

# **Women in Technology:**

*Where are they going and why are they here?*

An Undergraduate Thesis

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## Abstract

Studies have shown that the technology sector, or tech sector, in the American economy is dominated by men, a phenomenon that has limited the diversity of thought present there; yet, though they seem few in numbers, there are women in the tech space. The questions then become where are they? How did they get here? And why?

Over the course of a year, I conducted research on women in the computer science community, and in doing so have set out to answer two main questions: *How do the women involved in computing conceptualize the computer science community, and how does this perception affect their desire to work in technology?* In order to answer this question, I conducted an ethnographic observation of the 2018 Grace Hopper Conference—the largest gathering of women in computing in the world—as well as a series of interviews with women in the entry level stages (less than 5 years) of a technology occupation. With this data, I am able to make a number of observations about how women perceive the computer science community and technology sector, as well as how that perception affects their desire to work in those worlds. My research showed that some women in computer science are attracted to the need to creatively solve problems, in addition to the job stability and unique benefits that are often associated with these positions, but are unsatisfied with the minimal social interaction and explicit social impact. As a result, they are not motivated to stay in the tech industry for a long period of time. This is despite their viewing the community as a viable and even favorable career option for anyone with an interest in innovation, no matter their previous experiences or background. Consequently, I raise two structural changes that may help to increase the number of women who go into and stay in technology: educating more women on the structure and value of computer science (CS), thereby encouraging them to give the discipline a try, and evolving traditional Developer roles to incorporate more social interaction and thoughtful design strategies.

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I would like to acknowledge how grateful I am for the friends I've made over the past four years; you have really become more like family to me and have been there for me through the ups and downs of Swarthmore. I would never have been able to make it this far without your encouragement and support. Lastly, I would like to thank my mother for supporting me through everything, since birth. You are the best role model I could have ever asked for and without you, I wouldn't be the person that I am today; you've truly made all of this possible and for that I am eternally grateful.

As a first-gen, low-income, black woman, I would also like to use this space to encourage all women, no matter their background or experience, to consider moving into the technology sector. *You can do it, and it is a place for us!*

## I. Introduction

### *Overview of My Project*

Since the early 2000s, the speed with which technological advances have emerged has increased exponentially. Consequently, the demand for workers with some sort of technical expertise has followed suit. Studies have shown that the technology sector, or tech sector, in the American economy is dominated by men, a phenomenon that has limited the diversity of thought present there; yet, though they seem few in numbers, there are women in the tech space. The questions then become where are they? How did they get here? And why?

Over the course of a year, I conducted research on women in the computer science community, and in doing so have set out to answer two main questions: *How do the women involved in computing conceptualize the computer science community, and how does this perception affect their desire to work in technology?* In order to answer this question, I conducted an ethnographic observation of the 2018 Grace Hopper Conference—the largest gathering of women in computing in the world—as well as a series of interviews with women in the entry level stages (less than 5 years) of a technology occupation. With this data, I am able to make a number of observations about how women perceive the computer science community and technology sector, as well as how that perception affects their desire to work in those worlds. My research showed that some women in computer science are attracted to the need to creatively solve problems, in addition to the job stability and unique benefits that are often associated with these positions, but are unsatisfied with the minimal social interaction and explicit social impact. As a result, they are not motivated to stay in the tech industry for a long period of time. This is

despite their viewing the community as a viable and even favorable career option for anyone with an interest in innovation, no matter their previous experiences or background.

Consequently, I raise two structural changes that may help to increase the number of women who go into and stay in technology: educating more women on the structure and value of computer science (CS), thereby encouraging them to give the discipline a try, and evolving traditional Developer roles to incorporate more social interaction and thoughtful design strategies.

### *Motivations for My Research*

As a woman who will be joining the tech sector after finishing my bachelor's degree, this population and thus topic has a special place in my heart. Having said that, this research is important for more than personal reasons. In 1991, 36% of occupations in computing were held by women. However, this value has steadily declined since then such that in 2015 the percentage had reduced to 25% (Ashcraft, McLain, and Eger 2016). This is not just a problem for those in favor of gender equality; research shows that groups of people with diverse experiences and approaches to problem-solving perform better than groups that are homogeneous in nature (Capretz and Ahmed 2010; Jehn, Northcraft, and Neale 1999). In particular, “gender-diverse work teams [have been shown to] demonstrate superior team dynamics and productivity” through increased creativity, experimentation and knowledge sharing, lower project cost, and higher employee performance, pay bonuses and “collective intelligence, defined as ‘the general ability of a group to perform a wide variety of tasks’ (Lecia Barker, Catherine Ashcraft, and Cynthia Mancha 2014: 2,4). Gender-balanced companies have also been shown to “perform better financially, particularly when women occupy a significant proportion of top management positions” (Lecia Barker, Catherine Ashcraft, and Cynthia Mancha 2014: 2). Consequently, if

companies want to produce the best products and make more money, they need to diversify their workforce, and thereby hire more women.

By analyzing the perception women currently have of the occupational landscape in technology, I hope to shed light on what facets of the tech industry are appealing to the women who choose to work in technology, as well as the factors that influence their occupational choice in hopes of suggesting ways in which we can encourage more women to get involved in this work. This is a question that has been repeatedly asked as we as a society try to encourage more women to work in technology, but whose answer is constantly changing in response to new innovations, and thus utilities for technology, as well as the creation of new technical occupations. Consequently, I hope my research will help to illuminate the current state of this phenomenon.

### *Outline of this Work*

In this thesis, I will characterize the way in which women in computing conceptualize the computer science community and how that perception affects their desire to work in technology. I will then use this information to suggest ways in which changes in the tech sector may elicit an increase in the percentage of women working in computing. In chapter 2, I detail some of the literature relevant to my research topic, namely some of the theories presented on women's occupational choice and the findings of some of the previous research conducted on women interested in entering this community. This provides the foundation for my own qualitative research, which is discussed in chapters 5 and 6.

In chapter 3, I try to provide some necessary definitions and background information on the computer science community and the technology sector, so that readers can fully understand and engage with my research. In chapter 4, I outline the methods I used to conduct my ethnographic observation of the 2018 Grace Hopper Conference and interviews with women who have worked or are currently working in entry-level positions in technology.

In chapter 5, I discuss my experience at the Grace Hopper Conference, and consequently the ethnographic data I was able to collect from the event. Here I focus on the prevalence of non-traditional—non-Development focused—occupations in the tech sector, and the experiences of those interested in technology, but not specifically coding. It is from this information that I construct my commentary on the current occupational landscape, and women's notable demand for more non-traditional roles in technology, as well as how the community as a whole is responding to the varying needs and interests of women interested in joining the sector.

In chapter 6, I present the data I collected from my interviews, as well as put it in conversation with the aforementioned literature. This provides the basis for my conclusions about how women currently conceptualize the field, as well as my commentary on how educating more women about the actualities of computer science, and evolving traditional CS roles to incorporate more social interaction and discussion around societal impact may increase the number of women in this community.

In chapter 7, I summarize my findings, as well as detail my concluding thoughts on this subject.

## II. Background & Definitions

In this chapter, I hope to provide the background information necessary for readers to fully understand and engage with my research. The following is a description of the technology sector and computer science community as I have come to understand them through various experiences in internships and conversations with people in the technology industry.

### *Common Roles in Technology*

In all of the organizations I have observed, the people who conduct the technological work are situated into a technology department composed of various technical teams. These teams are tasked with working on various facets of a product and each team member has their own role and thus tasks to fulfill for their team.

### *Traditional Roles in Technology*

There is a range of different roles available for those interested in working in technology or computing. The more traditional roles that are centered around coding or algorithmic design are often the most prevalent—as underscored in studies on the prevalence of the geek stereotype. These roles are generally referred to as *Development* roles, whereas the people who work in these positions are called *Developers*, because they physically develop and maintain the mechanisms that do the work; in short, they are the people that code. Developers work on the *Back-End* of a technology, which is the part that users never see or physically interact with.

The most common title for Developers is *Software Engineer (SE)*; it currently serves as a catch-all title that is used to describe all types of back-end coders, no matter the coding languages they are familiar with or types of coding projects they are tasked with. A *Data*

*Engineer*, or Database Engineer, is a Developer tasked with designing, implementing and maintaining the data or database used by a system or organization. Likewise, a *Systems Engineer* is someone responsible for building and maintaining the infrastructure a product uses. Lastly, a *Quality Assurance Engineer (QA)* is responsible for thoroughly testing and debugging all features of and updates to a product before it is put into production and sent out to users. This task requires similar knowledge to that of a Software Engineer, and thus Developers who perform these duties are sometimes titled as such; or in other cases, this role removed altogether and the necessary quality checks are conducted by workers who have one of the previously discussed titles.

### *Non-Traditional Roles in Technology*

In contrast to the more traditional technology roles, non-traditional technology roles focus on a product's utility and purpose, as well as its ornamental design. In my experience, the roles most commonly referenced that fit into this category are *Product Manager (PM)* and *User Experience (or User Interface) Designer (UX/UI)*. The Product Manager (who is sometimes referred to as the *Product Owner*) is the person in charge of articulating what features of a product to develop and thus what projects the technical team takes on, in what order, and why. They do this by regularly engaging with the people who are stakeholders in the product's success, whether that's through direct interaction or data analysis. After they have gained a thorough understanding of what the user's needs and desires are, they then create a backlog of features for the Developers to implement, as well as work to ensure that the way in which these features are implemented guarantees that they are as effective and efficient as possible. In my experience, the Product Manager knows more about the product than anyone else on a technical

team and is a key person to contact when things do not go according to plan because they regularly communicate with all of the people involved in the project and thus know exactly how to move forward. A User Experience Designer is charged with designing and coding a product's user interface—what it's users see and interact with—its *front-end* design. To do this, they do a lot of research into how users interact with their product, as well as run tests on all of their proposed improvements.

Unlike more traditional computing roles, these roles are focused on the user's experience and thus the implementation of a product's design rather than the way in which it physically functions; however, this work is still crucial to the overall success of the technical team. Aside from a comfortableness discussing computing topics, these roles require one to effectively communicate and discuss technical ideas and concepts to people with a range of technical knowledge. As such, they are responsible for acting as the “voice of the user” and are responsible for ensuring that the team's final product is as effective at serving its intended purpose as possible.

Although I have found these roles and titles to be commonly referenced by those who work in technology, they are still only a handful of the types of jobs and titles present in the tech space. Similarly, although these titles are more commonly found across organizations focused on developing technology, different people might specialize in one or two subfields of computing—such as Artificial Intelligence, Cloud Computing or Machine Learning—and thus have a title or role different from those detailed above. There is also a lot of variance in the

specific responsibilities attributed to different positions. This summary does, however, provide a sufficient overview of the types of roles I will discuss throughout this work.

