The Gender Gap in STEM and Computer Science Jobs:

A Study Investigating Job Abandonment Rates of Women in Computer Science

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Abstract

The purpose of this phenomenological qualitative research study was to investigate the experiences of women in the field of computer science to gain a better understanding of the obstacles that prevent them from enjoying lengthy successful careers in the field. This research study sample represented 10 women from various parts of the country holding many titles but sharing the common denominator of working in the field of computer science. Women participating in this study provided valuable insight into the challenges that many women face within the field of computer science and STEM as a whole. Atkinson's Expectancy Value Theory (EVT) served as the theoretical basis for this study. Data was gathered by way of personal interviews that were conducted by phone. As a result of these interviews five major themes were developed: (a) Role models, (b) Mentoring, (c) Training opportunities, (d) Lack of support, and (e) Sexual harassment. Mentoring was suggested as a recommendation for practice. Recommendations for future research included (a) an ethnographic study following girls and women over a progressive period of time to better understand how developmental experiences impact decisions to pursue STEM fields, (b) a qualitative study to explore schools and universities who have achieved success in STEM programs for girls and women to understand the nuances involved in creating diverse programs, and (c) a qualitative study involving the families of successful women in STEM to better understand their perceptions and the roles they played in providing support.

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Chapter 1: Introduction

Before, during and after the great recession the entry of women into the United States labor force drastically reduced shortages in labor. According to the Bureau of Labor Statistics (BLS, 2017) women began entering the labor force as early as the 1960s, with the largest proportion entering leading up into 2000. With many baby boomers helping to account for these increases, as of 2017 there were 74.6 million women in the United States (U.S.) workforce, accounting for 47% of the total workforce. The BLS projects that women will account for 77.2 million in 2024 for a 47.2 percent share. It is projected that the gender gap will continue to narrow. Population experts expect it to drop as low as 5.6 % by the year of 2024 (BLS, 2017).

While the number of women entering the workforce continues to bolster creating less of a gender gap, women continue to be relegated to select occupations (BLS, 2017). Dating back to 1964, these occupations generally consist of work in the fields of trade, transportation, and utilities and has increased from 20 million to roughly 80 million. With the burgeoning need for skilled workers in fields related to Science, Technology, Engineering and Math (STEM), the Committee on Maximizing the Potential of Women in Academic Science and Engineering and the Committee on Science, Engineering, and Public Policy report that the number of women seeking degrees in these fields began to increase significantly in the late 1970s increasing between two and ten times (Sassler, Michelmore, and Smith, 2017).

Although tremendous efforts have been made over the past 50 years to increase the representation of women in STEM jobs, numbers have fallen off steeply with less than 22% (BLS, 2017) remaining in the STEM jobs after pursuing degrees. Through efforts to increase the number of women in computer science, at least three billion dollars was raised to help encourage girls to study computer science (Kamberi, 2017). Despite the money and effort, women continue

to be underrepresented in the field of computer science (Kamberi, 2017, p.1). Data from the National Science Foundation (NSF) and Engineers Statistical Data System (SESTAT) confirms that between the years of 1995 and 2008, women holding degrees in computer science were 14% less likely to enter STEM jobs than men (Sassler et al., 2017). Even when family dynamics and demographics were taken into consideration, the gender gap persisted.

The importance of closing the gap between the numbers of men and women who pursue and stay the course in STEM jobs cannot be over emphasized and is critical to our nation's ability to thrive. The Department of Commerce (2017) emphasized that STEM workers drive our nation's innovation and competitiveness. Knowledge gained in these fields is transferrable and has the ability to generate new ideas and growth that will be critical not only to the economy, but also in stabilizing and improving our nation's infrastructure.

James Brown the director of the STEM Education Coalition in Washington D.C. asserts that the future of the economy lies in STEM. Data provided by the BLS supports this assertion by confirming that STEM jobs are expected to grow more than 9 million between 2012 and 2022 (BLS, 2014). This would be an overall increase of 1 million jobs.

