative. …. It's even harder for advice from other people to be effective. Well meaning people say, 'I just did this, and it worked for me' and they don't understand the interpersonal relationships that come into that. For instance, you'll get advice from people who are in a mentorship role who don't understand that if you're a Black woman, you cannot be pushy about salary, in fact you really can't be pushy about anything because you need to be differential or you're going to be seen as aggressive, angry and hostile. That's asking for something isn't going to get it done.

Holly felt more mildly about the intersectional impact. When asked explicitly about her intersectional identity (by this White-identified interviewer), she remarked, "I think the woman that trumps the 'being of color', I think … it feels like to me that a White woman and I have the same disadvantages, or advantages." However, at multiple points in the interview, she made more subtle references to feeling that intersectionality. She remarked that the impact of this intersection begins with the interview process, saying, "I don't interview well, which I know is true for a lot of people, but I think it especially is hard for minorities and people who are generally more insecure about their abilities to begin with." Additionally, the following exchange with this interviewer in response to Holly speaking about interviewing for jobs (see Theme 6), suggested that she experiences added pressure of her intersectional identity:

> Interviewer: It sounds like there are a lot of things coming into play, of both being a minority and I imagine being a woman is part of that?
> Holly: Right.
> Interviewer: Wow! And then the combo is extra?
> Holly: Yeah.
> Interviewer: And then having this extra pressure of eyes being on you coding with all of those things kind of swirling in the background.
> Holly: Right. Totally. I get how that's stressful for everybody and everybody is kind of in the same situation. But, I think there's an aspect of women feeling like they have to prove themselves more.
> Interviewer: And maybe people of color as well?
> Holly: Yeah. People who are minorities in tech feel like they need to prove more of themselves, and they do, honestly, at times which is just stupid

b. LGB identity or gender expression as a mitigating factor. All of the three of the participants who self-identified as members of the LGB community endorsed feeling less impacted by the culture of technology than those who identified as heterosexual. Note that in the typical LGBTQ+ acronym, the T, Q, and + are omitted as these identities were not represented by any of the participants, and the researcher does not want to make assumptions as to what this experience may be. Emma, who identifies as gay, endorsed this most explicitly when asked about her intersectional identity, remarking:

> I think it's probably been beneficial to me in the sense that I'm kind of off the sexual market from my colleagues… That, and I think I dress fairly androgynously, like I don't present really femininely, so I'm kind of off the sexual market. The idea of there being the potential for dating colleagues, like if you're in a group of guys and you're the only woman, there's sort of that expectation that maybe there are going to be crushes that form or that maybe you'll hook up with somebody that you work with or whatever. I don't have to deal with that. I don't really get approached by men that often, I think because of the way I present, but even if a guy were to approach me, it's not even an issue of 'I'm not interested', it's like 'Oh dude, you're barking up the wrong tree'. It makes it a lot easier and more comfortable because that is sort of off the table. That is just off the table. I think maybe that is one of the ways women experience a lot of stress in a tech workplace without there necessarily being any malice or intentional exclusion, it's that that is a question in a lot of people's heads and a lot of times, people don't act professionally when it comes to those sorts of things… Yeah, I don't experience much in the way of sort of anti-queer bigotry here.

> There are so many gay men in tech, like cis-men in particular, but there are so many gay men. And there are a lot of very big names, not gay women necessarily, that is different, but I think queerness in general, at least in the Bay area, isn't really … it depends on how you present it too. There are certain types of queerness that are absolutely still very marginalized. But, if you're a white cis queer person, gay person, it's kind of like 'Ehhh', you know? So yeah, actually I think I'm at an advantage because of that.

Gretta gave a parallel experience in fact stating that she tends to feel more comfortable around men than women. She described feeling it is normal for her to be in male-dominated spaces, and wonders if her gender identity being not so strongly female may have something to do with this:

> It's probably that I got used to the gender balance in EECS and it never really bothered me. I'm not sure I noticed it for a while either. And so, it was normal then to be surrounded by guys. I think I was probably the only woman in that room… My gender identity is definitely female but not super, super strongly so. So, maybe that's something to do with it. I'm trying to think who I know who is both a woman and a programmer who I talk to regularly. I'm not sure there's anyone in that category. I have some friends and if you told me to host a party that was full of women programmers I could find people, but I don't talk to that many. And, I don't have many friends that are women either.

Similarly, Francis wondered if her physical appearance or gender expression may have an impact on her experiences, reflecting:

> I am tall, and I am big, and I get catcalled less than other women… It's like you're walking down the street in the Mission and it's gross and then someone leers at you and it's like 'I could f*ing sit on you. Fight for it.' So, there's a physical aspect to it and sh*t like that. It makes a difference.

Domain 3: Impacts of These Messages

This domain includes themes that discuss the impacts of the various messages that the participants described in Domain 2.

Theme 11: Emotionally affected by experiences at work. Seven of the participants described feeling emotionally impacted by the implicit and explicit messages

that they had received as female programmers. Anna remarked "I hate to think of all the ways I've emotionally contorted myself to make work more bearable these last few years." She added that in the past couple years, "I would come home, and I would be crying all the time. It would be really exhausting." Even now, Anna noted that, "honestly, I don't know that I'm coping very well. I still feel very emotionally burnt out."

When asked about low-points, Bette described that "I can't remember them all or I wouldn't go to work." She added feeling that she needs to constantly monitor herself and work, is unable to show who she is, and feels much more negative than her normal self:

> I would like to be my whole self at work, but I can't do that. I can be myself in my private life, but I can't at work. So, at work, I can construct something. I don't necessarily like it, but it's what's required... I've always been a positive person, but working in the tech sector I feel like I connect with the negative.

Caroline built on these stories when she explained the impact of these messages of inadequacy, and the ways that it can cycle with non-belonging and unhappiness, and impact the quality of her work:

> When you constantly get that feedback that you're not enough it does wear you down. It makes you have these conversations about 'maybe I don't belong', 'maybe I am failing at some fundamental path that I don't recognize', and you sort of bounce back and forth between this unhappiness or even anger, that you know you deserve this and doubt yourself" "And, it certainly doesn't compel you to do your best work when you're doubting yourself, so it becomes this kind of vicious feedback loop.

Holly's experience echoed this feedback look of doubt. She shared, "I might be looking for a new job which is hitting my confidence really hard." Despite this, Holly was excited to as she remarked that outside of work:

> I feel like a bad ass most of the time.... I have a ton of other interests. When you meet people through that and through friends and they ask what I do, and I tell

> them that I'm a software engineer, they're impressed and say things like 'You must be kind of smart', which is great. I'll take it.

Gretta shared a similar sentiment, in that her work can impact how she feels about herself both if it is going well, and if it is going poorly. She remarked, "definitely work-related affects outside of work ego. I think a lot of my self-worth is tied into how smart I am, how much I can produce, and that sort of thing." Diane referenced leaning on her support system for emotional support when she is feeling upset about work, noting, "my husband is very helpful." However, she also endorsed feeling that she has to do extra work to get the same professional result, and having to deal with the emotional impact of feeling wrong for doing those things:

> Since I feel I have to do all this work on top of my normal work to get to the same place. But, sometimes it feels to conniving, and it feels like it shouldn't have to be that way. I feel like I'm just the bad guy in one of the Disney movies who do all the side hustle to get what they want.

Diane further reported feeling weighed down by needing to keep records of interaction, and promises of being given promotions, to avoid feeling the same "rage" that impacted her from her previous lost promotion:

> This is here, I hate it, I now have to keep a paper trail. I didn't want to have to do that, but I now keep pristine screen shot records of conversations I have with people. I write things down… It's a lot of other work that adds on to the actual real work I have to do.

Emma described the feelings of confusion and self-doubt that are brought up for her when she experiences something that feels rooted in sexism, which then distract her from her work:

> You still have that experience of interacting with colleagues where you feel like they are dismissing you, and you don't know for sure why. Is it just because he perceives me as being inexperienced, or is it because it's that unconscious bias there? Does he treat male reports or the male junior engineers the same way?

> You kind of start interrogating that, and watching that very closely, and it's not fun. It's not a fun way to be at work.

Theme 12: Feeling of un-safety in the larger community. Five of the participants referenced feeling unsafe about the idea of exposing themselves to the larger programming community, including in contributing to open source projects, participating in major conferences, or sharing their opinions online. Caroline was clear about the danger, warning, "In a public sphere, if you are vocal about this on social media, you get just even personal attacks, you get death threats, you get a lot of vicious stuff directed at you personally." Bette echoed this message of the danger that comes with visibility, warring with the wish to inspire other women and people of color:

> I think there can be a danger to being super visible on the internet as a lady… I know women, just by having an opinion on Twitter, who have had their addresses linked online. The physical addresses of where they live and where their families live… So, it's just very, stuff that's like innocuous and feels obvious. It's like 'Oh yea, women are treated differently in the sector.' It's like this huge outcry. So, I worry about trying to be too visible. At the same time, I know that seeing someone doing the job that you want to be doing, and succeeding at it, is like hugely inspirational, right?

Holly has spoken at conferences targeted at women, but has been reluctant to move to mainstream conferences, she voiced, "I actually haven't spoken at a regular old coed conference. I think I'm kind of afraid to apply, honestly. I just sometimes feel what do I know that all of these other smart people out there don't know." Anne expressed a mixture of excitement and fear thinking about attending her first mainstream conference, wondering how safe it will feel, despite carefully selecting which conference to attend with safety in mind:

> I'm going to my first technical conference in August and I'm both excited and anxious about it. I'm excited for all the content but I'm wondering how I'm going to feel there. The conference that I chose seems to be very intentional about the speakers and the panelists that they've selected, like diverse representation,

> different principles and specialization. So, I want to believe that people will self-select to attend that and for it to be a positive experience. But, I've heard from my partner what conferences can be like.

Francis has been very active in a technical conference, and has helped to make it safer for other women as well. However, she still described a sense of unsafety beyond the small refuges she finds for herself, and has been reluctant to enter communities that she does not have a personal connection to for this reason:

> I think my friend/mentor in that area sort of had this concept of just creating a circle that is safe, effective and what you want to work on and with people you want to work with and keep the bozos out of your safe space; he didn't use the words safe space, but that's what it is. You find the people you want to work with and sometimes that's all you can do rather than make the rest of the world a safer democracy for women. It's a fight that takes your whole life. I have found those refuges throughout my career in one space or another in the particular parts of the opportunities where I was active, the place where I was for 3 years. The wider community might often be a trash fire, and I certainly hear about that. I'm a frontend developer, I use React all the time. I develop components and libraries that interface with React, but I don't really consider myself a part of that community. And, maybe part of that is that I don't know if that community, I want to say is ready for me, which sounds like self-aggrandizing, but I don't know if it would be welcome, and I don't have enough personal connections with people for me to even try.