### *Defining My Scope*

In this work, the term *computer science community* refers to any and all people who are interested in computing, or “the process of using computer technology to complete a given goal-oriented task” (Techopedia n.d.), and actively participate in events and activities surrounding computer science. Namely, this includes people who have at some point studied or worked in computing, formally or otherwise, and currently contribute to or interact in conversations surrounding computer science and the development of technology. This definition is broad and all-encompassing so as to include all of the people worldwide one might discuss computer science topics with, whether that’s at a local hackathon or through an online forum.

In this work, the term *technology sector* encompasses any and all companies, organizations, and departments whose goal is to develop technology for some people, purpose or task. This can take the form of hardware or software but needs to have the goal of improving a process or experience.

This work serves to highlight and analyze the experiences of women who are involved in the computer science community—some of which currently work in the technology sector—as well as to elucidate how their resulting perceptions of the community affect their desire to work in the technology sector.

### III. Literature Review

#### *Notable Theories on Women's Occupational Choice*

Researchers have been interested in occupational choice, and in particular women's occupational choice for decades. As a result, a number of different theories have been developed as to how or why women choose the occupations that they do and what facets of an occupation are appealing to women. The theories developed in attempts to answer this first question tend to fall into one of two categories: those that concern the *individual*—or “theorise, either implicitly or explicitly, the individual as the primary site of occupational choice”—or the *social*—those that “emphasize extra-individual factors... [and] tend to attribute agency primarily to forces outside of the individual, which act upon the individual” (Woodfield 2007:13).

#### *Why these occupational segregation patterns?*

In terms of individual factors, a number of theories under this umbrella suggest that individuals seek occupations that align with their *self-concept*, or self-identity—their self ascribed “personality, beliefs, abilities, inclinations, attitudes, image, actions and behavioural tendencies” (Woodfield 2007:17). Gottfredson's theory of *circumscription and compromise* uses the self-concept, in conjunction with the existence of a societally shared cognitive map of occupations composed of occupational stereotypes, to theorize that “individuals identify the occupations they most prefer by assessing the compatibility of different occupations with their images of themselves... [and as a result that] occupations that conflict with the core elements of the self-concept will be most strongly rejected” (Brown 2002:91). A theory founded on the pervasiveness of work values suggests that people choose roles that fit their self-concept as well

as match their value system—“how and what we prioritise in our lifestyle, and what we perceive to be socially acceptable for someone with our particular identity” (Woodfield 2007:22). When applied to our current understanding of the issue of women being underrepresented in technology, this theory suggests that women have a “we can, but I don’t want to” attitude (Lightbody and Durndell 1998), rather than one that views their gender as “deficient” in the skills necessary to succeed in these disciplines, and thus that “women are selecting more highly paid professions, or professions that are more appealing” in comparison to those in technology (Woodfield 2007:23).

Another theory focused on the individual suggests that one’s self-efficacy, or belief that they can be successful at what they choose to pursue, influences their occupational choice. A prevalent study that supports this being the case sampled 272 children and concluded that “children’s perceived efficacy rather than their actual academic achievement is the key determinant of their perceived occupational self-efficacy and preferred choice of work life” because it had more influence on their occupational interests than the children’s actual academic achievement and abilities (Bandura et al. 2001:187); following from that, researchers argue that those who have more belief in their abilities are likely to consider a wider range of career options, and thus that women—who researchers have consistently found to have lower levels of self-efficacy than men—are less likely to pursue careers in science, engineering and technology as a result; they view social skills as their strengths, and thus pursue roles that utilize those skills over others because they think they are more likely to succeed in these positions (Woodfield 2007). Linked to this theory is that of a “fear of success” limiting one’s choice of occupation, and thus that women allegedly “have a greater motive to avoid success because of the negative

consequences associated with attainment” (e.g. being seen as unfeminine, becoming a social outcast) (Horner 1968; Woodfield 2007:25). As a result, it's argued that women are less likely to take occupational risks, and instead, choose occupations that are “gender-typical” and following with society’s expectations (Woodfield 2007).

One more notable theory of this type is that which emphasizes the role of preference in one’s occupational choice. One such theory worth discussing is that of Catherine Hakim who argues that social science approaches toward studying occupational choice need to modernize themselves by using data from longitudinal studies and uses the 1999 British national survey to test and develop her theory (Hakim 2002). She argues that female work patterns are the result of their being fundamentally different types of women, and even delineates three different groups: work-oriented women, home-oriented women and adaptors (women who try to combine work and career)—where each group is distinguished by their different level of commitment to being involved in the workforce (Woodfield 2007); thereby, she suggests that social and economic factors have much less of an impact on women’s occupational choice than their personal motivations and aspirations—namely the extent to which they want to work, as well as their preferences regarding friendly and social work environments as opposed to competitive ones, among other things (Hakim 2002; Woodfield 2007).

One theory that suggests the influence of social factors on women’s occupational choice is that of the prevalence of “gender-normative careers,” and consequently the steering of women toward occupations that are perceived to be more suitable for females from a young age. As noted in the Economic Policy Institute’s report, *“Women’s work” and the gender pay gap:*

*At a time when parental influence is key, parents are often more likely to expect their sons, rather than their daughters, to work in science, technology, engineering, or mathematics (STEM) fields, even when their daughters perform at the same level in mathematics (Gould and Schieder 2016:4).*

As a result, young girls are not encouraged to work in STEM fields and thus become Engineers or Developers like that of their male counterparts. Another theory suggests that “individuals’ self-perceptions of masculinity and femininity contributes to gender differences in occupational values,” and thus choice; mainly in that masculine social norms and traits—such as dominance, independence, assertiveness, strength and serving as a provider for one’s family—motivate men to “desire jobs that are high in salary and have influence over others” while feminine ones—such as warmth sympathy, sensitivity, “expectations of serving as a nurturer, maintaining positive relationships with others, and serving in submissive roles”—motivate women to “desire jobs that allow them time to spend with their families and children, allow them to help others, and allow them to avoid leadership roles and authority over others” (Weisgram, Dinella, and Fulcher 2011: 244-245). These preferences are based on societal social norms, however, and as a result, as society’s definitions of masculinity and femininity change, so will men and women’s occupational choices.

Researchers have also pointed out the effects of labor policies on women’s ability to work whilst doing traditionally feminine familial duties, and that if countries implement “welfare policies that support full-time work for women, including the provision of good childcare options, then women will feel more easily that full-time work is an option... [instead of] being confined to part-time work ghettos that have often developed alongside, instead of within, the mainstream employment economy” (Woodfield 2007:41). Crompton, a notable theorist who

supports this thinking, argues that “although women do have choices, which their individual attitudes can influence, we need to keep focused upon the ‘disparities in power and resources between men and women in the labour market’ that create structural and interpersonal constraints on how these choices are formed, and how effective women are at realising their goals” (Crompton 1997:18; Woodfield 2007:42)

### *What do women want from work?*

In attempts to elucidate the facets of an occupation that appeal to women, studies have asserted a couple of key factors. First, that to women altruistic values are more influential than personal interests in determining their occupational choice (Lightbody et al. 1997; Davey 2001). Motivated by the need to explain disparities in the number of women who gravitate to some careers instead of others, a number of studies conducted on this topic have corroborated this finding. One study, that has been sighted by more recent works on the decreasing number of women entering the tech sector, surveyed first-year college students enrolled in programs geared toward traditionally male-dominated fields. It concluded that “although women tend to avoid technological courses this is not a negative choice, rather they positively choose courses which lead to careers with higher levels of social involvement” (Lightbody et al. 1997:25). They thus argued that the reason that the number of women studying fields like law and medicine increased, while the number of women studying engineering and technology decreased, was because of the former’s opportunity for social impact, and the latter being less appealing in comparison. In a similar study that surveyed 401 high school seniors in Nova Scotia, researchers noted that “almost all [women] specified an expectation of direct contact with those they would help, as opposed to a more general altruistic ideal such as ‘making a better world’ by, for

example, designing a better pacemaker” when describing their future occupation (Davey 2001:226). Given that women have historically been expected to coordinate their career goals with family responsibilities, researchers have also suggested that one’s ability to manage work and family responsibilities concurrently may also be an occupational appeal, or in the least a consideration (Davey 1998; Marks and Houston 2002). However, the extent to which this phenomenon persists greatly depends on the maintenance of said social patterns and thus may vary as societal norms change (Kaufman 2005). Accordingly, these results have had a large impact on the research being conducted on women’s occupational choice for all sectors, but in particular, that of women in computing, as they elucidate a way in which the sector fails to appeal to women, as well as present an avenue through which to change that.

### *Studies on Women in Computer Science*

Since its initial boom, the tech industry has experienced a number of different occupational and technological expansions. The current ramp in technological innovation has resulted in a large increase in economic development, and thus jobs. As calculated by the Federal Reserve of St. Louis, jobs in the tech sector expanded by 20.3 percent from 2010 to 2015 (Gascon and Karson 2017). That being said, the percentage of women graduating with undergraduate degrees in computer science nationally hovered around 18% from 2007-2014, a value that is the result of a steady proportional decline over the previous 20 years (Women, Minorities, and Persons with Disabilities in Science and Engineering 2017); this is despite the total number of people graduating with computer science degrees increasing from 37,992 in 2009 to 55,271 in 2014 (Dan Wang 2017; National Center for Education Statistics n.d.).

Correspondingly, the experiences of women who choose to work or study technology have been studied at varying degrees over the past three decades.

### *Earlier Literature*

Research conducted in the 1990s and early 2000s focused on determining the best way to attract more women to study computer science, and retain the women who already are. During this era and earlier, the number of women pursuing computer science degrees was relatively small. In 1986, 35% of the women receiving STEM degrees had studied computer science. This remains the highest percentage recorded to date. From 1987-1996, however, this value declined steadily, and except for a minimal increase from 1996-2000—followed by a steep decline during the tech bubble burst of the early 2000s—has continued to do so. This is despite increases in the number of women studying other STEM disciplines. Whereas computer science was ranked as the 3rd most popular STEM major for women in the 1980s, in 2014 it was ranked as the least popular discipline when charted alongside biology, mathematics, physics and engineering (Ashcraft et al. 2016).

In response to the initial decline, Fisher and Margolis conducted a 1997 study, on the experiences and motivations of women in the School of Computer Science at Carnegie Mellon University. In doing so they found a couple of things to be true. They found firstly, that the confidence of women studying computer science increased as they continued through their junior and senior years of school—a phenomenon that was actually contrary to those found in similar studies of women in other disciplines. Also, that American women referenced class experiences and the sense of promise they saw in the field, as well as intrinsic interest, as motivators for their

majoring in computer science. And lastly, stereotypes of what the “ideal” computer scientist looks and acts like were pervasive amongst all students surveyed; males thought women were unable to do computer science or, in the least, were not as interested in the field as men—an idea which they mostly attributed to having to help their mothers use household appliances and technology. They also noted that all students had a narrow perception of what one could do with a computer science degree, or what a Computer Scientist actually does, often conflating Computer Scientist with computer programming (Fisher, Margolis, and Miller 1997).