Statement of the Problem

There are significant shortages of experienced women in computer science jobs in the United States. Despite the efforts of various state-level programs dating back to the 1950s designed to address the STEM crisis, the United States continues to lag behind other countries who excel in STEM. Even with notable increases in both education and skills levels, very few overall gains have been made (Mansfield, Welton, & Grogan, 2014). These gaps play a pivotal role in helping the U.S. remain competitive (Mansfield et al., 2014). If these jobs are not filled at the national level, the demand for labor will drive wages down, potentially triggering an

economic crisis (Sassler et al., 2017). One possible cause for this problem is the lack of support that women receive while pursuing their formal education and transitioning into technology jobs. In a recent study investigating the value of access to mentors for women in STEM professions, Hernandez et al. (2017) reported that access to informal groups of faculty mentors promoted stronger identification and greater motivation; both factors have contributed to long-term persistence and achievement outcomes. A qualitative study involving the use of a case study approach would be useful to investigate this phenomenon. Using John William Atkinson's Expectancy Value Theory (EVT), this study explored the relationship between the expectations of women entering technology jobs versus the actual outcomes in terms of job satisfaction and their willingness to remain in the field. This study is critical in providing information that will help technology leaders understand how supportive networks for women can increase retention rates. Women between the ages of 22 and 35 were investigated to obtain a greater understanding of circumstances that may impact newly graduated women and those starting families.

Purpose of the Study

The purpose of this qualitative phenomenological case study was to investigate the experiences of women between the ages of 22 and 35 who have overcome barriers that often prevent women from making long-term careers of their education in computer science. According to Sassler et al. (2017), women continue to be underrepresented in the field of computer science and are more likely to depart the field within two years of graduation.

Data was collected related to background, educational experiences, mentoring experiences, EVT intrinsic values, and success expectancy. Data gleaned from interviews provided researchers with an opportunity to understand the lived experiences that encourage women to persist. This study used EVT to demonstrate how individual beliefs regarding the

ability to succeed at a given task impacts long-term success (Wigfield & Cabria, 2010). Methods of inquiry for this study included interviews with 10 participants. All interviews were conducted via telephone. Participation was limited to women with formal education in computer science and those having tenure in the field of computer science within the last 10 years.

Conceptual Framework

The conceptual basis for this study was EVT. EVT is built upon two constructs. The first most basic construct is based upon an individual's persistence and motivation to succeed (Ball, Huang, Cotton, & Rikard, 2017). This construct taps into individual beliefs about the ability to succeed. The second construct is based upon task values. The level of value that individuals place on a particular activity or choice influences their likelihood for success (Ball et al., 2017). Accordingly, the values associated with different tasks can impact individual success rates.

It is important to understand how expectancies and values impact the choices that women make in the field of computer science due largely in part to barriers that have prevented women from entering STEM jobs (Sassler et al., 2017). These lingering barriers and biases may contribute to the expectancy for success and value that women place on their jobs. For example, working in a position that has traditionally been considered masculine work can place undue hardship on a woman who may be struggling to fit in and find respect among her peers. Furthermore, it is important to understand the factors surrounding the assimilation of women into masculine jobs and the support systems needed to help women achieve success. The value that women place on these positions is subjective based upon the environment and support systems.

Ball et al. (2017) define the sub-constructs as value attainment, intrinsic value, utility and cost. Value attainment relates to how important an activity is to an individual, while intrinsic value defines the level of interest and enjoyment that comes with a task. Intrinsic value is very

much linked to defining when and why individuals persist for longer durations where various tasks are concerned. Utility defines the usefulness of a task to an individual and how it relates to desired outcomes. Finally, cost refers to time that an individual might be working on other activities as it relates to long-term goals and stem career choices (Wang & Degol, 2013).

Where career choices and factors related to the STEM pipe line are concerned, research suggests that attitudes influence selection and future career options (Ball et al., 2017). For example, students who believe that STEM related studies offer a good opportunity to secure STEM jobs, are more likely to have positive attitudes and to display interest in those areas. EVT therefore, may explain why women decide to pursue computer science jobs, but may also explain why women abandon computer science jobs in the absence of systems that redefine and support their expectations to be successful.

By exploring the perceptions of women in relation to EVT, this study provided a useful foundation for determining how women can be better supported and have lengthy careers in the field of computer science. Data gleaned from this study was also useful in revealing ways that women can be more supportive of one another and potentially become mentoring and support systems for other women.

Research suggests that student attitudes play a large role in determining which courses they select. Anderson and Ward (2013) have used EVT models and concepts to evaluate the choices of different groups of teens and to explain why some choose STEM courses while others do not. These tools have also been used to evaluate various groups of elementary students. Many of these studies have shown a positive relationship between students in computing courses and long-term choices.

EVT is a useful tool in evaluating attitudes and outcomes where computer intervention is concerned. It can also be used as a framework for understanding why individuals make choices for or against STEM jobs and provide more detailed information. Finally, EVT offers an opportunity to investigate future factors that may attract or deter potential candidates.