Caroline was similarly unsure in thinking about if she is willing to contribute to open source code, due to anticipating hostility in response to her contributions:

> It's also knowing that that is yet another environment where, if I were to join, would also be subject to the same thing of participating in open source projects. That is yet another environment that is hostile to me, that if I want to navigate, requires additional resources and energy to do. It's almost like I'm spending a lot of energy buffering my life from the negative side effects forming in the industry.

This lack of safety also impacted these women when searching for jobs. Emma expressed, "On the whole though, I've been pretty selective with who I actually interview with. I do a lot of research any time I'm going to go onsite with a company" to screen out unsafe environments. Similarly, Francis cautioned other women "Don't join a start-up

as the first/only female engineer… Unless you specifically know the people there, like your friends who can vouch for people there, find somewhere that there is at least one other person." Caroline endorsed similar feelings, and noted that there is a large community that helps to protect each other around finding a safe place to work:

> Certain companies have greater tolerance for people who express negative sentiment about women and people of color and because of that, they're just off the list. I don't think a lot of companies recognize that that's the problem, that there's this expectation that when you're hyping jobs for the great benefits, I don't see what the problem is if women don't apply, it's because they don't want to be here. They don't recognize that there's so much energy happening behind the scenes with people talking about whether or not your company is actually a good healthy place for people like them to work.

Theme 13: Importance of community with shared identity group. Seven of the eight participants spoke of having a community of other women and/or people of color in technology as key in coping with the larger culture of technology. Diane expressed that having a back-channel discussion forum for minorities is important for releasing her pent up stress and anger so that it does not come out elsewhere:

> You talk to other people who have the same problems at your job. You have a rage channel where you type in all caps, and you can just yell into this channel. You go to the gym, which helps to get all that rage out.... you just kind of try to let it go, and hope for the best. Keep talking to people who are in the back-channels, and have meetings with other people who have different perspectives

Caroline echoed this sense that back-channels are the safe place to explore these experiences, remarking, "The microaggressions, the comments, and the stuff that you can't prove? There's just no benefit in raising it, so it's only spoken about in back-channels and in face-to-face conversations where you say this is a thing." Bette had a similar strategy and perspective, using these same channels for normalization, validation of her experience, and to combat isolation:

> by engaging the wider community, it makes me feel better, and kind of takes all assumption out of people's reasoning, and realizing it's true for me as well. Even if in my working life I feel a little stymied externally, I know other people are also feeling that. It, at least, is a little bit of an alleviation of those fears.

Emma built on this idea by naming that it feels very important to have a group who have an implicit understanding of your experience because of their shared identity. She noted that:

> When you pull in a male colleague, he may not see it and dismiss it. He may not see it and be like 'Oh, I didn't realize this was a thing and I'm upset because I didn't realize this was a thing', but that's not the same thing as having that camaraderie. You can have a very supportive male colleague, even somebody who maybe does see it and does sort of get it, and has done that education, but he still doesn't experience in the way you would. While I'm very grateful for those individuals who have done that work and do give a damn, it's not quite the same thing as having other women to connect with who do probably experience things in the exact same way and can sort of, you know, … 'am I crazy?' and they're like 'no', 'am I making these things up?', 'is this weirdness that I'm experiencing or this feeling that I'm being dismissed that I'm experiencing, is this legitimate?', and you have somebody that is like 'no, I totally see what happened there' or whatever. I think that's huge.

Anne expressed feeling mixed, as she values the support and validation of speaking with other women, but also feels emotionally impacted and stuck by hearing their stories:

> I think it's really good when I get to talk to other women. Or, at my workplace, I went to a women's empowerment workshop recently that encouraged me to talk about how much I'm making with other women and it's great to have that sense of community, but I think it's tricky sometimes to find a way to make those relationships be productive instead of communal griping. I think it can often, like if you start a conversation, it ends up just being a lot of frustration expressed. Which is good in that I feel supported and understood but it also can just be such a downer.

Holly shared that her community with other women aspiring to be programmers in college was a large part of what kept her going, saying, "one of the things that actually kept me in it was I joined an engineering fraternity because I needed more friends in this

space and I didn't know how I was going to keep doing this." She added that at this point in her career, being able to speak with women who have been in the field for longer has been very important for her, stating, "I know a couple of women who are a couple of years ahead of me in their career journeys and being able to talk to them and ask their thoughts is super important."

Francis emphasized that having a community with other members of marginalized communities is key in establishing as space where you are not as impacted by stereotype threat, suggesting that women should:

> Make friends with other people in your program who are female or at least not male, not White would be great. Make those friends and cherish them. Make those connections. Even if it's just finding people to follow on Twitter or find someone who can recommend people to follow on Twitter and have that virtual crew at the very least. Find your space where you can program and not think about you programming, if that makes any sense. Like, 'I am a woman programming' or 'this is going to get reviewed by asshole Todd'. Find your space that doesn't have that, the meta crap.

Caroline added to this larger conversation when she expressed that the sense of the larger programming community being unsafe (Theme 12) emphasized the importance of community for her:

> There is such a large back-channel community in terms of what places are good, and even what teams, what people. Because sometimes you have pockets of good leadership in a broader company that isn't and vice versa. Now that I am more connected into the broader community, I am part of that back-channel network, and I see it now every time someone wants to change a team or change a job. Anybody that is connected to that network is doing that research ahead of time, of is this a good company to work for? Entire companies are ruled out right off the bat because it's not a good company to work for. There are a lot of people who will not work for Uber because of their reputation and how they treat women and just what they value.

Theme 14: Thoughts of leaving programming. Five of the participants referenced feeling uncertain if they would stay in programming, either in thinking they

may transition to a non-technical role or leave the field all together. Francis shared that she has been reflecting on her career thus far, as well as the path forward:

> It's like 'Ok, this is a ten-year project of becoming a programmer and I'm at this stage in it', whether that's really early on or dependent on how you count, eight almost nine years in? I'm not at that ten-year mark yet and I wonder what happens after that? Do I continue to be a programmer? Is this also the measure of when women drop out of programming to do something else?... Hopefully not.

Bette does not want to leave her current technical role, but feels that she should in order to create more opportunities for other women and people of color in technology. She clarified:

> My career ambition right now is 'how can I get to the point where I can open the door for those people?' I don't know how to do that. I don't think it is in being an individual recruiter, I think I have to go into management. I don't want to go into management, but I think that's the next step in order to help people. That means doing things I don't want to do.

Holly expressed that she may want to shift away from technical work in order to do something that would bring more attention and value to the "soft skills" (non-technical skills) that she excels at:

> I think there a lot of other things I can do with that technical background, plus my other communication skills and people skills and all that stuff that is more impactful. I can see that I'm being a software engineer now and learning a ton of skills and that's super valuable and I want to do that, but I see how that could be working toward something like a product role or manager role that's less writing code and more facilitating the code being written, or like being behind the product decisions that are higher impact.

On the other hand, Caroline expressed the demoralization of fighting every day without feeling a change. She referenced a temptation in herself and other women to leave the field for an area of work that could help them feel valued:

> There are a lot of ways that it becomes almost like PTSD where you've experienced this kind of gaslighting before, you've experienced this and there's only so much of that you can take in the daily grind of them saying 'you don't belong here', 'you're not enough', over and over again. So, you know that there's

> a cap before you just can't do it anymore, before you're completely demoralized, and so it's like you only have a certain number of chances that you're willing to give to companies and teams and once that's done, that's when people exit the industry and say, 'I'm going to find somewhere else where I feel wanted'. A lot of times it's not about money or titles or that kind of thing, it frequently comes back to recognition and feeling valued.

Anne echoed this, and explained that she already has a foot out the door, and is feeling very ambivalent about staying in programming. She stated, "I think the way I see it now is that I'm going to try that other tech job, probably not enjoy it, and save up money and figure out what I'm going to do after that." She explained that she is exhausted with the constant nebulous sexism around her:

> There have been days that I've been so exhausted, and I couldn't pinpoint the reason why and I would come home and talk to my partner about a lot of this and I would tell him if I was asked for a reason why I would quit, I wouldn't know what to say because it's hard to point something out. There was one day, and I still can't believe I got to that point but, I remember one day I said I would rather be sexually assaulted so that I would have a clear reason to leave.

Emma reflected that while she is not thinking of leaving programming herself, she understood the urge to do so, and amplified the sentiment that this type of environment puts women at increased risk for leaving the field:

> I do think women are at risk for burn out in a way that men aren't. Men are at risk for burn out too, but for different reasons. Women are at risk for those reasons, and for the extra burden of sometimes being the only woman in the room and experiencing a lot of very subtle things, and then you spend the next half of day thinking about whether or not that was rooted in sexism or whether that was just a thing that you suspect was rooted in sexism, but you can't prove it and you just know now that you don't want to really interact with this person but maybe you have to. To say nothing of the women that experience it out and out, like the Susan Fowlers of the world, where it's obvious, explicit sexual harassment or just being treated very differently and it being 100% clear that you are being treated differently because you are a woman.

Theme 15: Seeing the damage of homogeneity. Five of the interviewees expressed that their experiences as programmers have emphasized for them the damage

of homogeneity in the field. Emma put it clearly, explaining that diversity would improve projects because having a person who may be impacted by a different experience in the room can help you plan to take steps against it:

> I think [diversity] makes product better too because we've seen in a lot of the big apps that almost everyone uses like Facebook and Twitter and what have you, where these were built primarily by White guys and I think that they probably had the best of intentions. I'm not going to subscribe any malice to anybody, but it basically sort of comes down to when you're designing a product and you're not thinking about all of the experiences could have on this product … like you don't know what you don't know, and you can't blame anybody for not knowing what they don't know, and then there's this product that gets used that other people might have anticipated. One of the most obvious examples of that would be Twitter's complete lack of tools to handle abuse and tools to handle harassment… Expressing an opinion online will mean you get some comments but you're not going to get that same type of targeted, bigoted harassment that women and people of color and a lot of queer people get. So, if you don't fit any of those categories and you don't have that experience, how are you going to know? You're just making this really cool tool. I think having women in the room when product decisions are getting made can make a big difference in terms of making the tool usable and safe for more people.