Findings like these were extremely significant at the time, and continue to be referenced today. Nevertheless, it’s also important to note that economic and social changes within the technology industry, as well as within American society as a whole, have influenced the way researchers interpret these results and use them as influence for more recent studies. Most notably, access to computers and other advanced technology has increased dramatically over the last two decades, and thus women are more likely to have used a computer in some capacity during their childhood (Ahuja 2002; Messersmith et al. 2008). This presents an interesting difference in the literature on this community, as previous studies have referenced the differences in exposure to technology between men and women as a compelling argument for women’s limited population in the community.

Similarly, the criteria of what can and cannot be considered a computer science or information technology occupation have become more complicated as more and more technologies are developed, and conglomerates grow. Large technology companies like Google and Facebook have a variety of different services and products and therefore need large teams of people worldwide to do a variety of different jobs that require some sort of background in

computing but may not intersect with Development directly. As a result, roles like Product Manager, User Experience Designer, and the like, that are more creative and people-oriented have been established, but are not included in previous studies that focused on more technical occupations, and are also not as well known.

### *Recent Literature*

After their original publication in 1997, Fisher and Margolis continued their work, expanding their research to other schools and using their findings to influence a number of educational policies, even going on to publish a book about their research. These findings have consequently served as a starting point for more recent works that have taken their conclusions and utilized them to frame various other research studies. One theme presented that has been researched further is that of people's perceptions of the type of person who makes a good Computer Scientist and what computer science is, and consequently the prevalence of "Geek Culture" (Fisher and Margolis 2002).

A 2007 study, conducted by Varma, investigated the prevalence of geek culture, described as "a set of idealized male norms such as falling in love with computers with the first exposure, being extraordinarily well-versed in the inner workings of computers, myopically being focused on them to the point of obsession, and being antisocial" (Varma 2007:360), and in particular its effects on the proportion of women in computing. They defined the term "geek" as someone who aspires to become a "true technology user," and through a series of 150 in-depth interviews with undergraduates from a variety of racial and ethnic backgrounds concluded that it comes with negative connotations: "geeks [are thought to] possess traditional masculine

characteristics, such as [a] fascination with technology, but lack traditional feminine characteristics such as social skill[s];” moreover, the “typical Computer Scientist” is envisioned as someone who codes on their computer all day, and is an extremely skilled programmer (Varma 2007: 360).

In response to this stereotype, researchers have found that young girls and thus women exhibit a couple of different responses. Those who are not pursuing computer science cite this stereotype as a crucial motive for their disinterest. They see computer science as a field open to women, but not themselves as they have good social skills, do not think they personally have the skills necessary to succeed in computing and do not find programming all that interesting (Hur, Andrzejewski, and Marghitu 2017). In the American Association of University Women Educational Foundation’s 2000 publication, *Tech-savvy: Educating girls in the new computer age*, researchers maintained that the middle and high school-aged girls studied acknowledged that computers will be central to the 21st-century economy, but described computing jobs as “kind of a waste of intelligence,” and asserted that “they are not anxious about their abilities, but simply lack interest in further study of technology or related careers... [because they are] unambiguous, unchallenging, antisocial, and tedious;” they believe that other girls can do it, however, just not themselves. (American Association of University Women 2000: 59) Although these findings are from a while ago, the sentiments still persist as young girls are not completely aware of the variety of applications available for one’s computer science experience, and thus do not see their place in the CS community.

On the other hand, women who are studying computer science have been shown to see the stereotype as something they have to live up to, so much so, that those who do not feel as if they are living up to this expectation continually compare themselves accordingly and “suffer from a perceived inability to measure up” (Varma 2007:362). Remarkably, women who are low income or ethnic minorities have been noted to be less affected by the geek stereotype, and feel that the benefits (e.g. job security, high wages, and social capital) outweigh the stigma (Varma 2007). Having said that, the fact that this stigma is prevalent to any degree still negatively impacts the percentage of women who end up in technology (Anderson et al. 2008; Cheryan et al. 2017).

Another research theme which has carried through to the present era is that of the issues surrounding the recruitment and retainment of women in computing. When quantitatively analyzing and comparing the educational pipelines from elementary to graduate school of STEM subjects, researchers concluded that the limited number of women studying computer science is more attributable to a failure to recruit young girls into the field, rather than an inability to retain those who have already chosen to study the subject (Ceci et al. 2014); computer science actually has “less of a decline in the proportion of women through the academic pipeline than more gender-balanced fields” of science, as of late (Cheryan et al. 2017). Moreover, in an analysis of girl’s exposure to computer science topics in the U.S., researchers concluded that “the majority of girls in the U.S.... are exposed to them most prominently in the media, where most people in these fields are depicted as male, socially awkward, and intensely focused on machines. The lucky ones may get some exposure through summer or afterschool programs, but most may never get high-quality and sustained experience or meet a role model or mentor in one of these

fields with whom they relate,” as a result this lack of sufficient early exposure is partially responsible for the gender disparity present in this field (Cheryan et al. 2017:24). This then begs the questions, what aspects of computer science attract women? What career goals do they have and how does a career in technology fit them?

As suggested by a variety of different studies, women tend to have more personal and altruistic concerns and objectives when evaluating potential careers. As one article concluded, “they seek careers that match their interests, allow them to help others, work with people, and provide the opportunity to combine career and family” (Beyer 2014:172). In another study, three key inclinations were displayed across women’s career preferences: the need to help others—and a desire to make things for other girls; affinity for the occupation; and confidence in their ability to succeed in it; girls “felt they could be successful if they pursued a job in a field in which they felt confidence and contentment” (Hur et al. 2017). Notably, researchers have found that women in computing rate themselves higher on artistic ability and creativity than those considering pursuing other STEM majors, but lowest in a number of other areas including academic ability, drive, intellectual self-confidence and leadership ability (Lehman et al. 2016). Recent findings also suggest that both men and women are starting to see computer science as a creative field, or in the least, as an interdisciplinary skill that can lend itself to a number of different areas, especially artistic ones. In a 2015 study of 187,717 first-time, full-time college students entering four-year colleges and universities, conducted by Lehman et al., the most common proposed career choice chosen by students intending to major in computer science was computer programming but was followed by indecision as the second most popular. Furthermore, the percentage of women who selected each answer was lower than that of men in the case of the

former and higher than them for the latter. Additionally, this study found that women who intended to major in computer science were also more likely to have career interests beyond programming, including, medicine, law, psychology, social work, and education, and that the career interests of women in computer science were more diverse than those of women pursuing other STEM fields (Lehman, Sax, and Zimmerman 2016). This suggests that the way in which women think about the applications of computer science outside of computer programming and Development might influence their continued interest and persistence in the discipline, especially in the face of gender inequality and the prevalence of geek culture.

### *Where do we go from here?*

As shown by the aforementioned literature, the lack of women in computing has been of interest to researchers for some time. This in conjunction with the literature on occupational choice provides us with a number of findings about how women have traditionally conceptualized and interacted with work and their choosing of occupations; but can the occupational opportunities currently presented by the tech sector be characterized as traditional? In recent years, as the presence of feminist ideas have become more prominent and the way we characterize work has changed, it makes sense that the factors that have historically influenced a women's choice of work would change as well. I argue, however, that certain facets of technology occupations, as well as the commitment to transparency and collaboration that is evident throughout the computer science community, sets computing further apart.

For one thing, to work in the tech sector, one does not currently need a certain degree or certification. It is sufficient enough for one to demonstrate their mastery of the coding or designing skills necessary for a specific role during a technical interview or portfolio

presentation for them to get the position. Furthermore, the information and tools needed for one to develop and even master these skills are available from a number of different resources on and offline, free of charge. Consequently, anyone who has the desire to pursue these occupations is relieved of some of the monetary or educational obstacles that are often present in other skilled careers. The open source nature of these resources also makes it so that those who want to learn these skills can do so on their own time, at their own pace, furthering the accessibility of computer science professions.

Moreover, larger technological organizations are known for having more modern policies concerning the time frames within which the office is considered open or the flexibility with which employees have to work remotely, as well as a number of attractive employee benefits and perks like subsidized transportation and health and wellness resources—which can be accessed right on the workplace’s campus; extravagant and exhaustive dining options available at all hours of the day and night; welcoming lounge spaces stocked with different recreational games and equipment; and continued opportunities for personal development through online or in-person workshops, monthly workplace events, or tuition and conference registration reimbursements. This in conjunction with the increased demand, high monetary return, and variety of roles available, makes these occupations a desirable and accessible option for those who are in the process of choosing a career. Why then has the percentage of women in computing continued to decrease over the last two decades?

## IV. Methods

### *My Positionality*

My own journey toward joining the computer science community has been unique, to say the least. I came to undergrad without any previous exposure to the discipline. My high school had a variety of in-depth natural science courses, Advanced Placement courses, and extracurricular art and music courses, but nothing that introduced students to the wonders of computing. Consequently, all of the knowledge I had about computer science and the tech industry came from pop culture references and science fiction movies, and I had no real interest in learning more about the subject. I could not see myself becoming an engineer or programmer because I enjoy talking to people, learning more about them, and helping them solve problems, or create solutions. I did not know that there were technical occupations that allowed, and even required, you to do just that.

When I enrolled in my first computer science course, during my first year of undergrad, I continued to have no interest in the field and only took the class to fulfill a degree requirement. Fast forward to the present, and I am now about to obtain a Bachelor's degree with a major in Computer Science. During the time I have taken to earn my degree, I have interned at a small tech startup and the headquarters of a large financial technology, or FinTech, corporation. I have done work that would fit under the purview of a Data Engineer, Quality Assurance Engineer, Product Manager, Software Engineer and more. I have also attended a number of hackathons and conferences for those in computing. By virtue of these experiences I have learned a lot about technology, as well as talked to a lot of different technologists, and in particular women, about

their motivations for pursuing computing, and experiences interacting with those in the computer science community. Although everyone's experiences and thus answers differ, I have observed some common threads in the facets of the discipline women tend to emphasize, as well as the things they hope to accomplish with it. This in relation to the lack of women in computing has inspired my interest in conducting this research, as I hope that understanding the facets of technology that appeal to women, and marketing the field accordingly, will help to encourage more women to join the computer science community, or in the least recognize that it is a place for women too.