Nature of the Study

This qualitative case study research examined the experiences of women between the ages of 22 and 35 who work in the field of computer science. This age range was selected because its representation of newly graduated employees as well as those with more experience with the goal of gleaning knowledge from various generations. The case study approach was used as a method of inquiry to understand the unique experiences of women transitioning into computer science jobs after college. The case study approach allowed researchers to conduct in-depth analysis of the events, processes and activities unique to this group and to study them based upon specific periods of time (Creswell, 2014). Yin (2013) describes the case study approach as a good-fit when the researcher needs to investigate and retain the holistic and meaningful characteristics of real-life events. Case studies most often arise out of the desire to understand complex social phenomena (Yin, 2013). An explanatory case study approach was used in this evaluation. According to Yin (2013), an explanatory approach is most useful when operational links need to be traced over time versus infrequent occurrences.

This qualitative study involved interviews with 10 women between the ages of 22 and 35. An open-ended question format was used to address the research questions designed for this study. Questions were presented in a manner that allowed the candidates to more extensively share background and contextual information through rich detailed answers. This one-on-one format provided a greater opportunity to explore and share in the participants lived experiences.

QDA Miner Lite was used to provide meaning to the data by first coding and then producing themes and interpretations that helped explain theories associated with this phenomenon.

Research Questions

The following case study research questions were used to explore the experiences of women who obtained college degrees and progressed into computer science jobs. The questions that follow explored individual journeys from earning degrees to assimilation into computer jobs and job abandonment where appropriate. The primary questions addressed were "How do the lived-experiences of women within the age group of 22 and 35 impact decisions to maintain careers in the field of computer science? How have these experiences deterred women, possibly contributing to greater job abandonment rates versus their male counterparts?"

RQ1. How do women between the ages of 22 and 35 describe their recruitment and onboarding experiences entering the field of computer science?

RQ2. How do women between the ages of 22 and 35 describe their developmental experiences to include support from management and peers?

RQ3. How do these experiences influence their decision to remain in the field long-term?

RQ4. Why do women abandon computer science jobs within the first few years of employment?

RQ5. How do women between the ages of 22 and 35 describe their decision-making experiences relative to work with various agencies?

Significance of the Study

STEM jobs are a vital aspect of how we live and provide support to every industry in one aspect or another. In the next ten years, STEM jobs are expected to double in the United States. If the United States does not position itself, other countries will surpass the United States both economically and technologically. The BLS (2017) has already made important projections

about how STEM jobs will be the leading jobs in innovation and growth. The absence of women in STEM jobs diminishes this nation's ability to generate innovative ideas, create cutting edge technology and to become leaders in technology.

Where education is concerned, it is vital that we continue to study and gain a better understanding about gender gaps in all areas, specifically in STEM jobs. Having limited diversity in the STEM workforce has negative implications for scientific innovation, creativity, and social relevance Hernandez et al. (2017). By continuing to study this phenomenon and increasing the availability of literature that adds to theory, future students will have the resources needed to advance these studies until the phenomenon is no longer valid.

By developing this study based upon the EVT framework, researchers have the ability to more adequately define and understand women's attitudes and perceptions about success expectancy and task value. This data will provide a benchmark for understanding how and why women choose jobs in computer science and also provide insight into why women abandon jobs in the field of computer science. Data from this study will help researchers, scholars, and employers understand how to promote and develop policies aimed at achieving diversity across programs.

Developing an understanding about mentoring can further the cause for women aspiring to work in the field of computer science and help researchers understand important implications regarding the future of technology. This information will also be vital to employers, universities and school programs. Furthermore, by gaining an understanding of the "lived" experience of participants, all parties will gain a broader understanding of why women choose to enter STEM jobs and how to be more impactful during the process.

Definitions of Key Terms

EVT – EVT is the belief that one will be successful in a given task (Ball et al., 2017).

Gender Gap – Observable differences between women and men and other characteristics surrounding employment such as pay, grade, and type of work (Leslie, Flaherty, & Dahm, 2017).

Self-efficacy – Bandura (1977) described the concept of self-efficacy as an individual's belief in their ability to perform and successfully complete a specific task (Brown, Concannon, Marx, Donaldson, & Black, 2016). The task may refer to a multitude of actions; for example, a student's lack of confidence in his or her abilities to do well on a physics test stems from low self-efficacy.

Mentorship – A developmental relationship between a more experienced person and a less experienced person where the mentor's aim is to support the protégé's professional development and socialization into the profession (Hernandez et al., 2017).

Summary

With expected growth of one million jobs within the next six years, the STEM industry is burgeoning. Unfortunately, the labor force is currently not prepared to handle this influx of jobs. In an industry where women were once highly-represented, the job abandonment rate is at an all-time high.