Bette voiced both the frustration at being excluded from decisions, as well as questioning the quality of those decisions being made without including different perspectives:

> I remember the last place I worked… they would have these technical meetings every Tuesday, and I remember walking by these conference rooms that are glass, so they're like fish bowls so you can see what's going on, and was like 'Look at all of these dudes in this room. What are you talking about?' There's something like an iPad or something on the outside so you can see what the meeting is, and it was technically all men, to the point I was the only non-male on the team, so for this to be all men technically, I'm like 'How did this happen?' 'How did this organize out such that it's just men in this room?' I still wasn't very clear because it was very archaic at the time. This is a room where decisions are being made, and it's all the same person making the decisions. Not to question those decisions, but could they have been made better with a different viewpoint? Probably.

As one of the first female programmers at her company, Francis remarked, that no one had considered creating a policy for parental leave, which likely impacted their

ability to hire women. She felt that it was a risk to bring this up, but decided that it was worth trying. She explained:

> I actually wrote our parental leave policy long before I got pregnant, maybe six months after I started there, because I thought it was the right thing to do, to have an explicit policy that people who come onto our website looking to come work for us would see. It was gender neutral and it was pretty generous.

Holly added to these sentiments, that it is difficult for companies that are not already diverse to attract diverse candidates, creating a cycle of homogeneity that damages the company. She remarked that, "I think it's a big red flag if your entire team is White, male engineers. It's something I'm looking for." Caroline expressed a similar view, adding that companies are denying themselves different talent, different perspectives, and people doing their best work by not taking issues of diversity seriously:

> As an industry, we really have so much more to go. It's… even materially impacting the quality of work that is produced, the quality that it's not just a warm and fuzzy feeling that this is definitely affecting their bottom line. There is so much talent that they don't have access to because of back-channels and people saying they don't want to go there. There's so much talent there that is not being utilized to its full potential because people feel demoralized and they feel like why bother if we're not going to get anywhere. Until companies materially recognize that this is not just the right thing to do, but it's also sound business practice to do, I don't think it's going to change and it's something you need to know before you get in.

Theme 16: Giving back, becoming a sponsor/mentor/role model. Six of the participants reported that they were intentionally working on being a mentor or role model for other women, regardless of whether or not they experienced any mentorship themselves. Bette described becoming a mentor to several women, and explained the process she went through of being disappointed by the lack of role models available to her, and deciding to take up that mantle for other women. She said, "I am hoping to find

these people, these role models, but at the same time, either I keep looking and they're not appearing, so I might as well be the role model."

In contrast, Emma described having some positive mentorship experiences, and using those lessons to act as a mentor herself, seeking out venues where she feels she can make an impact. She explained, "I've done some volunteer work and some mentor work through HackRite. I've mentored for them for a few different classes. I've volunteered at Women Who Code. I've volunteered at Black Girls Code before." Similarly, Anne described beginning to act as a mentor to younger women as early as college, when, "I led a program that taught computer science to middle school girls on the south side of Chicago."

Caroline agreed with the other participants about the importance of mentorship. She spoke about mentorship, which she defined as providing validation and guidance, and about sponsorship, which is about creating opportunities for others. As part of this, she expressed commitment to showing up in both of these ways for other women and people of color:

> Providing in whatever ways I can, support and/or sponsorships for other people, fixing what I can and giving what options I can, and also just being vocal about what I see and experienced to tell people again that this is not normal, not real, it's happening to you and other people, you're not a bad person because it happened to you. As much as possible, sharing strategies to make that better. Sharing the hard lessons that we've learned.

Holly also spoke about intentionally mentoring other women on her team, even when she was feeling discouraged from her own lack of mentorship at the time. She recalled:

> I ended up being one of the more senior people on the team and had people working under me, so I was mentoring them. I didn't have any mentorship of my

> own and that's when I think I definitely hit a rut at [company] and that's when I decided to leave.

Holly then briefly referenced continuing to act as a mentor at multiple points during the interview. Gretta did not reference any explicit experience as a mentor, but described trying to be a support for a woman on her team in subtler ways, but trying to ensure that she can be heard, saying:

> One of my own co-workers on my last team tended to be very timid in speaking, so if you didn't consciously leave her space to speak or call on her to get her attention, she usually wouldn't. I don't know if that applies more generally but I remember being conscious that if I was running the meeting or something like that, to try to give her space to speak.

Bette expressed the struggle in mentoring women entering the field with high expectations. She recalled:

> One woman who actually just graduated from school, said she had a roadmap. I was like 'Oh, you sweet summer child!' No, no, that's not going to work. I can't tell her why. She has her thoughts, and maybe that will help her. I don't know if that's going to happen for her, based on what I know, but I don't want to sink her ship… I don't want to demotivate her. What I can do is give her things to try. Things I learned to do. I can give technical advice, but I can't comment on her goals or aspirations. It's her dream. It's more like how I can help and be constructive. It's the tack I'm taking now.

Chapter 5: Discussion

Summary

This study aimed to explore the lived experience of female programmers working in the San Francisco Bay Area. Eight semi-structured interviews were conducted with participants who identified as cis-gender female programmers, and had been working professionally in the Bay Area for over one year. Through analysis of this interview data, following APA guidelines, 16 common themes emerged within three domains.

In the first domain, "Early experiences," captured themes surrounding the experiences that began before the participants become professional programmers that influenced their path, and may continue to impact them. These themes included: having a family influence to provide guidance or a model (Family role model/mentor), lack of a future vision of themselves as a programmer from childhood (Did not envision herself as a programmer as a child), having felt behind or inadequate in school studying programming and/or having taken a non-traditional educational route to becoming a programming (Negative experiences in school/non-traditional education), and enjoying programming as both a factor for entering the field and staying in it (Experiencing programming as fun).

The second domain, "Feeling like the 'other,'" encompassed experiences of feeling negatively compared, and/or differentiated from, their male colleagues. This included themes of: receiving implicit messages that they do not belong in programming (Messages of non-belonging), hearing messages that they or their work are not enough as programmers (Messages of inadequacy), being given messages that they or their work is

not as valuable as that of their male colleagues (Messages of not being valued), experiences of sexism towards them or in their environment (Exposure to sexism), seeing women leaving the field and not seeing women in senior positions (Lack of seeing a path forward in career), and intersectional identities interacting to worsen or lessen the feeling of being "other" (Intersectionality impacts feeling of "otherness": Otherness heightened by racial identity, and LGB identity or gender expression as a mitigating factor).

The third and final domain covered the impact that the experiences and messages from the other domains had on the participants (Impacts of these messages). This was comprised of the following themes: feeling emotionally impacted by their experiences at work in a way that impacts them personally or professionally (Emotionally affected by experiences at work), feeling that they are not safe in the larger culture of programming (Feeling of un-safety in the larger community), feeling the significance of having support from a group that shares a marginalized identify (Importance of community with shared identity group), considering moving away from programming either to a non-technical role or leaving the field all-together (Thoughts of leaving programming), seeing the damage that a homogeneous culture on the company (Seeing the damage of homogeneity), and working to support other women or people of color (Giving back, becoming a mentor/role model).

While this is a very small sample size, and is not generalizable to the experiences of all female programmers, it is important to note that the participants in this study represented a diverse range of identities. Of the eight participants, three were women of color, which is significant given the disproportionately low representation of women of color in programming (National Center for Women in Information Technology

(NCWIT), 2016). Additionally, three of the participants identified as gay or bisexual. It is important to note that the specific experiences of these three women as members of the LGB community may be significantly different working in the San Francisco Bay Area than they would be in other parts of the country. Other than the results regarding this specific identity, although this study focus on women in the San Francisco Bay Area, the experiences of these eight participants are likely reflective of the cultural norms in programming throughout the country.

This chapter will consist of a discussion of the results of the study, including the implications of these findings. The strengths and limitations of this research study will be discussed, and recommendations for future research will be presented. The clinical implications of these results in the context of psychological treatment will also be explored.

Discussion of Themes

Theme 1: Family role model or mentor. More than half of the participants spoke about a parent or close relative in computer science, who provided them with encouragement and mentorship in their studies. This appeared to serve as a protective factor in persevering through schooling to become a professional programmer. This finding is consistent with a 2015 study that found that family influence, both in exposure and support, was a significant factor in motivating women to study computer science, and was significantly more important for women surveyed than for men. In fact social encouragement overall (from family and beyond) accounted for 28.1% of the factors leading high school girls to want to major in computer science (Wang, Hong, Ravitz, and

Ivory, 2015). This finding was in line with a 2003 study, which found that women who had a family or friends who were supportive were more likely to pursue a computer science major (Beyer et al., 2003).

Additionally, research suggests that high school women and minorities who did not have a family member in a technology field were far less likely than men to take classes in math or computer science, thereby making women without a family role model less likely to try computer science at all (Chute, 2009). This is not a new phenomenon, as Fisher, Margolis & Miller, reported a similar finding in 1997, when they reported that the majority of their participants, male and female, were introduced to computing at home (Fisher, Margolis & Miller, 1997). This idea is also found in the broader literature about women in STEM, as in the 2009 article by Eccles, in which factors such as family income and parental occupation impacted girls' academic motivation and achievement (Eccles, 2009). This suggests that such family role models may have been an important factor in these women's exposure to computer science, and in their motivation to pursue professional work in the field.

Theme 2: Did not envision herself as a programmer as a child. Despite this strong family influence and early exposure to computers, the majority of the participants did not envision themselves as going into programming. This may be due in part to a differential parental belief and expectation of their daughters, as opposed to their sons, that is based in traditional gender roles, which research suggests may perpetuate the gender divide in STEM fields (Wang & Degol, 2013). This is supported by the finding that women tend to describe seeing their father work on the computer while men relate that their fathers showed them how to use the computer (Fisher, Margolis & Miller,

1997). This lack of girls foreseeing themselves as programmers is consistent with a 2007 study that interviewed high-achieving girls in middle-school, finding that 25% of them were interested in IT careers at that time, but that four years later the same young women were now focused on other areas of STEM, and demonstrated lack of information about computer science as an area of study and as a career (Howe, Berenson & Vouk, 2007).

A 2012 study by Bystydzienski and Brown builds on this with a longitudinal study from 2006 to 2009 of 132 high school girls excelling in STEM, including in depth interviews with 24 of these participants. In this study, they found that the participants were aware of engineering and technology being unwelcoming to women, and some even questioning their capabilities to do such work as women (despite excelling in high school). In addition, they revealed that most of the participants were most attracted to areas of engineering where they felt they would be able to help people (Bystydzienski & Brown, 2012). This sentiment is echoed in a 2010 study which suggested that a key reason for the gender discrepancy in STEM is that STEM careers are understood as being less likely than other careers to accomplish communal goals, such as altruism (Diekman, Brown, Johnston & Clark, 2010), as well as women's perception that computer science in particular is not related to "real-world" concerns (Varma & Hahn, 2007).