### *The Ethnography*

#### *What I did and why?*

During the course of my research, I was fortunate enough to attend the 2018 Grace Hopper Celebration of Women in Computing. The Grace Hopper Conference, commonly referred to as Grace Hopper, is currently the largest gathering of women in computing in the world. Co-founded in 1994, by Anita Borg and Dr. Telle Whitney, it is named after Grace Murray Hopper who was the first woman to earn a Ph.D. in math from Yale University in 1934, and helped create the first compiler (or program through which to translate written language into machine code) for computer languages in 1952. The conference is currently hosted by the Anita Borg Institute, which is an organization renamed after Anita Borg—who founded the institute to encompass projects she had created like the conference and *Systemz*, an online community for women in computing to connect and “discuss issues they experienced at work and share resources with each other”(AnitaB.org n.d.)—and whose goal is to “offer women the chance to improve their technical skills and connect with each other” (AnitaB.org n.d.). In 2018, over

20,000 people from 78 countries attended the event in Houston, Texas—the largest number of attendees to date (AnitaB.org 2019); it was also their largest event yet, with 16 event tracks on different topics in technology, for a total of 407 conference sessions, and 416 organizations participating in the career expo (AnitaB.org 2019). Consequently, attending the conference gave me insight into the current career offerings available for women in technology, as well as the interests, motivations, and experiences of women who are currently in this space.

I had originally planned to attend the conference for my own personal development, and had received the finances to do so through an all-inclusive scholarship sponsored by the Anita Borg Institute, but whilst attending, I made sure to go to a number of workshops, panels and other activities that aligned with my research interests, namely those that emphasized the interdisciplinary nature of computer science and technology, and discussed topics that focused on the work of non-traditional roles in technology. During each event I attended, I took notes on what I observed—the interactions I had with other attendees, the topics discussed by facilitators and panelists, and questions posed by others in the audience. The provided ethnography and observations are based on these notes.

### *Benefits and possible limitations of my methods*

The scale, duration, and nature of this event made ethnographic observation an effective form of data collection in that I was able to attend events and take notes relatively unnoticed. I was, therefore, able to observe things as they happened naturally, making it very likely that the activities and behaviors I witnessed from all parties in attendance were authentic. This was also

an efficient form of study in that I only needed to attend events to do research, and so I was able to collect data throughout the day, whilst also fulfilling my own personal goals for enrichment.

However, Grace Hopper is an extremely large conference with hundreds of events and thousands of attendees, it is consequently possible that the scheduling of events, in combination with the limited number of activities I was able to attend, may have negatively influenced the amount or type of people I was able to observe and thus my sample. Likewise, my choosing to attend and thus record data from activities that were focused on the non-traditional approaches to technology limits the type of people I was able to observe to those who were interested enough in these subjects to attend these workshops instead of events on other topics that occurred at the same time. Similarly, the data I collected is limited to what I was able to personally observe, and thus phenomena and activities that may have occurred but that I did not personally witness are excluded from my findings.

### *The Interviews*

#### *What I did and why?*

In addition to my ethnographic observation, I conducted interviews with four women who have worked in entry-level positions—ones that require less than 5 years of experience—that utilize some knowledge of topics in computer science or information technology. I used these requirements so that I could gather information on the experiences and perspectives of women who have recently joined the technology sector and were thus still in the process of evaluating whether or not they wanted to continue to work in tech. In attempts to gather research participants, I posted a request for interviewees on two separate Facebook groups

for women in computer science: “GHC Scholars” and “Ladies Storm Hackathons (Jobs/Internships).” Unfortunately, my advertisements failed to elicit any responses; as a result, I had to reach out to a number of women in my own professional network, who I thought would fit my research requirements, in order to conduct a sufficient amount of interviews. Fortunately, I was then able to expand my set by contacting women who were referred to me by previous interviewees, or by other personal connections.

Although an undergraduate degree in any discipline was not required for interviewees to participate in this study, three of the four women I interviewed attended the same liberal arts institution and had completed their bachelor’s degree with a major in Computer Science. The fourth woman I interviewed had attended a large university prior to working in the tech sector but had dropped out of her non-computer science undergraduate degree program. At the time of her interview, she was seriously considering going back to school to finish her degree in a discipline other than computer science.

With each participant’s consent, I took audio recordings, as well as typed my own notes, during each interview. I started each interview by asking each participant to describe her journey to finding computer science as a possible career path, what her prior impressions of the field were and what it was that initially motivated her to give it a try. I then asked them to characterize their motivations for continuing with computing—whether that was academically or otherwise—and in particular why they applied for and accepted their current position. This helped me ascertain what facets of computer science as a discipline were most appealing to them, as well as the personal and societal barriers they faced when they initially started pursuing

computing, and again when they were considering technical employment. Moreover, I asked them to describe their long and short term career goals—no matter how subject to change they may have been—and to elaborate on why they had an interest in these occupations. This really allowed me to make connections between each interviewee’s personal and occupational interests and values, as well as compare and contrast them across my sample set.

In addition to their personal motivations and goals, I asked them to detail their interpretation of what the computer science community is, who it encompasses, and what the people included in it do, or value. I also explicitly asked them who they thought could be classified as a Computer Scientist, and what occupations they thought a Computer Scientist could have. Not surprisingly, these seemed to be the hardest questions to answer, as a number of my participants had never explicitly thought about this question, nor conceptualized who they thought the thousands of other people, who contribute to various online forums, or documentation websites, were. Lastly, I asked them to tell me about their experience interacting in the computer science community and technology sector overall; and in particular, if they thought any of their identities, and specifically their being a woman, had any influence on their experiences in technology. If so, I asked them to elaborate on how—making sure to emphasize that these experiences could be positive or negative.

As the prevalence of gender bias and discrimination are a huge motivation for this work, I feel as if my research would not be complete without providing my participants the opportunity to speak candidly about these experiences. Furthermore, asking this question provided me with insight into the extent to which companies in the tech sector, as well as the computer science

community overall, are actually changing in response to calls for more action to offset gender bias; And although this is not the focus of my research, it is certainly tangentially related.

### *Benefits and possible limitations of my methods*

My decision to use interviews as the primary source of data collection was based on the successful use of this type of data collection in a number of the previously discussed studies. Consequently, by using this medium, I was able to ask my participants follow-up questions that further explored the thoughts or comments I thought were fundamental to answering my research questions. Furthermore, the addition of audio recordings allowed me to replay and review each conversation in full, thus facilitating my ability to accurately note common themes that were present across multiple interviews. Moreover, this type of evidence collection gives people from the group of interest the opportunity to tell their own story, an agency I personally feel is important to maintain when one sets out to conduct any type of social science research.

Possible defects of using this type of data collection include the inaccuracies that are introduced when an interviewee distorts the realities of their experience, intentionally or otherwise, as well as the possibility that I, as the researcher, misinterpreted the ideas or experiences participants were trying to communicate. Similarly, my relatively small sample size allows me to formulate corroborative conclusions but makes me wary of broadly generalizing these findings to the full population of interest. My findings should thus be used as a reference point for researchers who would like to explore this phenomenon further, as well as documentation that the referenced phenomena exist.

## V. Ethnography: *Grace Hopper*

I attended the 2018 Grace Hopper Celebration of Women in Computing from September 26-28 of 2018. As it is currently the largest gathering of women in computing in the world, it was a great way for me to get some insight into the current career offerings available for women in technology, as well as the interests, motivations, and experiences of women who are currently in this space.

### *Overview of the Grace Hopper Conference*

This year's slogan, "We Are Here," served to unite women in computing around the world and draw more attention to their continued existence and contributions to the computer science community. Over the course of three days, attendees were presented with workshops, panels, lectures and presentations that covered a variety of different niches of technology. In order to better communicate the specific content and audience appropriate for each activity, events were classified into a number of different tracks, or classifications, designated for attendees with a certain set of skills or experience level. This made it easy to differentiate events concerning the interdisciplinary and creative applications for computing, from those that took a more traditional and technical stance. This created an interesting dichotomy between a more inclusive and creative explanation of what tech is, or could be, and the traditional narrative where coding is the primary focus. For example, the *Mentoring Circle* event on the *Career* track featured conversations around *Tech Opportunities in Entertainment*, *Making an Impact in Precision and Genomics*, *Breaking into Enterprise Technology* and the like; however, all of the designations on the *Technology* track were technical in nature (e.g. Software Engineering and

Artificial Intelligence). It was thus clear that the conference tried to showcase the interdisciplinary and artistically creative facets of computer science through a handful of its individual workshops and panels.

### *Ethnography of Notable Workshops, Panels & Activities*

#### *Find The Job That Is Right For You*

One panel of note was titled *Find The Job That Is Right For You*. It focused on helping attendees figure out their desired career path, and in doing so really emphasized the variety of applications for technical experience. This panel was marketed to all conference attendees, no matter their educational background or stage in their career, and required participants to ask themselves introspective questions such as, “What activities would I do if I had free time?” and “What am I good at?” Participants were then asked to take some time to reflect on their answers to the questions and brainstorm ways to combine their strengths and hobbies with their technical expertise. As an example, the facilitators suggested that someone with a keen interest in food and knack for cooking or fine dining try to get a job at a company like Yelp or OpenTable—whose platform helps connect customers to quality restaurants as reviewed by their peers—because doing so would allow them to employ and even develop their interests through their profession, thereby keeping them motivated and engaged. Similarly, they suggested that someone who loves to travel might aim to work for TripAdvisor for similar reasons.

When we finished brainstorming, we were asked to share our ideas with the people sitting next to us. This provided me with a unique opportunity to hear from two middle-aged women who attended the event. Although they worked at the same company, they did so in different

departments and had different career paths. Both women attended the workshop because they wanted a career change that would allow them to do more “fulfilling” work. In describing her career, one of the women emphasized her traditional technical background, but sequential move out of the Developer’s space. She had started as a Software Engineer, and after a couple of years was promoted to a Project Management role, and then a Senior Project Management role where she was responsible for overseeing a team of Project Managers with their own individual teams to manage. She was no longer satisfied with this role, however, and through the facilitation of this workshop had decided that Relationship Management, a role where she would interact with clients, rather than overseeing employees—updating them on the progress being made, whilst attending to and communicating their needs—was more of what she was looking for. The other woman was younger, and less advanced in her career. She also began in Software Development but had furthered her position by getting her Scrum Master Certification. She too was unhappy, however, and yearned for a position that would allow her to educate and instruct others whilst maintaining a leadership position. In response to the product of her brainstorm, the first woman suggested she look into becoming an Agile Coach—a newly developed position as the Agile methodology for product development is still being adopted by companies—which would allow her to engage with a number of different technical teams and help them learn and adopt the techniques she was currently using.

Both women had similar advice for me, especially as I expressed an interest in client-facing roles and thoughtful design. They suggested that I look into Product Management as an introduction into the technical career landscape, but emphasized that that position was not the only option for someone like me who wanted to do more than just code; that there are a lot of

different jobs in tech, that positions with the same, or similar, titles often encompass different responsibilities depending on the organization's needs and that new types of positions are emerging every day.