This qualitative case study was aimed at exploring the experiences of women in the field of computer science to gain a better understanding about the circumstances surrounding the job abandonment of women in computer science jobs. Through the use of a case study approach using one-on-one interviews, participants were afforded the opportunity to share their lived experiences and to provide personal insight into a highly pervasive issue. Guided by the theory of expectancy value, participants shared their expectations versus outcomes. Data from this study

will be used to inform students, practitioners, employers, educational institutions, the government and women considering entry into the field. Women will be better informed and provided with tools to assist in future decision-making and more clearly understand the role they play in assisting one another. Finally, this study will also help women understand how their own value systems align with their expectation for success and potentially change the way they view their current work and diversity programs.

Chapter 2: Review of the Literature

Whether tacit or explicit, Vitores and Gil-Juarez (2016) highlight the fact that not much has changed over the past decade in regard to women in the field of computing. Reporting a downward trend for women in computing, Vitores and Gil-Juarez (2016) challenge the notion that the gender gap has been closed or is near. Caroline C. Hayes (Hayes, 2010a, p. 27, by Vitores and Gil-Juarez, 2016) reports that if the trend were to continue at the rate experienced from 1986 to 2006, there will be no women bachelor's degree graduates in computer science by 2032.

The unfortunate reality of this statement is that as of 2014, women accounted for only 18% of degree holders in the field of computer science (National Center for Education Statistics [NCES], 2014), which represented a steep decline from the high point of 37.1% in 1984. We are reminded that running parallel to these shortages of women in the field of computer science is the need to bolster the number of college-level training in computer related fields (Sax et al., 2017). In the absence of drastic changes put forward to increase these numbers, the United States will be looked upon as a country once known to produce the most technological solutions, to one harvesting the least amount of resources.

From a resource standpoint, the United States has not positioned itself to make full use of its resources. According to research conducted by Lucena (NSB, 2015), the pipeline metaphor created by the NSF in the mid-80s was an attempt to project the number of scientists and engineers that would be needed in the future. Initial predictions identified future shortcomings in (white male) scientists and engineers sought to prepare policy makers for these impending shortages by encouraging educational institutions to create recruitment and retention programs that would attract women and minorities (Sax et al., 2017).

As a result of the government's absence of action to prevent this shortage of educated and skilled workers, the United States is at risk of losing its competitive advantage. Sax et al. (2017) predict further discourse as policy makers attempt to patch a drastically "leaky pipeline" and bridge the gap between (white, male, national citizens) and women and minorities. While Faulker (2004, p.3 by Sax et al., 2017) calls out the inability of the market to prove useful improving inclusion, Adam (2005, by Sax et al., 2017) argue that the real issue is society's denial of women's achievements and its unwillingness to consider the needs of women and other minorities, thus continually fostering exclusion.

Since it is difficult to completely account for periods where black women were largely represented in studies representing women in computer science jobs, this study focused on women in general with the understanding that the gender gap represents women as a whole. This study therefore, utilized data from studies where a distinction was not made regarding race/ethnicity.

In the Literature Review, an in depth look at ways in which women continue to be marginalized was conducted through the review of various articles detailing ways in which once male-dominated fields continue to operate in ways that perpetuate old stereotypes and the maltreatment of women. An exhaustive search was conducted with few returns. Due to the limited amount of literature available on this topic, saturation was achieved fairly early. Additional research would not improve the depth of this study.

Documentation

Research conducted for this study included search strategies using various search engines and databases. Some of these included Google Scholar, ScienceDirect®, ProQuest®, EBSCOhost®, and PsychINFO. Initial search strings included Women in STEM positions,

Underrepresentation of Women in STEM jobs, Gender Gap in STEM Jobs, Salary Gap in STEM Jobs, Computer Science in the Future, Future of Computer Science and Women, and Number of Women Currently in Computer Science Jobs.

Conceptual Framework

To better understand the lives of participants in this study, EVT was utilized as a basis for understanding the motivation of individuals participating in this study. Use of EVT as the focal point, created broader knowledge regarding individual beliefs about success and how those beliefs influenced career decisions. Additionally, EVT provided a glimpse into how specific stages of life experiences impact choices and the likelihood of success for participants.

Despite gains made in STEM education Wang and Degol (2013) contend that the size of the workforce continually fails to meet demand. It is therefore paramount to the success of these industries to gain an understanding about the factors contributing to the gap in the STEM workforce. The EVT framework is a well-developed tool for identifying various aspects surrounding STEM interests and how various sociocultural, contextual, biological, and psychological factors impact career choices.