This brings into the discussion a variable of women's career aspirations tending to be more communal or altruistic in nature than men's. This notion is supported by research findings from a sample of 77,528 individuals from 70 countries, which found that male-identified people consistently placed added importance on power, achievement, and similar values, whereas women tended to prioritize values of benevolence, universalism, and security (Schwartz & Rubel, 2005). Such messages were also

communicated by many of the participants in this study across multiple themes, including doing extra un-valued work to help their team despite this not advancing their careers, and in giving back as mentors.

Finally, the participants' stated lack of envisioning themselves as programmers in childhood, may be linked to stereotype threat. This would be consistent with the literature on stereotype threat, such as the 2013 finding that men being perceived as better suited to CS was a barrier to women's participation in the field (Bock, Taylor, Phillips, & Wenying, 2013). This is additionally supported by research cited in the literature review of this study, suggesting that stereotype threat combines with messages from the educational system to discourage women in computer science (e.g. Margolis & Fisher, 1997; Milgram, 2007).

Theme 3: Negative experiences in school/non-traditional education. All of the participants referenced either negative experiences studying computer science in college or graduate school, or having pursued a non-traditional computer science education. This is very consistent with the literature, and is described as a component to the leaky pipeline. This may be due in part to women being less prepared and less counseled about computer science than men (Buzzetto-more, Ukoha, & Rustagi, 2010), as well as the classes being taught with an assumption of previous computer science exposure that many women lack (Stoilescu et al., 2007). Further, women may question their ability and belonging in the field due to ambient signals that they do not fit the mold of a programmer (Cheryan et al., 2009; Cheryan, Master, & Meltzoff, 2015).

Several of the participants in this study noted that their experiences in school made them feel less confident, or like an imposter. This too was supported by the existing

literature. For example, in a 2003 study contrasting the self-report of male and female undergraduates, Beyer et al found that the women computer science majors who participated reported significantly less confidence in computer science than their male counterparts, and that women majoring in computer science perceived the academic environment in a more negative light than female non-majors (Beyer et al., 2003). Additionally, studies have shown that undergraduate women are discouraged by feeling behind their male peers, by perceiving themselves as less passionate, feeling they need to work harder than their male classmates, feeling they receive the message that the bar is lowered to admit them, and more (Margolis, Fisher & Miller, 2000).

On the other hand, this also suggests that with the increase in women pursuing a non-traditional education, the decreased number of women completing majors in computer science (X. Chen, 2014), may not reflect a decrease in the number of women qualified to work as programmers. This is supported by the 2017 statistic by Course Report that 36% of people who participated in one of 73 surveyed coding boot camps were women (Eggleston, 2017).

Theme 4: Experiencing programming as fun. The majority of the participants expressed enjoying the work of programming, finding it both fun and exciting. This is consistent with a qualitative study by Margolis, Fisher, and Miller, which found that many women planning to study computer science in college express enthusiasm and enjoyment for programming. However, this study found that the multiple barriers in college caused this interest to wane in most of the participants, resulting in them leaving the major (Margolis, Fisher & Miller, 2000).

This message of enjoyment for programming being the driving force for both genders choosing to study the subject was echoed by a 2005 study, where female participants described feeling excitement and a "rush" when programming (Tillberg & Cohoon, 2005). Enjoyment of programming was also found to be an important factor in women persisting in a programming career (Teague, 2002), and a study by the National Center for Women and Information Technology (NCWIT) found that 74% of women employed in technology jobs state that they "love their work" (Ashcraft & Blithe, 2010). This is significant, as it suggests that the high rate of attrition of women in programming jobs is not due to lack of enjoyment of, or ability to do, the work itself.

Theme 5: Messages of non-belonging. All but one of the participants endorsed receiving implicit or explicit messages that they do not belong in programming. This feeling is supported by the literature both in women's experience in school and beyond. These implicit messages of non-belonging in classroom settings, and the impact on women's interest in pursuing the field are well studied (Cheryan et al., 2009; Cheryan, Master, & Meltzoff, 2015). In fact, a two minute interaction with a role-model who fits the stereotype of a computer programmer negatively impacted women's interest in the field, whereas the same interaction with someone who does not fit that stereotype, regardless of the role model's gender, increased women's sense of belonging and interest (Cheryan, Drury, & Vichayapai, 2013). Also supported by prior research is women's sense of not fitting with the professional environment in other STEM fields, such as engineering (Gill, Sharp, Mills & Franzway, 2008). These messages are likely closely tied to the "computer geek" mold created in the 1960's in order to transform the field into a more prestigious, and male dominated, job (N. L. Ensmenger, 2012).

This is a very important consideration, as having a sense of belonging has been shown to be a predictor of professional success and is important for employee retention (Freeman, Anderman, & Jensen, 2007; Good, Rattan, & Dweck, 2012). This has also been demonstrated in terms of work productivity; in 2008 a meta-review listed the sense of belonging as motivating for software engineers, whereas being a "poor cultural fit" was demotivating (Beecham, Baddoo, Hall, Robinson, & Sharp, 2008).

One area that the participants of this study emphasized was feeling the need for work-life balance, which goes against the stereotype of the programmer (N. L. Ensmenger, 2012). The interviewees in this study referenced feeling that this wish for balance differentiated them in a negative way, as they felt less "passionate," or less productive, than male colleagues. This wish for balance is not unique to the women in this study. The same result was found in the interviews contained in a 2011 master's thesis looking at women in software design (Patz, 2011), and Beecham et al. found work-life balance to be another motivating factor for both genders in software engineering (Beecham, Baddoo, Hall, Robinson, & Sharp, 2008). In their 2003 book, *Unlocking the clubhouse: Women in computing*, Margolis and Fisher summarize this phenomenon, also found in their research, perfectly when then say:

> The rub for women in computer science is that the dominant computer science culture does not venerate balance or multiple interests. Instead, the singular and obsessive interest in computing that is common among men is assumed to be the road to success in computing. This model shapes the assumptions of who will succeed and who 'belongs' in the discipline. (p.71)

The hiring process also contributes to this sense of not belonging. Several of the women interviewed in this study also mentioned negative interview experiences as being related to the "white board" interview, where you are expected to solve problems on the

white board as part of the evaluation. Given factors such as stereotype threat and that half of the women interviewed have non-traditional education for a programmer (a non-computer science degree), these problems may not have been an appropriate fit. It is interesting that companies are screening for candidates who will excel at these problems, those most likely being people who have completed an undergraduate computer science degree, who are largely male-identified (Chen, 2014). While this particular area is understudied, it must be considered that such interviews may also discourage women from applying to a job, as they call to mind similar typecasts as using stereotypical terms, such as "rock star hacker," (Simard & Gammal, 2012, p.14) which may drive women away from applying to jobs using these terms to advertise.

Theme 6: Messages of inadequacy. Many of the women who participated in this study endorsed receiving messages that they are not "enough" for the job. Most often, this came in the form of being told they were "not technical enough." This message is also documented in a 2001 qualitative study of women in information technology, in which participants described being informed they were "not technical enough" for a position (Lemons & Parzinger 2001). This message is also repeated in a 2017 news article by Liza Mundy, in which she reports that "Stephanie Lampkin, who was a full-stack developer (meaning she had mastered both front-end and back-end systems) by age 15 and majored in engineering at Stanford, has been told when applying for a job that she's 'not technical enough' and should consider sales or marketing" (Mundy, 2017, para.14). Despite the pervasiveness of this message, little research has focused on this phrase and its impact on women.

Several of the women referenced that such messages have reinforced feeling like an imposter. The term "Imposter Phenomenon" was first used by Clance and Imes in 1978, to describe what was happening for high achieving women who found it difficult to internalize their achievements. Research has shown that when someone is struggling with imposter phenomenon, they drain psychological resources in a way that leads to emotional exhaustion and decreases job satisfaction in University faculty (Hutchins, Penney, & Sublett, 2017). Thus, if pervasive messages are reinforcing this feeling, it may contribute to the attrition of women from the field of computer science.

Theme 7: Messages of not being valued. The participants spoke to these messages as often being implicit in lower monetary compensation or feeling held back from promotions. These assertions are supported by statistics from the 2014 Silicon Valley Index, which found that for those employed in Silicon Valley, men with Bachelor's Degrees are paid 40% more than women with the same degree, and that for men and women holding graduate degrees the pay gap widens to 73% (Hancock & Carson, 2014). In fact, looking at census data from 1950 to 2000, researchers found that as more women enter a field, the pay deceases, which they attribute to the devaluing of work done by women (Levanon, England & Allison, 2009). This is further supported by the 2017 census, which found that for computer programmers specifically, women were earning 89.5% of what men earned in the same position (Bureau of Labor, 2017).

The valuing that the participants' spoke of was not only in salary, but also in the form of feeling held back from promotions. Similar stories of being "passed over" for promotions were also found in the aforementioned 2011 master's thesis by Patz, in which she looked at women in Information Technology (IT). This makes sense, given that in

hiring, the qualifier of "goodness of fit" is used to rationalize the hiring, and promoting, of men over women (Lyness & Heilman, 2006). This idea of "fit" may be a key component of this imbalance, as an important component of finding success as a woman in IT is adapting to the male environment, including participating in activities that may not be of interest (Pringle, Nielsen, Von Hellens, Greenhill, & Parfitt, 2000). Thus, as Caroline described, one is expected to either adapt to the culture and priorities of the environment, or their work may be unrewarded. This uneven playing field was nicely summed up by one woman interviewed as part of a case study of a consulting and accounting firm, when she said, "Women get evaluated on their performance; men get evaluated on their potential" (McCracken, 2000).

Finally, many of the participants alluded to feeling that they are expected to do significant extra diversity work that is not expected of their male counterparts, and is not valued by their company or peers, as well as perform emotional labor. Emotional labor is a concept first described in by Hochschild 1983 as "the management of feeling to create a publicly observable facial and bodily display" (Hochschild, 1983). Since that time, the impact of emotional labor has been well studied. For example, a 2001 study demonstrated that needing to manage feelings of agitation in particular correlated with increased burnout and a sense of inauthenticity for both genders (Erickson & Ritter 2001). Further, in a survey of workers in a large organization, Pugliesi found that emotional labor actually increased the level of emotional distress felt by workers, as well as how stressful one's job is perceived to be, while simultaneously decreasing satisfaction with work in both genders (Pugliesi,1999). Thus, this may be an important aspect of the experience of

a female programmer to attend to when seeing such individuals in a clinical or therapeutic role.