### *Tech: More Than Coding*

One other panel I attended, *Tech: More Than Coding*, featured four females in occupations that required technical expertise but involved more than coding, namely a Technical Writer, Product Manager, User Experience Designer, and Co-Founder/CEO. Opening questions centered around their career paths, previous occupations, and motivations for entering their current field of work. Interestingly, each woman came into the tech sector in a non-traditional way, but found that their previous work or educational experience served them well, and even strengthened their ability to carry out their responsibilities, in comparison to that of their colleagues who followed a more traditional career path (e.g. obtaining a degree or certificate in Computer Science or Software Engineering). The panelist who worked as a Product Manager actually studied fashion design in school and argued that the skillset she gained from that trade, in particular, is what influences her ability to think about and articulate a customer's needs and communicate them effectively to her teammates. Likewise, the co-founder and CEO actually studied Anthropology in undergrad and went into Management Consulting after deciding that academia and research were not career paths that interested her. From there she decided to take a leap of faith and launch her startup after noticing a need for better educational tools for children who want to learn about robotics. Further enriching this interaction was the use of a female Software Engineer—who was continually impressed by the narratives and experiences presented by the panelists—as the moderator. Her sincere interest was substantiated by her excitement and

continued inquiries into how each panelist got to where they were, as well as the contribution of her own narrative, where she expressed her recent discovery of the existence of each panelist's position, and thus inquisition into the intricacies of each panelist's work.

When it came time for questions from the audience, all of those that were broached came from women without traditional computer science backgrounds, or who expressed a disinterest in Software Engineering in favor of an occupation that is more creative or soft skill oriented in nature. Consequently, what each woman was looking for was advice on how to find and obtain positions like those of the panelists. In response, they were told to “rethink their limitations,” keep working to hone the skills they want to utilize in their desired occupation and to look for a mentor or someone in their chosen profession who could help to guide them on their journey. In response to this last piece of advice, one of the panelists—the CEO—had a caveat concerning the scarcity of role models as the number of women in working in technology is limited, and thus argued that those who are unable to find a person to shadow should look to the wider community for support, but also do their best to be secure in their abilities, especially in the face of workplace discrimination.

### *Falling Into Tech: The Non-Traditional Path*

Another notable panel was called *Falling Into Tech: The Non-Traditional Path*. Whereas the aforementioned panel focused on technical positions that required proficiency in skills other than coding—and just so happened to feature a set of panelists with non-traditional journeys into technology careers—this panel was centered around women without the traditional computer science education, but who nonetheless made their way into the tech space. The panelists ranged

in age, tenure, occupation, and expertise and thus had interesting perspectives that differed in a variety of ways. It became clear very early on, however, that although they had an abnormal introduction to the CS community, they really enjoyed the work being done there and were thus extremely motivated to get more involved and to learn more about computing.

To this end, each panelist was able to speak to a number of different ways in which they took it upon themselves to learn the skills necessary for their occupations. Most often, this meant learning to code in one or multiple languages, learning to use a new software, or even learning the intricacies of a new hardware—skills they would actively develop on their own time despite the personal or structural obstacles in their way. Remarkably, when describing the career trajectories that led them to technology, every panelist talked about the things they admired about their previous professions, and how they were able to find those same characteristics in the tech sector—as well as the things they disliked or felt were missing from their careers before going into technology. Moreover, not all panelists had a deep interest in coding, or fell in love with tech after their initial exposure; a number of panelists moved into technology because they saw a pressing need or application for their original expertise, or were enticed by the opportunity to create things that would serve a large number of people, try something new and be continuously challenged. Last, in closing the event, the panelists left the audience with a couple of different pieces of advice, the most notable of which were to “seek out mentors,” for reasons similar to those expressed at the aforementioned panel and that “there are lots of diverse options for you to work in tech,” a number of which are still emerging, so one should think about what is

actually required for the job they want and work on honing those skills, and getting experience in that area.

### *The Career Expo*

In addition to the workshops and panels, the Career Expo is also a large part of the Grace Hopper experience. Every year hundreds of corporate, nonprofit, government and educational organizations sponsor the conference in return for a number of recruiting and interviewing booths at the conference's career fair. Eager to recruit talented female technologists—for a number of different reasons—companies are known to provide successful applicants with on-the-spot internship or job offers after sequential screening, coding, and fit interviews. It is therefore not surprising that, given the popularity of the conference and large number of skilled attendees, more and more companies with niche services, and hence a need for employees with an interdisciplinary skill set, are vying for space at this event.

Surprisingly, a minority of companies with booths at the expo had user experience or product-focused roles available for applicants, and the companies that did, either did not have enough representatives from those departments to keep prospective applicants engaged, or did not have any representatives at all. Women with an interest in these roles had to wait in lines that were often twice as long as those for other, more technical, specialties—namely Software Engineering or Data Analytics. Moreover, in a number of cases, applicants for these types of roles were told to apply online and thus stripped of the priority status awarded to those who interview at the expo. It is important to note, however, that it was not that these companies were uninterested or dismissive of applicants who were looking for non-technical and thus more social

or creative roles. On the contrary, after looking over my resume and hearing a bit of my elevator pitch, recruiters were eager to get my contact information and have me start the application process. The limiting factor was the amount and type of resources they chose to bring to the event, which left them without the infrastructure in place to evaluate these applicants as thoroughly as required for job offers to be made.

### *Analysis & Conclusions*

Although this summary of events includes a limited subset of my interactions at Grace Hopper, it still provides enough information to make some conclusions about how women involved in computing view the computer science community, and thereby what interests them about the work being done there.

The conference included programming that underscored the variety of different occupations available for those with a background in technology, and even provided workshops available for people to brainstorm ways to get a more interdisciplinary role, a topic that women in technology want to learn more about. Having said that, those included in the computer science community are extremely dedicated to cultivating resources for others to learn more about the different facets of computing and the technology sector, and thus the types of questions asked and number of women in attendance at these events indicates that this information is not being received. This in conjunction with one moderator's vocalized intrigue and surprise at the information presented by her panelists suggests that the presence of these occupations, or in the least the avenues through which one obtains one of these positions, is not sufficiently broadcast. Furthermore, my experience at the career fair paints an even bleaker picture, as the women privileged enough to know about this work and who were actively in search of these positions

were continuously faced with barriers that made their job search much harder than those in search of more traditional computer science roles. This indicates the extent to which it is more difficult to get one of these non-traditional positions because companies have yet to evolve their recruiting tactics to reach their demand.

It is also important to highlight the prevalence of women who came into technology occupations from non-traditional avenues, and thus originally fell in love with a different occupation but switched to technology because of the utility and challenge they saw in the work being done in this field. This corroborates the claim that one does not have to have extensive Software Engineering experience, or be the most skilled coder to succeed in a technical occupation, thereby further undermining previously discussed stereotypes. It also shows that women who may have originally discounted computing as a viable career can still be enticed to join once they are educated about the realities of the field, or discover a societal need that they can fulfill through this work. Similarly, the commentary from the women on the *Tech: More Than Coding* panel validates the existence of non-Development focused occupational opportunities and that technical occupations that require one to utilize a diverse set of skills, in addition to their computer science expertise, can and do exist in the tech space.

The career paths detailed by the women I spoke to at the *Find The Job That Is Right For You* panel also provide relevant information. Instead of moving into a different industry, these women changed technical roles and were momentarily fulfilled. However, they had not given up on technology as of yet and were brainstorming internal career moves that would bring them the social interaction and societal impact they desired. They, therefore, exhibit a desire outlined in

the research of previous scholars: that when it comes to their occupations, women desire social interaction and societal impact.

## VI. Interviews: *A Piece of this World*

In order to gain more specific information about the experiences, perspectives, and perceptions of women in the technology sector, I conducted interviews with four women who have worked in entry-level positions—ones that require less than 5 years of experience—that utilize some knowledge of topics in computer science or information technology.

### *Prominent Themes & Notable Trends*

One of the first things I asked my research participants to talk about was the journey through which they came to see computer science as an academic or occupational interest. Similar to what was mentioned in the literature, most of the women I spoke to described having very little exposure to computer science topics, or technological development generally, before the experience that motivated them to study computer science.

### *Getting Into Computer Science*

Although all of the women I interviewed had prior experience working with computers, and some had even taken computer classes as part of their grade school education, these classes never exposed them to fundamental computer science topics like coding or algorithmic design. Rather, they focused on teaching them how to use popular software, like Powerpoint, or developing their design skills through online tutorials. Consequently, all of the women who shared this experience said that they lacked an understanding of what computer science was, and what it was used for, during this time. Some interviewees, however, could recall there being a computer science club at their high school but recalled being deterred from interacting with the organization because of the seemingly ‘esoteric’ nature of the group. As one interviewee put it,

*“There was a CS program at my high school, but it was very, like, esoteric. It felt like a very impenetrable space, so I was never like, ‘ya, I wanna go do that...’ It just was not a very inviting vibe at all. So I was just like, ‘Ya, computer science? Not for me.”* In particular, interviewees cited there being a large number of males involved in these groups. Moreover, they noted that the people involved in these groups seemed rather standoffish and not open to educating or recruiting non-members, *“They never really came off as willing to explain anything... There was no outreach at all in that way, it was just like.. If you sort of have this independent interest in computers, enough to just insert yourself into this space, then you could be [in it]...”* This combined with the regimented nature of K-12 schooling made the prospect of joining these groups seem unappealing and impracticable, as there were other activities that appeared to be more open to accepting new members and applicable to their interests.