John Atkinson (1957) believed to be the founder of EVT was first known for his work in motivational theories. Atkinson believed that it was impossible to put any theories of motivation into practice without first understanding two basic behavior issues (Atkinson, 1957). First, Atkinson knew that gaining an understanding of how individuals made choices among alternatives was most important. Second, he sought to understand the factors motivating individuals to remain on a given course over time, especially where difficulties were concerned (Atkinson, 1957). Atkinson asserts that individuals experience higher levels of aspiration when choosing among alternatives with varying levels of difficult outcomes. Where the level of vigor

is concerned, Atkinson states that strength of motivation is most commonly linked to expected outcomes. As a measure of attempting to understand this phenomenon, Atkinson's seminal work focused on the relationship between achievement motivation and risk-taking behavior.

Earlier studies such as those conducted by Tolman Ritter (Wang & Degol, 2013) suggest that performance is largely based upon individual perceptions about the ability to achieve based upon experiences. These beliefs are static until external or situational cues are introduced into the picture. Once this has taken place, only then will an individual be motivated to achieve based upon a standard or a performance measure. The strength of this performance can be measured by the expectancy of success (Wang & Degol, 2013).

Drawing upon Tolman and Ritter's concepts, Atkinson later described motive, expectancy and incentive as the three variables necessary to describe motivation and how individual choices are made. Atkinson's theory of motivation purported that the strength of motivation to perform an act is assumed to be a multiplicative function of the strength of the motive, the expectancy (subjective probability) that the act will have as a consequence and the attainment of an incentive, and the value of the incentive: Motivation = / (Motive X Expectancy X Incentive) (p.360, 1957). The underlying attractiveness of an incentive is the end result whether it presents itself as a reward or punishment. Either event can incentivize or disincentivize behavior.

These characteristics later became the basis for EVT. Atkinson (1957) later summarized EVT as the expectancy to succeed at a given task based upon the value of the task. When an individual their ability to succeed, their expectancy to succeed is high (Penk & Schipolowski, 2015). The value component consisting of attainment, intrinsic value, utility value and cost determine the level of importance, enjoyment, usefulness of the task and emotional effort

individuals assign to tasks. Eccles and Wigfield (2002) and Penk and Schipolowski (2015) purport that although effort is largely determined by expectancy and value, cost also plays a major role because it is the true measure of the level effort required to succeed.

EVT has been used as the basis for a variety of studies related to individual success expectancies. Some of these groups include student test takers, groups of female and ethnic STEM students and to evaluate women in STEM work. In studies related to test taking, Penk and Schipolowski (2015) used EVT as a measure of gauging test-taking motivation among a group of ninth-graders. It is important to note however, that current models of EVT have been adapted (Penk & Schipolowski, 2015). According to Penk and Schipolowski (2015), Eccles and colleagues expanded the Atkinson model to include more internal and external constructs that could be used to more clearly define opportunities for success. Newer models are used more broadly in natural settings recently especially in classroom settings (Penk and Schipolowski, 2015).

Science, Technology, Engineering and Math (STEM)

As the economic landscape rapidly changes, the need for increased innovation in science and technology are critical to the success of the United States and its competitors (Dejarnette, 2012). As a means of competing against other countries who are also making the transition from manufacturing-based economies to innovative, knowledge-based economies (Han, 2018), the United States must establish policies and programs that support recruitment and retention of highly-skilled workers.

China is currently outpacing the United States with an 18.9% growth rate in scientific papers, which according to Han (2018) is double what the U.S. is producing. China's investments in higher education in science, technology, research and development is evidence of

their commitment to take action. Although there have been issues with corruption within China's education system, Han (2018) reports that nearly 84% of students study abroad and then return to China to pursue careers.

Although steady growth has been experienced over the last decade, the U.S. continues to lag behind. With growing competition from China, Europe and other countries in Asia, a long-term plan is needed to prevent the U.S. from losing its global position (Dejarnette, 2012). As an integral part of this planning, leaders must develop a full understanding of the problem and the future needs of the U.S. from an economic standpoint. McDonald (2016) argues that although various education programs have been established around the country, it is not clearly known if the current levels of enrollment are adequate to meet future workplace needs. Additionally, there are continued concerns about a potential shortage of engineers and information technology professionals (Boe et. al., 2011, by McDonald, 2016).