Theme 8: Exposure to sexism. All of the participants in this study referenced some exposure to sexism, though the perceived impact of this varied. Much of the sexism described was ambient, or benevolent sexism, which is harder to defend against and has a larger effect on women's sense of their competence (Dardenne, Dumont, and Bollier, 2007; Dumont, Sarlet, and Dardenne, 2010). Thus, this experience may be linked to some of the participants' reported sense of being an imposter. Further, such subtle sexist behavior may further the perpetrator's career, reinforcing a culture embedded in subtly sexist behavior (Watkins et al., 2006). It is surprising that none of the women in this study reported being sexually harassed, though many referred to feeling "lucky" that they have not had that experience, as prior research shows that 64% of women in technology report having been sexually harassed (Hewlett et al., 2008).

Additionally, many of the women interviewed in this study referenced seeing or hearing about hostile sexism being directed at other women, which has been shown to be sufficient to decrease both women's self-esteem related to their performance and their career aspirations (Bradley-Geist, Rivera, & Geringer, 2015). Such experiences may also increase the amount of emotional labor a women must do, as exposure to ambient sexism has been shown to generate anger and anxiety (Swim, Hyers, Cohen, & Ferguson, 2001), which must then be managed lest it contribute to the stereotype of women as more emotional than men.

Theme 9: Lack of seeing a path forward in career. A majority of the participants in this study referenced a lack of seeing a path forward in their career. This

comes in part from starting as one of few women, and then seeing more than half of those women leaving the field within the first ten years (Ashcraft & Blithe, 2010), as well as a lack of seeing women in senior positions. In addition, 27% of women in the United States, in science engineering and technology (SET) as a whole, feel that their career is "stalled," and 46% feel that they are less likely to be seen as "leadership material" than male colleagues (Hewlett, Sherbin, Dieudonne, Fargnoli, & Fredman, 2014, p.2-3). This "stalled" feeling is likely reinforced by feeling "passed over" for promotions and by a dearth of women in senior role especially in software engineering. The lack of women in senior positions is again likely related to both the factors above and the attrition of women from the field, creating a cycle of a lack of role models and sponsors (someone who will help open opportunities and provide guidance) for women.

Why is this a problem? According to a 2014 report on women in SET, with a sponsor, women are significantly more likely to succeed and feel satisfied with their rate of promotion. In fact, with sponsorship women were more 70% more likely to have their ideas heard, 119% more likely to see those ideas advanced, and 200% more likely to have those ideas realized as a product or change (Hewlett, Sherbin, Dieudonne, Fargnoli, & Fredman, 2014). Additionally, while male or female role models may be effective in recruiting women to STEM, female role models are important for the retention of women in STEM (Drury, Siy, & Cheryan, 2011).

Theme 10: Intersectionality impacts feeling of "otherness." Six of the eight participants in this study held intersectional identities; three of them were women of color, and three others identified as under the LGB umbrella. These identities contributed to their experiences as female programmers in different ways. It is important to

acknowledge that this is a very small sample size for the experiences of both identities, and further study is needed to draw any conclusions about the experiences of these intersectional identities.

a. Otherness heightened by racial identity. The three women of color in this study all spoke about ways that this intersection of identities strengthened their feelings of being the "other." This makes sense as, according to a 2015 report by the Bureau of Labor, 16% of jobs in computing occupations are held by White women, where as only 5% are held by Asian women, 3% by Black women, and 1% by Latina women (Bureau of Labor, 2015). Further, in a 2011 survey of people in IT, people of color expressed the least job satisfaction, and were more likely to leave the company within a year (Kapor Klein & Scott 2011). A 2011 review emphasized that undergraduate and graduate women of color in STEM face additional stressors and barriers from their intersectional identities than women who identified as White (Ong, Wright, Espinosa, & Orfield, 2011).

Included in these stressors may be a compounded sense of isolation, as there are so few women of color in technology roles, and White women cannot fully understand this racial and gendered intersectional struggle (Turner, 2002; Taylor, 2002). This may also lead to inadequate support, as needs for support as a woman and support as a person of color may be found separately, with only part of the identity being fully supported at any time. Further, women of color may be given twice the "non-technical" responsibility, as they may be asked to represent both women and people of color on diversity panels or boards (Taylor, 2002). This may lead to a compounding of being undervalued and held

back from career advancement. Further research is needed on this topic in order to more fully understand the impact of this intersectional identity in computer programming.

b. LGB identity or gender expression as a mitigating factor.

Unexpectedly, the women interviewed in this study who identified as either gay or bisexual were also the ones who reported feeling the least impacted by the culture of programming. It is important to note that all of these respondents also identified as White. This is supported by 2017 study, which found a greater sense of belonging at work for White and Asian women who identify under the LGBTQ+ umbrella, have a gender-fluid presentation, and who work in the technology industry. The study suggests that this is due to being viewed as more competent, and avoiding some female-specific microaggressions, by male coworkers (Alfrey & Twine, 2017). Thus, the experiences that the women in the present study endorse may be linked to gender expression as well as sexual orientation.

This experience may be strongly linked to the location of this study, in the San Francisco Bay Area, which has the highest percentage of LGBTQ+ identified residents in the country (Newport & Gates, 2015). Technology companies in the Bay Area are making efforts to recruit members of the LGBTQ+ community, and showing visible support for the community in general, including Facebook's founder Mark Zuckerberg marching in the LGBTQ+ pride parade (Haber, 2014). However, according to a 2014 article in Forbes, technology's supportive relationship of the LGBTQ+ community is strongly linked to economics; both the financial support of the LGBTQ+ community, and free marketing among the community (Sharma, 2014). There may be truth to this, as metropolitan areas with a higher population of gay-identified people have a higher

concentration of technology companies, and that concentration is actually a predictor of the tech-industry's growth in that area (Florida & Gates, 2003). As a transwoman in tech who was interviewed for a news article put it, "Being here in the Bay Area, people tend to be very accepting — sometimes even celebratory," however, she cautioned, "there's a difference between being openly embraced and taken seriously" (Haber, 2014). While her experience may be different from the interviewees in this study, both because she is a different person and because none of the women interviewed identified as transgender, it is important to heed this cautionary message.

Unlike the messages from the women in this study, other women in tech who identify as lesbian, gay, or bisexual, report additional negative experiences from this intersection of identities. In fact, in a 2017 nation-wide survey of 2,006 adults who recently left jobs in technology, LGBTQ+ employees were reportedly the most likely group to be bullied or embarrassed publically (Scott, Freador, & Uriridiakoghene, 2017). For example, in a 2015 news article, a lesbian woman related, "I experienced things like having to pair all day with someone who would make comments about how I should be more open-minded about having sex with men." She continued by noting that "I felt my being a woman was more a barrier to being in tech than being gay," and elaborated that, "I often find that men are willing to act as if I'm one of the guys in that they like to express their objectification and misogyny toward women around me because we both like women" (Brown, 2015). Thus, it may be the case that the women in the current study may be feeling less impacted than other women by their treatment as "one of the guys," but they may actually be exposed to more ambient sexist remarks due to that role. Further research is needed in this area to understand this experience.

Theme 11: Emotionally affected by experiences at work. Nearly all of the women interviewed in this study referenced being emotionally impacted by their experiences at work, which some noted affected their self-confidence, work quality, and/or personal life. This experience is supported by the literature, which has demonstrated that exposure to sexism, even if it is not explicitly directed at oneself, results in difficult emotions such as anger and anxiety, and affects the comfort and self-esteem of women (Swim, Hyers, Cohen, & Ferguson, 2001). Additionally, struggling with stereotype threat can spill over to affect multiple areas of functioning. These areas include working memory (Beilock, Rydell, & McConnell, 2007), emotion regulation (Johns, Inzlicht, & Schmader, 2008), cognitive or social tasks, and sensorimotor tasks (Schmader, Johns, & Forbes, 2008). Thus, it is unsurprising that women coping with both sexism and stereotype threat would feel impacted emotionally and functionally.

This emotional burden can also impact women's careers, both in the effect on their work, and as it feeds into stereotypes about women as emotional and overly focused on life outside of work. This influences the hiring, career advancement, and retention of women at science engineering and technology companies (Braun & Turner, 2014; Diekman, Weisgram, & Belanger, 2015). In addition, this can create a problematic feedback loop in which both this negative managerial perspective and interactions with men with sexist attitudes both trigger stereotype messages in women that, in turn, negatively effect the quality of their work in engineering (Logel et al., 2009).

Theme 12: Feeling of un-safety in the larger community. Many of the women interviewed alluded to feeling unsafe venturing into the larger computer science community, such as co-ed meetings, open source submissions, or even in interviewing at

companies that have not been vetted by other women. This feeling is supported by both documented case examples, such as that of Jessie Frazelle mentioned in the literature review, as well as research studies. For example, when their gender is identifiable, the submissions made by female contributors to open-source software are less likely to be accepted than if the contributor is identified as male, or the gender is not identifiable (Terrell et al., 2016). In addition, companies may send implicit messages during recruiting fairs that signal a lack of welcoming or safety to women, such as involving from the company women in only marginal roles, using images that perpetuate stereotypes (such as sexualized women), making comments that indicate a "masculine geek" culture, and more (Wynn & Correll, 2018, p.153).

In a 2013 blog post, Ginny Hamilton expressed shock and gratitude at seeing a co-ed conference state an explicit no harassment policy front and center in their messaging. This, she says makes her feel safer, and similar actions by other conferences have attracted more female participation (Hamilton, 2013). This reinforces the message that unless a conference environment is specific in creating safety for women, it will be assumed to be unsafe, given the history of harassment and threats from being visible as a woman in computer science (e.g. Frazelle, 2015). Such incidents are being documented and shared via http://geekfeminism.wikia.com/wiki/Timeline_of_incidents.

Additionally, many of the women interviewed in this current study stated that they would not consider interviewing for jobs that they have either heard negative things about in terms of diversity, or are an unknown. The base assumption seems to be that a company is unsafe until proven otherwise. However, given the lack of literature this

researcher could find on this topic, it may be that this is not currently being studied, and further research is needed in this area.

Theme 13: Importance of community with shared identity group. Nearly all of the participants in this study spoke about the importance of having access, whether online or in person, to others that share their identity as female programmers. The power of the group to validate and normalize individual experiences in order to help women combat the messages they were receiving was named as being key. Research has demonstrated that small cues of social connectedness have a large impact on motivation to perform well (Walton, Cohen, Cwir, & Spencer, 2012). Additionally, in a study of women of color who worked as executives in information technology, the results showed that it felt important for these participants to create a network with other women of color to share support (Jiles-Charles, 2017).