In contrast, when asked what motivated them to try computer science, all of the women who shared the aforementioned experience noted being motivated by a necessity or requirement, such as needing to fulfill a graduation requirement or needing some form of income. In the case of the former, interviewees also mentioned feeling as if they were freer to try new things in their new environment, and were even encouraged to do so—*“In high school, it didn’t really seem feasible to try new things, whereas in college it seemed like something you could do”*—and in that of the latter, they emphasized that seeing the successes of those with experiences similar to that of their own motivated them to finally give the discipline a try—*“[I attended a demo day for the coding bootcamp and] I thought their projects were really cool’ and they made it seem like ‘girl you can learn this.’ And I was like ‘I had no idea that I could do this. Now I’ll have a job,’ and they were paying me really well [too].”* From there, after learning more about what

computer science was, they found the discipline both challenging and exciting. As one woman reminisced:

*I liked the teamwork. I liked that we got to work together and no one was competing with one another... I also liked [that] it's kind of like a one-man thing, like it's just you and your computer... and sometimes it'll take you like one try and you'll figure it out. And sometimes it'll take you a hundred tries and you'll figure it out. So it was challenging but also fun because when you finally got something to work, it was like 'finally!'... And I also like the designing aspect too. A lot of people don't like it, some people just like coding and making things work. But I like making things look pretty too. So that's another thing.*

Contrary to their previous beliefs, and despite their initial hesitations, they actually liked computer science. When pressed as to why, they talked about how much they enjoyed problem-solving and being able to create something that has a function:

*I love the concept that I can make something out of nothing. I really enjoy just like having a finished product that I built, and I like seeing it work, and I like tinkering with it too. I like to debug things. I like to figure out what's wrong with them and fix them...*

They also talked about appreciating the deterministic nature of their assignments, and how there is measurable progress to observe throughout:

*I think computer science is really fun. I really like solving problems, or puzzles... and I think that CS is, at its nature, kind of solving problems... I like that it seems like you're able to readily measure progress, or like there's a feedback loop, I guess, with the work that you're doing, because you're debugging when you get certain sections working. There are measurable things you are doing.*

As young girls, the women I interviewed were taught neither the value of Computer Science nor any of the fundamental topics that characterize the discipline. Although they knew what computers were, and used them to complete various school assignments, or browse the

internet, their exposure to computing was surface level at best. Furthermore, the opportunities they did have to learn more about computer science were present in the form of small-scale clubs that were dominated by men, minimally advertised and lacking in effective recruiting efforts. This made joining these groups seemingly unappealing and implausible to anyone without background knowledge in the discipline—knowledge that was virtually out of reach if you lacked a connection to any wider computer science community.

These women were not educated about Computer Science at a young age. As a result, their trying and consequently choosing to study the topic came later—when they were encouraged, and in some cases recruited, to do so. It is thus likely that they would have enjoyed computing had they been encouraged to pursue the discipline when they were younger, as would other women if they were given the opportunity. But what about the women who were never given this support? As shown in previous studies, women who lack any exposure to the actual work being done in computer science are unlikely to consider it a discipline of interest. As a result, the population of women who have the experience necessary to work in technology is negatively affected. Yet this is only one factor shown to be impeding the growth of this population.

### *Why Get a Job in Technology?*

After establishing their initial interest in the field, each woman continued studying computer science until they finished their desired qualification. As they neared the end of their courses, however, things began to get complicated as they considered their post-graduation plans—and in particular their job prospects. All four women decided to use their computer

science knowledge by pursuing positions in the tech sector. Three of them became Software Engineers, whilst the fourth became an Analyst with a Software Development focus. Nevertheless, in looking for employment they all seemed to emphasize a number of similar considerations that factored into their job search.

Aside from their actually being qualified for those positions, the most common motivation for their choosing to move into the tech sector was the need for financial security and job stability. As described by one interviewee:

*When I was applying for jobs, I was looking at, 1—What I was qualified to do, 2—what that would look like on my resume [and] 3—how stable of a job that would be. And so combining all of those things CS was a financially sound choice... And so I was like, I'm maybe not gonna code forever, but I think right now, going into coding is like the best choice for me.*

In particular, participants articulated that these job offers included benefits and perks that were very appealing—namely the ability to work from home, an adequate salary, and acceptable work-life balance—and fit the lifestyle they desired for themselves after school:

*It seemed like the job that made sense outside of college... It is a good career. It does pay well enough for me to live the way I want to live. The hours aren't insane, it's like a good lifestyle fit for me.*

One participant also described societal pressure to get a “grown up,” or professional job bearing some influence on their decisions during this transitional period, lamenting, “*I didn't want to go back to my old job... I wanted to change careers. I wanted to feel like I had a grown-up job. Like I feel like I'm getting old. I need to start getting my shit together...*”

This seemed to stem from personal doubts, as well as community expectations, “...*You know in the Hispanic community there are only like three careers, you know like if you’re a Doctor, a Lawyer, or an Engineer. Those are the only careers that matter.*”

Alongside the aforementioned personal and social benefits, these women also emphasized aspects of these positions that allowed them to work on something that would affect some sort of change:

*I like the company a lot. I think that it's doing an important thing. In particular, what we do is very time appropriate in terms of our political and social climate. I think that that combined with my passion for the industry our product is in, in general, is probably what's driving me towards working here and trying to make an excellent product.*

This is not to say that they thought their efforts would affect widespread societal impact, rather the women who cited this quality as appealing felt that they needed to be able to understand, and even see, that the work they did had a utility, and thus contributed to some common benefit—that someone found it useful. For one interviewee, in particular, the industry her company’s product contributed to was one of deep importance to her, and she thus referenced her enthusiasm for the product as a huge motivator for her wanting to do her current role, as well as her continued satisfaction in it:

*I felt very strongly that i wanted to work on a product that I felt that, one, was not destroying the world, and two [was] something that I genuinely care about the quality of... I don't feel like I would enjoy my job as much if I didn't feel like I liked my product. If I was just working on whatever, I feel like I would be pretty unhappy.*

This quality is similar to one that was highlighted as a facet of computer science these women enjoyed; the ability to create something with a purpose was something they had

experienced and appreciated about the subject during school, and resultantly decided they wanted to continue to experience in their subsequent occupations. This follows from the research conducted by other scholars, as an interest in the physical work, in addition to the perception that their work results in their helping others, has been noted as a salient concern when women evaluate possible careers. That being said, it also incorporates some of the more recent changes that make this sector more unique, in that benefits, such as increased time flexibility and high monetary return, in conjunction with job security, were their main motivations for searching for and accepting these positions.

Having said that, it's also important to note that although they considered the aforementioned benefits of this type of employment, they also underscored the extent to which they considered whatever position they took as one of a temporary and even trial nature. In short, they were not expecting to start their dream job immediately after school—and in most cases, they were not even expecting to start in their ideal career:

*[I was looking] mostly not [for] work where I was like 'the mission of this work is really interesting', but where I thought 'this company does a useful thing and I think it's a good fit for my skills.' I wasn't looking for a job I'd be in for decades. I knew this would be my first job and I'd probably get another job, so I honestly was not hugely picky because of that.*

Although they found both the utility and the work interesting to some degree, the women I spoke to described their choosing to work in technology as one based more on ability and stability, rather than a passion for the work. As one commented, *"I think that for coding or CS, it can be really challenging to find a product that inspires you... I kinda threw that concept aside... Instead, I tried to find an environment that was inspiring to me."* They were then further allured

by the positive aspects of their individualized workplaces and in particular the prevalence of mentorship and other occupational supports, as well as an environment that was cognizant of gender bias and where, in some cases, employees actively talked about gender inequality. Inspiring, and therefore desirable workplaces were hence described as places where the employees were encouraged to ask questions about concepts they were unfamiliar with, or for help completing tasks for work assignments.

In following with their initial feelings, the women who described their workplace as having these qualities underscored the impact this had on their occupational satisfaction, as well as their fear of being able to find a similar environment should they choose to leave. As one woman put it:

*I think within my company there is very much an air of, 'ask questions about what you don't know,' which I absolutely love. Like, we do encourage people to learn [and] I'm totally happy to, like, ask what things are.. But that does not at all seem to be the atmosphere outside of my company.*

In particular, the ability to have discussions centered around gender bias was not present in all of the women's workplaces, but the women whose companies did really accentuated the salience of this one phenomenon. One even went as far as to say:

*I don't think I would be working for the company I am currently working for if I didn't feel like they valued... trying to remove bias from the hiring process... and things like meetings. I feel like people are very aware. We're able to have open conversations about [bias], and I'm able to be like hey 'it wasn't really cool the way you talked over me at the meeting' and they'll be receptive to it, and I feel like we're in a good place...*

Surprisingly, I only heard one form of exclusionary workplace criteria throughout my interviews and that concerned cultural fit. Of the women I spoke to, two of them expressed a desire to find a role in an environment that was not intensely technology focused. As one of them put it:

*I knew I wanted to go into tech by the time I went into my senior year... But I ruled out a big section of jobs by knowing that I didn't want to go to Silicon Valley. It was not a culture that seemed attractive to me at all. From what I knew about it, it just seemed very like, these people ate, slept and breathed tech, and [it was] also sort of clubby in that way, kind of exclusive, and I definitely felt like it was overwhelmingly white and male... I was very open to doing things that were not exclusively coding... I like computer science, but I wouldn't call it my passion. It's something that I'm good at and enjoy, and I didn't want to be in an environment where it was going to be expected to be my passion*

Although they had never actually been to, and thus worked in, Silicon Valley before conducting their job search, both women articulated concerns with the intense tech culture of the area. But this did not mean that they thought of themselves as unqualified, unprepared or unable to do the work. On the contrary, they ruled out considering these opportunities before even evaluating their fitness for these positions.

This presents an interesting dilemma which also corroborates findings expressed in previous studies. Although none of the women explicitly used the terms geek, the images they had created of intense workplaces where employees were expected to “eat and sleep tech,” whilst also proposing a “clubby” social environment are in line with those classifications. However,

this is despite their having studied and worked in computing. These women see a place for women in the tech sector generally but believe that there are some spaces that are too focused on technology, and do not contain enough diverse social interaction to be appealing. Consequently, they do not deny that women can and do have an aptitude for computer science but maintain that, like that of people in any industry, there are environments and roles that one may find more suitable depending on their preferences and desires.

In the opinions of the women I spoke to, environments believed to cultivate positive social interactions, like mentorship and community support, as well as constructive dialogue that encompasses more than one's technical know-how, were deemed acceptable workplace environments, and thus worthy of consideration during their job search. It thus follows that other women would have similar preferences and concerns when evaluating their job options, and consequently result in similar occupational conclusions, or in some cases make a decision that removes them from the tech sector entirely.

### *Career Goals & Observations*

After inquiring about their professional and academic path into the tech sector, I asked each interviewee to characterize their career goals from then on. Not surprisingly, the majority of them did not know where they saw themselves going next, although they had all considered it to some degree. Consequently, in response to my questioning, I was presented with a laundry list of professions or activities they were considering, and that they themselves described as ranging in feasibility and likelihood. There were, however, some common threads, and even occupations, present among the group.

All of the women I interviewed expressed some interest in going into the legal or medical profession. They referenced admiring the ability to interact with and help people, along with the opportunity to use their problem-solving skills to take on interesting challenges, as key motivators for their interest. A common occupation referenced that would allow them to remain in the technology sector was Product Management—a role that requires one to communicate effectively between customers and Developers in order to design and manage an effective product. That being said, it was referenced as more of a transitional occupation that would bring them closer to doing work that was more social and helpful in nature, rather than an exciting and desirable career path.