To avoid these potential shortages, McDonald (2016) argues that the focus of initiatives should be to increase the number of students in STEM programs and to ensure that they are prepared for future careers. In 2012 President Obama appointed a committee to address this and other concerns surrounding STEM. Regarded as "The Committee on STEM Education (CoSTEM) of the National Science and Technology," this council released its first report in March of 2013. Aimed at maintaining America's preeminence in the STEM workforce, the document titled "Coordinating Federal STEM-Education Investments: Progress Report," established a 5-year plan that would elevate STEM and create greater education opportunities (CoSTEM, 2013).

Even with an appropriation of $4.3 billion, shortages within the field of information technology continue to prevail. One major factor contributing to these shortages is the underused

pool of STEM educated women. With women earning one-third of computer science degrees, representation of computer science jobs continues to decline (Sassler et al., 2017).

Computer Science

Although the term "Computer Science" is not recognized as a global term, most recognize it as the common term to describe the use of computers (Fluck et al., 2016). From an academic standpoint, the term "Computer Science" has quickly become the standard for describing classroom curriculum focused on computer learning. Information Technology is the most widely-accepted term used to describe jobs in computer science. Though previous definitions described the two terms separately, the new accepted standard is to recognize them synonymously (Fluck et al., 2016). According to Denning (2007, by Fluck et al., 2016), computer science seeks to answer the following questions 1) What is information? 2) What is computation? 3) How does computation expand what we know? 4) How does computation limit what we can know?

Within most school curriculum there is the expectation that all students will be exposed to some form of computer science, thus increasing their ability to use computers for various types of learning. In the country of Cyprus and at least 12 other countries computer science programs focus on algorithmic thinking and programming (Fluck et al., 2016). In the United Kingdom (UK) students are exposed to more expansive programs involving abstraction, logic, algorithms, and data representation. They are expected to have the necessary skills to resolve problems in computational terms, and to have the aptitude to write, solve, and to put resolutions into practice (Fluck et al., 2016)

Ideally students exposed to computer science programs during their primary and secondary levels of education will be prime candidates for computer science programs at the

post-secondary level. In addition, being exposed to studies in computer science prior to college would provide students with the necessary skills to explore other areas in computer science (Fluck et al., 2016). Having experience with computer programs equips students with confidence, competence and provides them with the practical experience needed to solve problems (Berry, 2013, by Fluck et al., 2016).

As we forge into the future, the demand for new technology to support new innovations will increase. Keeping up with the demand and maintaining a competitive edge will require action on the part of our nation's leaders. Fluck et al. (2016) reminds us that economic rationale is a strong driver for computer science of the future. In a world driven by technology, the demand for trained professionals in the field of computer science will require an increase in trained experts. With computer and information services currently ranking as the seventh largest trade sector in the world's most developed countries, the gap must be bridged. If women are not included and recognized as an integral component to this equation, countries like China and the UK will quickly surpass the US in trade and technology.

Gap of Women in Computer Science

At a time when computer and information services are ranked the seventh largest trade sector with trade growing rampantly in this industry, the United States and other major developed countries are facing a shortage in computer scientists (Fluck et al., 2016). These shortages are expected to make a major impact on the industry with a potential shortfall of 100 to 500 hundred thousand scientists in Australia and Europe (ACS, 2015, p. 34; Husing & Korte, 2010, by Fluck et al., 2016). These devastating shortages are certain to be felt around the globe. One important area that will vastly impact the future lies in government IT positions. Kumar and Kalil (2015) highlight the need for computer scientists in the government and their role in

designing and launching new initiatives that inform policy decisions and lead the way for public-private partnerships and engage industry and academia.

Given the demand for computer scientists and increasing interest, there is a need to address the gap between women and men in the field. According to Sax et al. (2017), of all the STEM related fields, the gender gap is most prominent in computer science. The number of women who are bachelor's degree holders in computer science met a high of 37.1% in 1984 and has currently dropped to only 18% (National Center for Education Statistics [NCES], 2014). The Bureau of Labor Statistics (BLS, 2014) reports that although the field of computing and information technology is a booming industry, there is still a high demand for trained individuals in the areas of computer programming, computer systems analysts, systems engineers, and computer scientists. Although a substantial number of women work in these fields, the BLS (2014) reports that women continue to lag behind and that the numbers do not accurately reflect the gap. With the growing need for programmers, Uhlig and Menta (2016) report that employers are recruiting from abroad to fill these positions.

The need to fill this gap has not gone unnoticed by the government. In 2013 the Obama Administration set forth a 5-Year Federal Science, Technology, Engineering, and Mathematics (STEM) Education Strategic Plan designed to address STEM shortages. In its 2018 Overview, policymakers exert their enduring interest in STEM and ongoing debates regarding its impact on federal science, education, the workforce, national security and immigration policy. The result of these efforts created 300 new programs made available to 15 agencies with appropriations ranging from $2.8 to $3.4 billion (Congressional Research Service ([CGS], 2018).