The importance of online support is not unique to female programmers. In fact, such online support via forums or computer mediated support groups have been shown to be important in improving emotional well being for women with postpartum depression (Evans, Donelle, & Hume-Loveland, 2012), as well as for women battling breast cancer (Shaw, Hawkins, McTavish, Pingree, & Gustafson, 2006). A 2009 meta analysis of 28 studies of computer mediated support groups found that such groups improved the participants' experiences in many domains, including decreasing depressive symptoms and fostering feelings of self efficacy (Rains & Young, 2009). Such online groups allow members to receive validation of their experiences while also supporting others; thereby combatting isolation and reducing the feeling that their experience is atypical or that they are an anomaly (Bane, Haymaker, & Zinchuk, 2005). In this way, such groups may

promote a sense of empowerment and well being, however, researchers caution that this can become problematic if one becomes dependent or withdraws from in-person social supports (Barak, Boniel-Nissim, & Suler, 2008). Thus, it is not surprising that such groups may be very important for supporting female programmers, but is likely not sufficient in itself to moderate the impact of these women's challenging environments.

Theme 14: Thoughts of leaving programming. The majority of participants in this study endorsed some thoughts of leaving programming, either applying their knowledge in non-technical ways, or leaving the field entirely. This is not surprising, as despite 74% of women employed in technology jobs stating that they "love their work," 56% of women in technical positions leave within ten years (Ashcraft & Blithe, 2010). As of 2014, 32% of women surveyed in science engineering and technology (SET) jobs stated that they will likely quit within a year (Hewlett, Sherbin, Dieudonne, Fargnoli, & Fredman, 2014). Additionally, in an interview of 716 women who left tech, more than half left after an increase in stressors after becoming a mother, though only 85 listed this as the primary reason, and many cited the discriminatory environment. Eighty seven percent of these women stated that they do not plan to return to working in technology, though many mentioned loving the work of programming (Snyder, 2014). This is especially interesting given that only one of the eight women interviewed in the current study was a mother.

The participant's awareness of the sexism in their environment may contribute to the likelihood that they will leave. In a study of women in computer science and engineering graduate school, while not all of the women who spoke about considering leaving actually did, those who listed sexism as a primary motivator for leaving were 21

times more likely to actually leave than women who cited a different reason (Cohoon, Wu, & Chao, 2009). This is consistent with a 2017 study of people who left technology jobs, which found that unfairness and mistreatment were the largest drivers of attrition, and that women reported both suffering and witnessing more unfair treatment than men ($p<0.00$) (Scott, Freador, & Uriridiakoghene, 2017).

Theme 15: Seeing the damage of homogeneity. The damage of homogeneity was spoken of in several ways, both in reluctance to join a homogeneous team, and in impacting the quality or thoughtfulness of the company's products and policies. The importance of having a diverse team is statistically clear. A 2018 report looking at over 1000 companies internationally found that companies in the top 25% when rated for diversity were 33% likelier to have some of the highest profits in their industries, whereas those in the bottom 25% for diversity were 29% less likely to have above average profits (Hunt, Prince, Dixon-Fyle, &Yee, 2018). Additionally, racial and gender diversity are both associated with more customers, sales, and profits (Herring, 2009). This may be in part because women, who represent a substantial section of the market, have may different impetuses for both adopting and continuing to use technology than men, making it crucial to design products with women in mind (Venkatesh, Morris, & Ackerman, 2000).

If this was not enough of a monetary impetus to have diversity as a priority, it is also important to remember that the attrition of women from companies is not only a loss of talent, but is also costly to the company. In fact, a 2007 study reported that employee turnover cost companies approximately $64 billion each year (Level Playing Field

Institute, 2007). Thus, it seems clear from a business standpoint a lack of diversity is damaging to the company as a whole.

Theme 16: Giving back, becoming a sponsor/mentor/role model. Many of the interviewees spoke about ways they have been intentionally mentoring, sponsoring, or working to be a role model for other female programmers and women studying programming. Research has shown that female role models are important for the retention of women in STEM (Drury, Siy, & Cheryan, 2011), however, due to the dearth of women in computer science, many women do not have access to such a mentoring figure (Teague, 2002; Hewlett et al., 2008). Despite many of the women in the current study not having female mentorship of their own, they have committed to giving such support to other women. This may reflect both the resilience and community-based values of these women. Such peer mentorship has been shown to be effective for women in academia (Driscoll, Parkes, Tilley-Lubbs, Brill, & Pitts-Bannister, 2009). In fact, in a longitudinal study of undergraduate women in engineering, women assigned female peer mentors had and increased sense of belonging, higher career ambitions, and better retention (Dennehy & Dasgupta, 2017). Thankfully, there are organizations targeted specifically at recruiting mentors and mentoring women in technology, such as TechWomen, and in STEM in general, such as Million Women Mentors (https://www.millionwomenmentors.com). This offers a means to create an infrastructure that has the potential to buttress women in STEM with greater instrumental direction and support in the future, alleviating some of the challenges they currently face.

Strengths and Limitations

The method of this study carries significant strengths. The first and foremost strength is the population studied. Prior research has focused largely on the undergraduate experience. While this research is very important to helping us to understand the leaky pipeline; it does not speak to the impact of the rise of programming boot camps and it does not account for the continued attrition of women from programming. Thus, the experience of female programmers after they have entered the professional workforce is both less studied and provides crucial information about their STEM experience. The majority of the research that does exist on professional female programmers uses surveys or census data, which give a helpful overview, but lacks the depth and richness of a qualitative study. A second strength to qualitative research on this population is that it allows the researcher to add follow-up and unstructured questions in order to get a fuller sense of each individual participant's unique experience. Because this population has historically been punished for their attempts to speak out, the phenomenological approach seems most relevant and helpful in allowing these women to express themselves without danger of retaliation. It gives them the freedom to tell their story, in their own words. This depth of information is rich, and by using a structured method of analyzing the data via Interpretive Phenomenological Analysis (IPA), the 16 themes generated are robust. Further, by bracketing of the researcher's potential bias, as well as using an outside coder to corroborate the researcher's coding of the interviews, the validity of this research is increased. This data can therefore be used to identify other potential areas of focused research.

An additional strength of this study was the diversity of the eight specific

participants interviewed. The sample contained five White participants, three people of color, three people who identified as LGB, and one mother, as well as a diversity of academic backgrounds. This allowed themes relating to intersectionality to emerge, and may make the sample more representative of a range of experiences, thereby selecting mainly for themes that emerge from the experience of being a female programmer that are salient for women of multiple identities.

However, it is also important to acknowledge the limitations of such a study. First and foremost is the small sample size, as the experiences of eight participants are not necessarily generalizable to the larger population of female programmers. Another limitation is the geographical focus of this study. Looking at only the San Francisco Bay Area provides a distinct regional lens to view women's experiences, and is thus less generalizable to a national or international population of women computer programmers. Finally, the ages of the participants represented a fairly narrow range (20's and 30's), thus it is important to consider that these experiences may not necessarily reflect those of older women. Only one of the participants was a mother so the efforts of women in programming to juggle their deeply felt family responsibilities with the intense demands of the tech workplace could not be significantly investigated in this study. Given the notorious inflexibility of tech firms to accommodate the parenting needs of computer programmers, this is an area that has been associated with women's attrition from programming careers in the past (Snyder, 2014).

Additionally, the majority of the participants had a family member in STEM, which is not a universal experience, and likely influences the familiarities of these specific participants with STEM cultures. Finally, it is important to acknowledge that

qualitative research such as IPA is inherently vulnerable to researcher bias, despite the steps taken to protect against this. Thus, is possible that this researcher's experiences and beliefs may have influenced the data analysis and results.

Suggestions for Future Research

The results and limitations of this study suggest several directions for future research. First, it would be interesting to see quantitative research done on the 16 themes that were elicited by this study, to determine if these themes remain relevant with a larger and more diverse sample. Such data may be able to illuminate differences and similarities of these experiences across multiple intersectional identities, and across geographic locations that may impact the cultural experiences of technology companies. Additionally, it may be important to study the impact of news in the larger community on female programmers' sense of safety, belonging, and value. For example it would be helpful to research impact on prospective female programmers of the experience of reading or hearing about the negative experiences of other women, or seeing sexist writings such as the Google manifesto, a 10 page document detailing why women are inferior engineers written in 2017 by James Damore, a Google engineer, see the 2017 news article for the full text (Conger, 2017). These media reports may have complex and interesting interactions with stereotype threat, the impact of sexism, and other areas that might negatively influence women's attitude toward pursuing a computer-programming career, or towards persisting as a programmer.

In addition, an important further area of research would be to go more deeply into the experience of various intersectional identities in technology as an important next step,

such as the experiences of Black women, Latina women, or Asian women, and how those may be similar and different from the experiences of White women. Additional studies on the way that LGBTQ+ identities impact the experience of being a woman in computer science, which may vary with geography, would also be invaluable. Ideally, this would include studies focusing on the experience of being a transgender or gender-nonconforming programmer, which is likely a unique and complex experience that warrants further study.

Further, it would be interesting to do a longitudinal study that could follow women from early in their career to determine how these stressors may change or compound with time, as well as which of the women persist as programmers and which do not. This could give valuable insight into attrition, resilience, and culture shifts over time. This may also help to elucidate more about the themes of community and giving back, both of which are areas that warrant further investigation. Relatedly, this may help to determine how developing a shared identity community may influence the experience of unsafety in the larger community, and if this may shift over time as women build this support system.

Finally, given the emotional and functional impact of programming culture on the participants, it would be interesting to research treatment options for this population. Specifically, a study looking at the impact of therapy that is informed by the culture of computer science would be beneficial in guiding the clinical treatment of female programmers. Similarly studying the efficacy of different types of mentoring programs would be helpful to better support women in programming.

Clinical Implications

There are important clinical implications to be gleaned from the results of this study. First and foremost is that the culture of computer science has a significant impact on the women who participated in this study, which may at times cause clinically significant distress. It is important in working with these women to situate their experiences within the culture that is provoking them rather than blaming themselves for the challenges they face in programming. By educating ourselves as clinicians, and by extension our clients, we can help clients to make shifts that respond to the underlying systemic cause of the problems as a way of addressing and viewing their symptom. For example, naming stereotype threat, speaking about the importance of reaching out for mentorship or sponsorship, and emphasizing the importance of a shared identity community, may be helpful beginning steps in treatment.