Similar to that of their common occupational considerations, the women I interviewed also outlined somewhat identical reasons for wanting to leave the tech sector—a lack of passion for the work; they like it, but not enough to stay long-term. However, the narrative that they lacked drive for this work was presented in a couple of different ways. In the case of one participant, she saw her interests as more interdisciplinary than what occupations in technology could provide her, and as a result, wanted to do something that had ‘more of an impact,’ saying, *“A lot of the startups or tech companies, the things that they’re doing, not that they don’t have an impact, but they just don’t have an impact in the way that I imagined they’d have an impact...”* Likewise, in the case of another, she viewed her skills as applicable for the profession, but thought her current work was not the best utilization of her talents; accordingly, she thought someone else would be a better fit for her position, contending:

*I don't think I'm the best possible fit for my job right now. I think there are definitely people who could do my job better... and I also think it's not the best utilization of what I'm good at and sort of the kinds of skills I have. And so it's a great fit in many ways but I feel like it's not a perfect fit, and that's something that makes me sort of want to find something that seems like a better fit in both of those ways.*

Notably, although these women expressed dissatisfaction with their current positions, as well as some level of desire to move on to something outside of tech, they were more frustrated by the limits of the work, rather than the duties themselves. They enjoyed the key components of the tasks—how it is challenging and requires them to utilize their creativity and problem-solving skills—but found that it did not have enough of that. This, in conjunction with the feeling that their work lacked a meaningful enough purpose, made them certain of their need to eventually continue elsewhere. It is therefore not surprising that the specified occupations were referenced by the majority of participants as possible career paths, seeing as the roles in question incorporate all of those skills, whilst providing clear societal effects. Nevertheless, these women were not considering quitting anytime soon. Recognizing that they were still in the early stages of their careers, as well as how recently they had transitioned into the workforce, they were content to stay in their current positions a little while longer (6 months-2 years), whilst they prepared for the next steps in their lives.

The tendency to articulate a variety of passions, as well as show an interest in a variety of different careers, also corroborates findings observed in the preceding research. It is therefore not surprising that these women would, and have, considered moving away from the tech sector in favor of a community whose work encapsulates all of their occupational desires. Yet, the main grievance these women have with these occupations is a lack of passion for the work that stems

from their producing an insufficient amount of societal good. If this were to change, it's likely that their departure from the industry could be prevented.

### *Descriptions of the Computer Science Community*

From there, I moved on to asking each woman to articulate their understanding of the computer science community as a whole: *How would they describe it? Who does it encompass and who do they think is included and involved?* These questions were intentionally vague so that each interviewee's interpretation of them, and thereby their answer, would be unique to their perspective. Although this made them somewhat harder to answer, it allowed me to get a more thorough understanding of what they understood the computer science community to be. In response to my inquiries, however, I was presented with a number of key themes across interviews that described the community as moderately amorphous in terms of membership, occupations, and utility. In fact, they were hesitant to delineate any sort of specific limitations on the field and thus its constituents.

The responses I got to my main question—*What is the computer science community?*—were varied in narrative but articulated the same sentiments. Broadly, each woman maintained that the primary characteristic that defines the group is a fascination with innovation and efficiency. As one woman put it, *"I think everyone that is [involved in the tech community], they just want to know more. Like how can we make this more innovative? How can we make this more new, and futuristic?"* This yearning to innovate and create is then applied to any and all areas of life as community members utilize their prolific thinking to establish "better" ways of doing things in an attempt to change the way we function as a society. But that does not mean the

people involved know where things are going; in fact, this uncertainty is part of what makes this work appealing. As articulated by one respondent:

*I think the ways technology can totally change how I think about parts of life, that's something the tech community is really interested in. I think it's also really interested in the pace of growth. Tech changes much faster now than it did before, and I think a lot of [the people involved] are really excited by that and are really interested in what it could become, and the fact that we almost don't know where it's going.*

When asked to describe who they think is included in their definition of the Computer Science community, the women I spoke to gave similarly open-ended descriptions. They again stipulated motive and action as the main determinant for one's inclusion but made sure to emphasize the extent to which accomplishments or seniority were excluded from their rationale. Furthermore, they specified self-identification as another key facet of who is and is not included in this group, thereby recognizing one's personal feeling of acceptance as another indicator of one's inclusion.

As one woman responded:

*I think people who want to know what's happening in tech constitute the tech community. I think it's a little self-determining in that way, like if you feel like you are part of the tech community, the tech community is something you want to learn about, and want to be involved in, then you're already a part of it. And there is sort of like that exclusivity in play, where you can often feel like you're not a part of it, but I think if you want to be in it, if you are involved, you are a part of it... I think it's that involvement that is key.*

Another actually articulated her discomfort with attempting to segregate in this way, saying:

*I think it's like really anyone who wants to identify themselves that way. Like I don't think there should be a gatekeeper... because there is so much diversity and variety with what you can do with it that it shouldn't really matter. It seems kind of like arbitrary, like who would determine who is and who isn't.*

Having said that, my participants' hesitance to articulate any specific distinctions was most apparent when I asked them who they thought could be called a Computer Scientist, and what roles they thought would classify someone as a Computer Scientist or Technologist. In answering my question, they again specified classifications that emphasized one's motivations and conduct but went on to stipulate a lack of any temporal thresholds, providing answers like:

*I think that anyone that has some sort of passion for it, and does some sort of work in it—whether it's always coding, or just like sometimes coding to implement a specific thing, but they also do other things... can be called a Computer Scientist. And that's anywhere from just coding, to doing research, to... just doing coding sometimes for your job... [I think it's] someone that sees a problem, then thinks of a coding solution to it [with] a Computer Science approach to it...*

In answering this question, one woman actually mentioned the Grace Hopper Conference as an event that really opened her eyes to the vast array of occupations and applications available for someone with an interest in computing, as well as the wide variety of backgrounds that can make going into technology a viable and appealing option, sharing:

*Going to Grace Hopper was particularly eye-opening because... [it showed me that] technologists can be... teachers who taught themselves how to code and use it in their classroom, or technologists can be librarians who built python libraries to make their jobs easier, or they can be just like random people... People who were in prison, and learned how to code while they were in prison and then got out and became freelance developers. Like it's not just people who did the traditional route of, go to college, get your 4-year degree, go into industry, or grad school, it's definitely way bigger than that...*

That being said, when asked they were all able to specify a set of roles in the tech sector they believed were most commonly held by Computer Scientists, and the majority of these roles did tend to be more traditional in nature—focusing on Development rather than user experience or design. However, they continued to affirm the different duties associated with each role, and thus the variety of work available in the industry. As one interviewee declared:

*It depends what they like to do cause you can literally do anything. You can be a Graphic Designer. You can be a Data Analyst. You can be a Systems Analyst. You can be like a Back-end Developer. You can be like the UX/UI designer. You can do both things...You can pretty much do anything.*

For them, this variety signaled the versatile nature of the discipline and thus its ability to be applicable to a wealth of people with differing interests, by providing everyone the opportunity to do the role most favorable to them.

It's clear from their responses that these women's understandings of the computer science community are multifaceted, to say the least. Instead of presenting one singular image of what a Computer Scientist or Technologist is or does—like that of what researchers have previously received through similar studies—their definitions lacked this strictness. By their descriptions, Computer Scientists were not just non-social men who enjoyed coding but were people from all walks of life who shared a common interest: innovation, no matter the way in which they intend

to create. This is despite their being continually immersed in work environments that are dominated by men. They thus see themselves as part of a community that has the potential to connect an abundance of diverse people and are somewhat hopeful that this will become true at some point in the future. Noticeably, their hesitancy to vocalize restrictions in their definitions stems from their own experiences as a minority in tech, as well as their knowledge of and experience with the esoteric personas those in the community are known for putting on. They wanted to make it as clear as possible that the tech sector is a place for anyone who wants to do the work, and that there are countless resources available for those who are interested but do not know where to start. Similarly, the list of roles they referenced can thus be interpreted as a reflection of the current state of the technology sector, and it's slowly progressing to encompass roles that are wider in scope. This is verified by their continuing to reiterate the range of work available outside of the most common titles.

### *Experiences with Identity*

At the end of each interview, I gave each participant the opportunity to discuss any notable experiences they have had whilst interacting with others in the computer science community, where they thought their identities may have influenced the way things transpired. Unsurprisingly, the prevalence of gender dynamics was noted to varying degrees by my interviewees, as well as the interaction of gender and other identities.

Although each woman was able to discuss instances where they felt their gender had an influence on the course of events, they did so in varying ways. In instances where the interactions were more superficial in nature—like a momentary interaction with a peer or online

interaction with a colleague—the discrimination was direct and explicit. As one of the described:

*Like [when] I go and visit someone I know who works at Google and [their colleagues are] like ‘oh, what do you do? Are you in marketing or something?’ Like they don't think that I'm a coder, I guess, just from my appearance, because I like to dress up and I like to wear makeup, and I guess I don't [look like your typical coder].*

For this woman, in particular, experiences like this were common in her interactions with male clients and peers, so much so that she started using gender neutral identifiers throughout her electronic interactions and confidently defended doing so saying:

*I only have gender-neutral usernames, because I don't like to invite any extra bias into the equation, [and] I sign my emails [with my initials] for the same reason, because I do a lot of contracts with third party companies, and I noticed that I get treated a lot better if I sign my emails [that way] instead of [my first name], so that's what I do now.*

Participants had a harder time, however, articulating the more implicit things they had experienced as a result of gender dynamics. As another woman articulated:

*The fact that it is such a male-dominated industry, I do think it does affect how we [women] do work. I wasn't mistreated, or I wasn't like harassed... But there was like this energy... the way that you'll be in a full room of men and... without them even realizing it, even if they're being nice to you—it has nothing to do with you being disrespected—but it's just that sometimes they give off this energy that like they want to intimidate you. Like they're not doing anything on purpose or anything, but it does come off [that way]...*

Though she could not quite characterize what she had experienced in meetings, conversations, and groups dominated by men, she recognized that the gender dynamics at play made her uncomfortable, even if her colleague's actions were not specifically designed to make her feel that way. She also went on to describe the specific way in which the men at her company would

talk to women in trying not to “hurt their feelings,” when in reality it just exasperated the situation, saying:

*It's just the way men speak to women. I don't know if it's just me, but I can sometimes tell that the way that they'll speak to you when they don't want to hurt your feelings type of thing... And it was because [maybe] they didn't want to seem like there was anything sexist going on—they wanted to be very cautious maybe... I don't know sometimes I think that they treat you—they just want to make sure that you don't cry. [They think] that you're sensitive so they just wanna be extra nice to you. And it's like, why can't you just talk to me like a person? Just tell me straight up, you know?*

One woman actually took this time to discuss the friction she had observed between women in technology and thus her discomfort with computer science groups that exclude men, saying:

*In my experience, I think that there are two large groups of females working in male-dominated environments. There are the females that group together, they try and lift each other up. Maybe they're cliquy, maybe they're not, but they're really all about working with and inspiring their female coworkers. And that can turn into or manifest in negative ways, of like cliqueness—like they don't want to interact or, they're not excluding but they just don't really wanna interact with other groups of people, in particular, the men in the larger group... . Then I think there is this other group of women who don't interact with the female community. They see what's happening there and they don't like that and so basically they become like a "bro" ... . And so I think that what that picture kind of paints is that there are only these two ways to be [a] successful [woman] in CS. It's like, either you have to find a strong community of women that can lift you up, or you have to fight and do it on your own. And I think the bad thing about the first one is that you're not really interacting with other communities, and also those spaces can intentionally or unintentionally become uninclusive [sic] of other groups of people. [And] the bad thing about the latter, of being a lone ranger, is that I think what can happen in that case is you can both pit yourself against other women who are doing the lone ranger thing, or other people can pit you against each other.*

As a racial minority, this same woman went on to articulate how her discomfort with these spaces may actually be because of there being dominated by white women, saying:

*[For people that may be a minority] racially, or religiously, or for whatever other reason, I think that seeing a group of white women is also as intimidating as seeing a group of white men. So I think that, in CS, and in fields in general, a lot of times these female spaces become white female spaces... And so I think that that has been one of my experiences, that the women groups can often be very white dominated, and so I think that that is part of the reason I might not feel as comfortable in them*

Although her commentary was unique among the group, it is still important to highlight. It shows that the remedy for inequality is not further exclusivity, in that the groups formed in an attempt to support those in the minority may in some cases do the opposite of that, thus further fracturing

a community that is already weak. Having articulated her discomfort with these groups, however, she still maintained that they have value, but was wary of the cost of their benefits.