Regardless of government interaction and funding, the problems associated with STEM are not clearly understood. Policymakers state for example, that graduate student enrollments in

science and engineering (S&E) have grown. Although this may be true, traditionally underrepresented students (CGS, 2018) continue to lag behind other groups academically. Other issues such as the quality of STEM education, access and ranking among US students on an international scale continue to be an issue in a nation where demand is high and supply is low (CGS, 2018).

One theme discussed among policy makers centers on achievement gaps between women and men in the area of STEM CGS (2018). From an economic standpoint, the underrepresentation of various groups to include women limits the competitiveness of the U.S. (CGS, 2018). Similarly, Uhlig and Mehta (2016) assert that a lack of qualified candidates equates to limited growth due to missed opportunities. Missed opportunities in lucrative careers reduces economic prosperity, which in turn perpetuates economic gaps (CGS, 2018).

Life Stage Experiences of Women in Computer Science

While women continue to increase their representation academically in STEM fields, representation in the workforce has diminished as much as 28% (Main & Schimpf, 2017). Given the growing demand for increased participation by women in the field, Main and Schimpf (2017) suggest that a life course perspective approach is necessary to understand recurring themes that may be impacting women across various stages of life. By examining these very important issues through a holistic lens, researchers have been able to more closely examine various life stages to include high school, pre-high school, college major choice, and post baccalaureate employment. Research surrounding recurring themes has made it possible for researchers to demonstrate how experiences under different institutional programs and practices have impacted women and converged to create patterns of underrepresentation in computer science (Main & Schimpf, 2017).

It is suggested for example, that during primary years boys favor computer games, while girls prefer television (Cherney & London, by Main & Schimpf, 2017). These different preferences for leisure activities may play a role in choices and interest levels in computing. Researchers do point out however, that the number of male characters versus females may play a role in the interest level of girls in computing.

In terms of skills access, it was determined that the boys in the fifth and sixth grades tend to participate more often in computer testing than girls did. Whereas usage access indicates that preschool girls tend to dominate computer use. Researchers believe that an even task distribution can contribute to uneven development of computing skills (Main & Schimpf, 2017). It was also determined that boys tend to spend more time playing computer games where girls are more focused on homework.

Although most studies conducted for students at the high school level focused on course taking and relative knowledge, data collected revealed an overall decrease in the number of young women participating in computer studies programs at the high school level (Main & Schimpf, 2017). As a national average, this information indicates that women entering college with computer knowledge is significantly less than men, thus demonstrating that the gap continues to widen in terms of the proportion of female high school students taking computer courses versus their male counterparts.

According to Main and Schimpf (2017), the lower participation rates of women in computing fields at the college level can be largely attributed to several factors which include a lack of inclusion, perceived similarity, achievement motivation or EVT, and self-efficacy. These expectations can be further exacerbated by the lack of positive female role models and the (Main & Schimpf, 2017) overwhelming projection of stereotypical images, classroom environments,

and interactions with peers that do not contribute positively to the female experience in computer related fields.

At the college level the number of women who choose to major in computing as compared to their male counterparts continues to lag. Main and Schimpf (2017) contend that although many schools have worked hard to improve the proportion of women in computer science programs, the number of women completing degrees in computer science has steadily decreased since 1994. At Carnegie Mellon, the number of women increased by as much as 40% in 2014 however, still fewer women are completing degrees in computer science.

Low participation rates among women is often contributed to the prevalence of male stereotypes and individual self-esteem. Women suffering from self-efficacy issues often perceive themselves as lacking the qualifications necessary to fulfill the roles associated with work in computer science. Maine and Schimpf (2017) argue that a low level of self-efficacy is known to be a contributing factor among women. Research has also shown that working in male-dominated culture creates a defensive climate where a hierarchy is created that does not support inclusivity.

From a Post-Baccalaureate perspective, women continue to be the least represented in the U.S. computing labor workforce, with record numbers of women leaving their jobs. Main and Schimpf (2017) reported women as two and a half times more likely than men to leave their computer science jobs. The lower proportion of women in the computer science workforce was consistent with the participation levels of women and girls in computer science programs at the K-12 and college levels (Main & Schimpf, 2017).

Trauth et al. (2004) advanced theory to determine that there are various values and motivation factors that partially explain the underrepresentation of women in IT. For women in

IT, there is a variation in career anchors that motivate women to pursue jobs in IT to include self-perceived talents, values, and motives. These career anchors play a vital role in determining the type of work selected by women and the level of persistence. Trauth et al. (2004) emphasize that women may have various career anchors that change over time as women enter different stages of family formation.