In addition, helping such clients to understand, process, and learn to cope effectively with the negative messages they receive about their belonging, value, and ability, may be important in alleviating their symptoms of distress and discouragement. It is important to notice both the toll that this culture is taking on these women, and the strengths that they demonstrate both in their love for the actual work, and in their desire to give back through mentoring and solidarity with others. It may be difficult to remember these as strengths when they are not being valued culturally, but this cannot diminish their actual value. Essentially, this reflects an idea that the field of programming forms a unique culture, and therefore distress related to working as a woman in programming can and should be responded to in a culturally informed way.

Conclusion

This study explored the experience of female programmers working in the San Francisco Bay Area, using a qualitative method via in-depth, semi-structured interviews. Eight cis-gender women, including three women of color and three women identifying under the LGBTQ+ umbrella, were interviewed for this study. This data was then analyzed through the use of interpretive phenomenological analysis (IPA), which yielded 16 common themes related to the experience of being a woman in computer science. These themes were grouped into three larger domains, reflecting the early experiences, experiences of feeling like the "other," and the impact of these messages.

The results add to the literature of women in computer science by providing a more in-depth window into the experiences of women working as programmers, and the ways that this may be impacted by intersectional identities. Through these themes it is possible to see the thread of a journey to, and through, the field of programming that these participants shared in their experience. For many, despite having family support or role models for programming among a majority of the participants, most did not envision themselves becoming programmers until later than the majority of men who enter the field. The thematic results of this study reveal a pattern supported by existing literature that these women enjoy programming, and are drawn to the field both by a fit of interests and abilities, and by the financial stability it offers. However, both in school and in the work force, they were confronted with messages that they do not belong, that their work or efforts are inadequate, and that they are not valued as highly as male peers.

These messages combine with experiences of sexism and a lack of seeing a path forward to success due to both their own experiences and the lack of other women in

positions of power. This impacted these women both emotionally and functionally. Many of these participants alluded to feeling unsafe in the larger community of computer science, avoiding both co-ed conferences where professional knowledge is shared or companies that have a reputation for not being "safe." As a result, many of them have considered leaving programming, and the numbers show us that many do (Ashcraft & Blithe, 2010). One avenue of important support for participants was through forming alliances with other female programmers or programmers of color within and outside their workplaces. This reinforced their drive to give back through mentorship and sponsorship of other women and helped to locate the problem as outside of them, but rather within the homogeneity of their work environments. These efforts provide examples of their resiliency and amazing solidarity with other women and minority programmers.

Key suggestions for future research include: quantitative explorations of the above themes, focused research on the impact of intersectional identities on the experience of being a female programmer, the experience of being a transgender or gender non-conforming programmer, further exploration of women's experiences of juggling family and work demands in programming including longitudinal research on female programmers, and clinical studies looking at the impact of culturally informed therapy for this population.

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Appendix A: Human Subjects Protocol

Full Review CPHS Protocol

The Lived Experience Of Female Programmers Working In The San Francisco Bay Area: An Interpretive Phenomenological Analytic Study

A study conducted by Paige O'Connell, a doctoral student at the Wright Institute in Berkeley, California under the guidance of Dissertation Chair Dr. Patricia Wood.

Project Summary

This qualitative study proposes to explore the experiences of female programmers working in the San Francisco Bay Area, in order to better understand the highpoints and the challenges that these women may face as programmers, both personally and professionally. To recruit participants for the study, ten female programmers will be approached through a network of programmers using the snowball method of recruiting. In this approach, initial contacts who work as programmers will be provided with brochures about the study. The brochures will describe the study and provide contact information about the researcher so that she can be contacted if potential participants are interested in being in the study. These brochures will also be posted to online forums, and sent to conferences that draw female programmers. If interested, potential participants may contact the researcher for more information and to be screened for inclusion criterion. An in person or phone interview of approximately one hour will then be scheduled.

Human Subjects

Participants will be recruited from a general sample of female programmers currently employed in the San Francisco Bay Area. All participants must be 18 years of age or older, must identify as being female, and must be employed full-time as programmers of a company (not working as a consultant). They must have been employed as programmers at Bay Area companies for at least one full year leading up to their participation in the study. These women must do the majority of their work from a company office (more than 50%), as opposed to working remotely. Additionally, because the interview will be conducted in English and language is important to the success of the coding, all participants must be able to speak English fluently. The study will be limited to women in the San Francisco Bay Area, a growing technological hub, in order to facilitate in-person interviews. These subjects are not considered to be from a vulnerable population, as they employed adults who are not compromised or diminished in their capacity to give informed consent.

Procedure

The general nature of the study will be explained via the brochure (appendix A) or flyer (appendix B). Interested participants will contact the researcher, and will be screened (appendix C) over the phone to ensure that they meet inclusion criterion. Participants will then be given a packet of materials. First it will include a letter of introduction with an informed consent form. This will describe the study in greater detail and will cover all

required elements of informed consent, reminding participants of their rights. At the bottom it will include a formal informed consent form that includes consent to be audio recorded. This must be signed and returned to the researcher for the participant to participate in the study (appendix D). Second, participants who meet criteria will be given a brief demographic questionnaire to fill out (appendix E). This must be completed and given to the researcher at the interview along with the signed informed consent form. The interview will be scheduled if participants meet criteria and are willing to participate in the phone screen. The interview will last for approximately one hour, and will take place in a mutually agreed upon, quiet, location. The format of the interviews will be a series of semi-structured questions created by the researcher, and based on Interpretive Phenomenological Analysis (IPA) protocol. All interviews will be audio recorded, and will later be transcribed in a de-identified way by the researcher to facilitate accurate data analysis.

Potential Benefits

There are few significant benefits to the participants; however, they may find it validating to have a researcher be interested in understanding their experience. It may also feel relieving to express some of their struggles that may be difficult to discuss in a work environment. The benefits to the mental health field include an increased understanding of the potential needs of female programmers and some of the clinical issues that might results from working in a stressful work environment.

Potential Risks

The risks involved in this study are minimal. There is little risk of violation of confidentiality, as all subjects will be de-identified for data analysis. Audio recordings will be stored in a safe in the researcher's residence, and will be deleted immediately following transcription. Subjects may experience some mild emotional discomfort during the interview regarding the topic. Discussion may activate or heighten feelings of sadness, anger, or other emotions. Included in the letter of introduction are the names and phone numbers of contact persons who are available for consultation and discussion of any adverse reactions or problems that may arise as the result of the participants' involvement in the study.

Confidentiality

The confidentiality of the participants will be protected throughout the study. The researcher will notify all participants that all interviews will be transcribed with all identifying information removed. Participants will be identified by a pseudo name only. So only de-identified information will be used in the results section of the study in order to ensure confidentiality. This means that any identifying information that may come up during interviews, such as names, organizations, and teams, will be changed as part of the de-identification process. Audio recordings will be stored in a safe in the researcher's residence, and will be deleted immediately following transcription. Following transcription, the researcher will keep the transcripts, free of any names, password protected on the computer and any hard copies will be kept in a locked cabinet. Any forms that the participants fill out, including the demographic questionnaire and signed informed consent, will be stored in a locked file cabinet in the researcher's office or the

Wright Institute Committee for the Protection of Human Subjects, for seven years following the interviews. The key to this file will be stored in a safe in the researcher's residence.

Informed Consent

The researcher will receive written consent by having the participant sign the consent form before beginning each interview. Participants will also consent to the use of audio taping in order to transcribe each interview. The informed consent will systematically detail the ethical rights of the participant, including her right to anonymity, confidentiality, the ability to withdraw from the study at any time or not answer questions that make her uncomfortable. Participants will be informed that their individual answers, modified for protection of confidentiality, will provide the data and will be quoted as part of the results section but their names will not be used. . All these elements of informed consent will be fully described in the informed consent form given to each potential participant.

Debriefing

A letter of introduction describing the nature of the study will be provided to all subjects as part of the informed consent contained package. No deception is being used in this study. Subjects will be informed that they may contact the researcher by phone or email with any questions and/or to request further information regarding the study, their participation in it, or the results of the study upon completion.

Appendix B: Recruitment Brochure

ATTENTION: FEMALE PROGRAMMERS

PARTICIPANTS NEEDED for a study involving the exploration of the experience of women employed as programmers.

Hello! My name is Paige O'Connell, and I am a graduate student in a doctoral clinical psychology program at The Wright Institute in Berkeley, California. I'm conducting a study focused on exploring the experience female programmers employed in the San Francisco Bay Area.

My Dissertation Chair is Dr. Patricia Wood (pwood@wi.edu). The criteria for participation is as follows:

1.) You must identify as a female, and been designated female at birth

2.) You must be a legal adult (18 years of age or older)

3.) You must be currently employed as a full time programmer at a San Francisco Bay Area company (not as a consultant/freelancer).

4.) You must have been employed as a full time programmer professionally for at least one year, and perform over half your work from the company office (not remotely).

5.) You must speaks English fluently.

Participation in the study will involve an individual interview, which will be audio recorded, and last approximately an hour (although more time will be available if needed). Neither your name nor any other identifying information will be used in the transcription of the interviews, or in any results. You will be identified only by a pseudo name or number.

If you are interested in participating in this study, or if you have questions before deciding, please contact Paige O'Connell at poconnell@wi.edu or (510) 859-4430.

The brochure also included the following flyer:

Appendix C: Phone Screening Protocol

Interested participants will call or email the researcher. At this point, the researched will ask the following questions to determine if the potential participant meets the inclusion criterion:

1) Are you fluent in English?

2) Do you identify as female?

3) If so, is that the same identification as your sex assigned at birth?

4) What is your current age?

5) Are you currently employed as a full time programmer?

6) Is the company that employs you located in the San Francisco Bay Area?

7) Do you work at least half of your time from the company office?

8) How long have you been employed as a programmer?

9) Would you be interested in meeting in person for an interview?

Appendix D: Information and Consent Form

Dear Participant,

I am currently conducting my dissertation as a graduate student in the PsyD program in clinical psychology at the Wright Institute, Berkeley, California. My dissertation chair is Dr Patricia Wood. This study intends to explore the experiences of women employed as programmers in the San Francisco Bay Area. The study will explore what being a programmer has been like for you including any impacts that your work environment may have had on you personally and professionally. The study is interested in understanding the highpoints of your work in addition to any challenges that you may face. If you meet criteria, I would welcome your participation in this study.