### *Analysis & Conclusions*

Given these women's enthusiastic descriptions of the computer science community and technology industry, it's disappointing to hear that they are already intending to change professions after a short period of time. In their experiences, their impression of the computer science community, as one with endless opportunities for people with a variety of interests, has motivated them to enter it as a stable introductory profession, not a lasting career. However, they maintain that the tech sector is a good industry to be in and should thus be considered an ideal profession for other women, just not themselves. But what can their narratives, in conversation with other research, tell us about this population overall?

As we know, these women were not introduced to the intricacies of computer science until they were given the opportunity to study it as part of a larger program. The guidance and support they received throughout their first class, in combination with their enthusiasm for certain aspects of the work, is what prompted them to continue studying and eventually work in this field. It could thus be argued that the confidence gained through learning more about and working more in computing is what led them to consider working in technology a viable career choice. Furthermore, the more exposure they got to the community, and in particular its diverse workforce and variety of occupational options, the less rigid their definitions of the computer science community and who it encompasses became. As a result, they became more comfortable recognizing themselves as part of the community, thereby overcoming the stereotypes that often prevent women from giving the industry a try. Unfortunately, this is not an opportunity that is

shared by all women. The knowledge that has inspired these women to enter into this male-dominated field, learn its inner workings, and ultimately decide that it's not the space for them, remains to be made widespread. Consequently, the pool of women who can work in this industry continues to be limited by this phenomena. If more women were encouraged to learn about computer science it makes sense that a number of them might also be enticed by the technology industry's occupational stability and perks—similar to the experiences of my interviewees—but find the work being done in the industry appealing enough to stay long term, thereby increasing the number of women in this industry as time progresses. The women I interviewed wanted their work to have *more* of an impact, but not all women do. It thus follows that a wider pool of applicants and thus more women ingrained with accurate depictions of what doing computer science entails, would result in more women joining the field.

In terms of their occupational duties, the main grievances these women raised were a lack of sufficient social interaction and societal impact—or at least in the ways in which they wanted their professions to have. Consequently, one of two changes could result in their deciding to stay in the tech sector. For one thing, the way in which they interpret the value of their work could change; they could start to see the effects of their work on their clients as a sufficient source of social good. This could follow from a number of different events, like a company and thus product change, or a memorable interaction with a customer. In hopes of fulfilling their other desire, their work could evolve to incorporate more social interaction, whether that's with other technologists within their company, non-technical team members or the company's clientele. Notably, an occupational change of this sort could appease both of their crucial desires and was actually referenced as a contemplated career option by most of my interviewees in the form of

Product Management. Although participants were not convinced this role would satisfy their needs, it could be more effective in practice as they articulated their motivations for leaving technology as dissatisfaction with the occupations, rather than an explicit desire for something else in particular. It also follows that the types of positions these women would be more satisfied in do not currently exist, or are without commonly know titles. It is clear, however, that these women are looking for professions that challenge them to creatively develop solutions to problems that have an impact on people's lives, whilst requiring them to engage in social interactions to do so. If the tech sector had more positions like these, these women might be less likely to leave.

Although gender and racial dynamics and discrimination were not initially referenced as areas of displeasure in their current positions, it can not be denied that the identities of my interviewees have had some effect on their experiences in this community, and thus their work. They themselves described a negative cultural fit as their only exclusionary criteria and thus good cultural fit as the only requirement completely necessary to fulfill. Consequently, they all described some level of satisfaction with the social dynamics at play at their workplaces—though some were more satisfied than others. It, therefore, makes sense that these women did not reference workplace discrimination as a primary motivation for their wanting to leave the technology sector, as the dynamics they currently experience might not be perfect but are adequate. Nevertheless, this is not the case for all women as different people have different job search criteria and experiences and thus find themselves in dramatically different workplace environments where the amount and form of discrimination against minorities varies. We must

thus continue to educate people about the prevalence and effects of workplace discrimination in an attempt to improve the experiences of everyone in the workplace.

## VII. Conclusion

In this work, I have presented my research into how women in computing conceptualize the computer science community, as well as how that perception influences their desire to work in technology. Numerous women I encountered throughout my research underscored the wonders of computing and their delight with key facets of computer science work; they love that it engages one's problem-solving skills, is challenging, and allows them to create things that will help others. They maintained this positive perception of computing when describing the computer science community and technology sector, describing them as communities appropriate for a wide range of people and making sure to emphasize the wide variety of resources and opportunities available for someone interested in doing this work.

In the case of my interviewees, however, the journey through which they developed these sentiments was not uncomplicated. Without a sufficient amount of exposure to fundamental computer science topics and occupations during their youth, the women I interviewed did not gain a thorough understanding of what computer science was until they were required or recruited to do so. Nonetheless, their initial exposure blossomed into a passion, yet had this disposition remained uncultivated they would never have been interested in getting involved in the computer science community, let alone interview for and accept a job in the technology sector. Moreover, although my interviewees affirmed the aforementioned positive sentiments about computing, they insisted that these qualities were not enough to convince them to remain in the technology industry for more than a short period of time. They are unsatisfied with the minimal social interaction and explicit social impact this work elicits and, as a result, have

considered moving to other occupations that are known to incorporate these characteristics. Consequently, I raise two structural changes I think will help to increase the number of women who go into and stay in technology: educating more women on the structure and value of computer science, thereby encouraging them to give the discipline a try, and evolving traditional Developer roles to incorporate more social interaction and thoughtful design strategies.

After analyzing the data from my interviews, as well as the notes for my ethnography, it became clear that the various stereotypes and stigmas surrounding computer science work, and thereby those who work in technology, were major factors in the discouragement of women from getting involved in computing, and thus working in technology. Likewise, the amount of interest in non-traditional technology roles displayed by women at the Grace Hopper Conference, in conjunction with the sentiments broached by my interviewees about their lack of satisfaction with the jobs available in the technology sector, suggests that the way in which technology occupations are currently structured may present another problem. The changes I have proposed would fix this, however, in that educating more women about what computer science actually is as well as encouraging them to give it a try, would limit the uncertainty surrounding the subject, and thus any perceptions stemming from the prevalence of the geek culture mythology.

Additionally, evolving technology roles in the way that I have described would result in the people who take on these positions having more opportunities for social interaction and explicit knowledge of their social impact—the exact experiences requested by the women who expressed dissatisfaction with current technology roles.

Fortunately, changes like that which I have proposed are, to some extent, already going into effect. In recent years, numerous programs have been developed to encourage more women to get involved in computing, and technology companies have also partnered with organizations like the Anita Borg Institute to support the growth of women in the field, or change their policies so that they are more in tune with the needs of female employees. Consequently, the type of student who is encouraged to learn about computer science is broadening to include everyone and anyone who has access to the resources to do so, especially as more people realize the far-reaching effects of technological innovations. Similarly, the fact that non-traditional roles like Product Management and User Experience Designer currently exist shows that technology roles that incorporate more social interaction and user-centered design strategies are emerging; therefore, I am hopeful that there will be an increase in women entering the computer science community and technology sector in the near future.

Aside from my main findings and argument, I would also like to point out some of the other information I discovered during my research, and in particular, the remarks made by the women I studied about the accessibility of computer science tools, as well as their struggles in the workplace. Although computer science and thereby computing continues to be perceived as an esoteric subject and activity, it does not have to be. As mentioned repeatedly by the women I observed and interviewed for my research, anyone and everyone can get involved in computer science, regardless of their educational background or previous experiences. Moreover, the tools one needs to get involved in this community, and even get a job in technology, are available online, free of charge. *If you have an interest in computing, do not let the current racial and gender distribution of the technology industry deter you.* Having said that, if you are already

working in, or are interested in working in the technology sector and feel as if you need more guidance or support than you are currently receiving, follow the advice of the various panelists at the Grace Hopper Conference and try and find a mentor. Mentorship arrangements were noted as beneficial relationships on multiple occasions during my time at Grace Hopper, and for good reasons; mentors provide their mentees with valuable support and encouragement that often allows them to successfully reach perceivably unattainable goals, or in the least make an isolating occupational environment appear less daunting—which is often the case for women working in male-dominated spaces. If you feel you would benefit greatly from support like that, try reaching out to someone you feel comfortable with or admire in hopes of forming this type of bond.

Lastly, I would also like to acknowledge the narrow focus of my work. As is what usually happens during qualitative forms of research, each participant also talked about a number of other ideas, experiences and observations they thought were relevant to my study, but were not incorporated for one reason or another. Similarly, social phenomena surrounding a certain identity do not occur in isolation from other identities. Consequently, although I have done my best to address all of the social phenomena I have unearthed that pertain to my specific research questions, I would like to acknowledge the narrow scope of this piece—as well as thank the women who took the time to open up to me about their perspectives and experiences—and encourage other researchers to utilize the observations I have made to research these occurrences even more thoroughly, as well as on different axes of identity. It is also important to note that I did not discuss every negative social aspect of being a woman or minority in a field dominated by white men. Although the uncomfortable or discriminatory social interactions that women and

minorities experience in technology are extremely important to highlight, doing so requires a vast amount of care. As a result, I did not feel as if this work allowed me the time or space to analyze all of these phenomena as effectively as necessary. It is thus vital that we remember the prevalence of these encounters on the experiences of women and minorities working in technology, and thereby view the conclusions made through my research as an aside to them.

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