To participate you must be 18 years of age or older, identify as female and must have been designated female at birth. You must be currently employed as a full-time computer programmer working as an employee of a company (not working as a consultant). You must have been employed as a programmer at a San Francisco Bay Area company for at least one full year leading up to your participation in this study. Also you must perform the majority of your work (at least half of the time) from a company office, as opposed to working remotely. Additionally, because the interview will be conducted in English, you must be able to speak English fluently. If you meet these criteria and might be interested in participating, please continue.

Your participation would involve taking part in a one-on-one interview with me that explores your experiences a programmer, over the course of your career and to the present day, including highpoints, low points, and effects beyond the workplace. Interviews will last for approximately one hour, and will be scheduled at your convenience. Each interview will be audio recorded and then transcribed with any identifying information removed. You will be identified by a pseudo name only. In considering participation, please consider the following:

1. Participation involves minimal risk to you beyond the possibility of some heightened emotions in considering and responding to the topic, questions, and/or materials.

2. Participation results in no direct benefits to you beyond what might be gained by the experience of reflecting on the questions and participating in a research study that contributes to a better understanding of the topic. Participants who complete the interview will be thanked for their time with a $25.00 gift card for amazon.com, which will be handed to them by the researcher them at the end of the interview.

3. Your confidentiality will be protected to the full extent of the law. Your interview will be audio-recorded and converted into a full verbatim transcript (with any potentially identifying information altered) for coding and analysis. Once your interview is transcribed, the audio recording will be destroyed and the transcript, free of any names, will be password protected and any hard copies will be kept in a locked cabinet. The key to the transcripts will be stored in a locked safe and I (Paige O'Connell) will be the only

person to retain access to both. Your identifying information will be removed from my materials by the researcher with the exception of the signed Consent From that will be stored in compliance with the law, in the confidential files of the Wright Institute Committee for the Protection of Human Subjects.

4. If you have any questions or problems as a result of participating in the study, you may contact me, Paige O'Connell (poconnell@wi.edu) and/or my Dissertation Chair, Dr. Patricia Wood (PWood@wi.edu).

5. Your participation is completely voluntary. Refusal to participate involves no penalty or loss of benefits and you may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.

6. You may receive further information regarding the purpose and/or results of the study by calling or emailing the researcher, Paige O'Connell, at (510) 859-4430 or poconnell@wi.edu and/or her Dissertation Chair, Dr. Patricia Wood at pwood@wi.edu or call her at (510) 841 9230.

I appreciate your considering participation in the study and welcome any questions, comments, or suggestions that you may have concerning participation in this study. Thank you for your time.

Sincerely,

Paige O'Connell, M.A.

_____ _____

(Participant's Signature) (Date)

_____ _____

(Researcher's Signature) (Date)

Appendix E: Demographic Questionnaire

Current Age _____
Sexual Orientation _____
Relationship Status _____
If single, do you want/plan to become partnered/married?_____
Do you have children?_____
If no, do you want/plan to have children? _____

Your ethnic and racial background:
A. African Descent/Black
B. White
C. Latino/a/x
D. Native American/Native Alaskan
E. Asian/Pacific Islander
F. Multiracial (Please specify_____)
G. Decline to answer

Did you attend a non-college professional coding program? (please specify)
_____

Where did you go to school (after high school) and what degrees have you earned?
_____
_____
_____
_____

Annual Income:
A. $0-$50,000
B. $50,001-100,000
C. $100,001-$150,000
D. $150,001-$200,000
E. $200,001+
F. Decline to answer

What is your relationship status?
a. Single
b. Living Together
c. Married
d. Divorced
e. Widowed
f. Other
g. Decline to answer

Do you have children: Yes_____ No _____

If so, how many and what ages are they?

How many are living with you at least half time and what ages are they?

What is your sexual orientation?
a. Heterosexual
b. Gay
c. Bisexual
d. Queer
f. Decline to answer_____

To what extent did you feel mentored academically in order to become a programmer?

Not at all	To a small extent	To some extent	To a moderate extent	To a large extent

To what extent have you felt mentored professionally in the workplace in the past?

Not at all	To a small extent	To some extent	To a moderate extent	To a large extent

To what extent do you feel mentored professionally currently?

Not at all	To a small extent	To some extent	To a moderate extent	To a large extent

To what extent did you feel supported by your family of origin in you career path?

Not at all	To a small extent	To some extent	To a moderate extent	To a large extent

To what extent, if relevant, have you felt supported by intimate partners in your career path?

Not at all	To a small extent	To some extent	To a moderate extent	To a large extent

Are any members of your close family involved in STEM fields? If so, who and what field?_____
_____
_____
_____

What type of programming do you do?

Employment history (as a programmer, include company type and approximate size)

What are your future career goals?

Anything you feel would be relevant to add/helpful for the researcher to know?

Appendix F: Interview Guide

The Lived Experience Of Female Programmers Working In The San Francisco Bay Area: An Interpretive Phenomenological Analytic Study

Central questions for the interview will be along the lines of:

What drew you to computer programming?

What sustained your interest?

What was your education leading up to your employment as a programmer, and what was that experience like for you?

Tell me about your experience with mentorship:
- What was your best mentorship experience?
- What was your worst mentorship experience?

How was the hiring experience for you? (If you've worked at multiple companies, what were some highlights and lowlights of the various experiences?)

Tell me about your experience at work:
- What have the highpoints of your professional experience been?
- What have the lowpoints of your professional experience been?

How if relevant for you would you describe the culture of professional programming in general?

What have been some of the greatest challenges for you in the workplace? How have you coped with these?

Have you participated in professional activities beyond the office? (Conferences, writing papers, etc…)
If so, how was this experience for you?

What supports have you found most helpful for coping with any barriers or challenges you've faced?

How has your experience as a programmer/at work affected your life outside of programming?
- How has it affected your self-concept?
- How has it affected your relationships? (this could be family, intimate, friendships, etc)

Have you ever considered or sought outside help in coping, and if so what was that experience like for you? (e.g. outside mentorship, therapy, etc…)

Tell me about any "ah ha" moments you experienced as a programmer

If you had a platform to talk to other women entering the field, given what you have learned thus far, what would you want to tell other women entering the workforce as a programmer?

Appendix G: Bracketing of Potential Bias

Family:

I come from a family that is very focused on science and technology. My grandfather was a physicist, my grandmother was a science librarian, my uncle is an engineer, and both of my parents are professors of biology. As such, the language, politics, and impacts of STEM work surrounded me constantly as a child. I distinctly recall from an early age being aware that my mother was facing more barriers to success than my father. He would get a job, and then negotiate to help her come too, despite her having been valedictorian in high school, having graduated from an Ivy League college, and them having attended the same graduate school. As a child, I believed the given reasons for this: my father was just smarter, better, higher performing. Despite the fact that mush of their work was jointly published. It was not until my mother began the long fight to be paid as much as my father and other faculty working in their same department hat I really began to question these reasons. If they were both full professors in the same department, both had successful labs, why was she being underpaid?

The reality of gender bias in STEM became clearer to me as I began to question the "reasons" for these discrepancies. My mother was convinced that she simply wasn't as smart or valuable as my father. However, as her career evolved, she began to see her strengths. Her organization and management of the lab, her ability to write grants, her ability to ask interesting questions and make people think, and then her ability to use experiments to tell a story that could give a more complete glimpse into the biological area she was researching were all very valuable. She has

since been indoctrinated into the Academy of Arts and Sciences, and the National Academy of Science. This woman who honestly believed that she was just inferior has now accomplished more than most scientists of either gender could hope to. Experiencing her story and journey with her has shown me the insidious nature of sexism in STEM, in the ways that it made her doubt her intelligence and her deservingness of being treated and paid equally. It pains me to think that this woman who would go on to achieve so much may never have had the opportunity to show what she could do had my father not advocated for her to be hired. Having experienced this journey with her, I may carry assumptions that all women in STEM feel similar impacts, or even notice the sexism in their environments.

My background:

Because my family was all so involved in the world of STEM, I was interested in research from an early age. I began doing summer research in my mothers lab when I turned 16, and continued that work through some of college. Her lab was fairly sheltered from the barriers that many women face in STEM, as she tended to employ many women, and sought to empower them. It was not until I went to college that I began to experience some of those barriers first hand.

As a biology major, I took math, physics, chemistry, and many other science classes. I soon found that I felt inferior, as if I didn't belong, dismissed, and not taken seriously, especially in the "hard" science classes. Despite the fact that I has been doing research for several years at this point, I had published a paper, and I had been a regional finalist in a prestigious science and technology competition in high

school. I initially believed that college was simply harder, and I wasn't cut out for the "real world" of science.

I found it hard to perform at my best when I was convinced that my best was subpar and therefore it wouldn't help anything. It became hard to talk to professors and go to office hours when I predicted that it would just confirm that I wasn't smart enough or didn't belong, and when the office hours that I had been desperate enough to attend were for my worst subjects and confirmed my fears. It was hard to put myself out to compete for research positions or fellowships when I didn't feel confident in myself. By my senior year of college, I decided that science was not for me. I still completed the major, but no longer planned to move forward with science after graduation. This both felt freeing and shameful to have given up: a confirmation that I was not good enough. I did not realize until years later that this was likely the subtle messages about women not being as suited for STEM work that I had internalized.

My husband:

My husband has worked as a programmer, and now a programming manager, for about 7 years. In this time, we have become friends with multiple female programmers, and these women often speak to us about the challenges they face. We have heard of harassment in the office, at conferences, online. Being underpaid, underappreciated, and excluded. Through living with him and hearing the stories of our mutual friends, I may be pulled to feel that I understand the experience of female programmers. However, it is important for me to remember

that my husband's experience as a White male programming manager may color the things that female programmers feel able or willing to share with him. Further, these friends represent a small sample from very few companies, and are in no way representative of the overall experience. Finally, it is important for me to remember that the conversations I have with friends are not balanced or unbiased, and I may therefore hear more of the struggles than the positive experiences.

Clinical work:

Since beginning my clinical work through graduate school, I have had several clinical interactions with women who were either studying to be, or working in, the field of technology. In talking with these women, I often heard two stories repeated. In the first version, these women were shutting down at work or in school, feeling unable to participate, depressed, and it was negatively impacting their work. Alternatively, I would hear that they felt angry, on edge, explosive, and their "attitude" was impacting their reviews and putting their job in jeopardy. I found it very interesting that these two stories kept coming up in relation to people in the same field. As I reflected on my own experience in STEM and on researched reactions to sexism in the work place, and began to wonder if these were reactions to their work or class environments. While I believe that this is true, it is important for me to remember that these were the people who were distressed enough by the environment that they sought outside help (therapy). Thus, I cannot assume that their experiences are average or generalizable to all women in technology fields.