Although various studies focus on family demands as the largest stressors to women in the workplace, Main and Schimpf (2017) suggest that IT work produces a unique set of stressors. One of the most predominant stressors is the need to retrain and to seek continuing education. Men were found to have more flexibility which offers greater opportunities for commitment to work without stress.

Trauth et al. (2004) underscore the point that in IT specifically, women have fewer connections and networking opportunities than men. Reportedly women felt excluded from social networking opportunities such as golfing, which may have led to missed promotions. Ostensibly both male and female IT professionals exhibit a greater level of allegiance to the organization when mentored.

Although women are getting the message that computer jobs are for them as well, the number of women in professional computing jobs continues to decline. With a projected growth rate in the field of computer science of 5% by 2020, Women in Computer Science (WiCS) has predicted that few of those jobs will be held by women (Shein, 2018). Translated into the number of jobs, women could be missing out on as many as 1.7 million jobs.

One of the most common themes surrounding the gender gap in computer science and other STEM jobs is awareness and exposure. Depending largely on a student's sociocultural, biological, and contextual circumstances, awareness and exposure may be limited. Individual

motivational beliefs do not develop in a vacuum; rather they develop under the influence of various ecological contexts, including family, peer groups, school, biology, and society at large (Wang & Degol, 2013, p. 311).

Other factors such as classroom structure play a pivotal role. When class composition or the teacher to student ratio is unbalanced, the student experience can be less than ideal. Wang and Degol (2013) posit that smaller class sizes increase opportunities for individualized instruction. Individualized instruction is especially important in math and science.

Some researchers cite the uneven distribution of scores among males and females on high-stakes test as the culprit for the underrepresentation of women in STEM jobs (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000). Other studies have shown, that women are earning almost half of all bachelor's degrees and a third of PhDs in mathematics (Wang & Degol, 2013). Most researchers agree that aptitude alone is not the sole factor.

Other issues related to the learning environment include single-sex education. Some researchers believe that gender stereotypes can be eliminated by providing all-girl classrooms (Feniger, Zoll; Inzlicht and Ben-Zeen, 2000, by Wang & Degol, 2013). In some cases, single-sex schools did produce higher scores in math and science as opposed to co-ed programs. Researchers were not able to demonstrate an advantage however, where future placement in advanced courses and STEM placement were concerned (McEwen, Knipe, & Gallagher, 1997, by Wang & Degol, 2013).

General teaching practices suggests that teachers can foster student motivation and achievement in math through the use of activities that provide relevance to real world, classroom organization, and by making use of evaluation mechanisms that focus on effort versus normative

ability (Wang & Degol, 2013). Participation in group exercises provides a greater pool of resources to draw from hence increasing confidence (Wang & Degol, 2013).

Becker (1981) asserts that negative results have been reported in the treatment of girls in math classes (as cited by Wang & Degol, 2013). Data provided indicates that girls are alienated and receive less praise than boys. Girls with higher math skills receive even less interaction. The American Association of University Women (AAUW, Bailey et al., by Wang and Degol, 2013) deduced that boys receive more esteem-building encouragement and that teachers gear classroom activities toward boys. For girls who grow up in homes where parents endorse gender-stereotypes, expectancy for success is lowered thus reinforcing these behaviors and undermining the confidence of girls.

Teachers' expectations and stereotypes can be either highly motivational or detrimental to the achievement of students. Wang and Degol (2013) provide an example of a teacher responding to the students' needs based on preconceived expectations of competency. Negative results often arise especially where stigmatized groups are concerned (Wang & Degol, 2013).

Working in groups can also broaden peer support networks. Wang and Degol (2013) highlight the influence that peer relationships have on academic achievement, beliefs and behaviors (Berndt, & Murphy, 2002; Ryan, 2001; Wang & Eccles, 2012; Wentzel, 1998, by Wang & Degol, 2013). In addition, peer groups provide motivation in math and science curriculum (Frank et al., 2008, by Wang & Degol, 2013).

Support gained from peer groups is one of the most influential motivations for children. Wang and Degol (2013) explain that over time participation in naturally occurring peer groups bolsters engagement in the areas of math and science. These relationships can also become a strong trajectory for academic and career choices.

Mentoring and Development Programs

Having a connection to a supportive network is very important for women and dramatically influences both academic and career choices. Considering the current gender gap and impending changes that are destined to increase this gap, drastic action must be taken to address this issue. It begins with finding ways to bridge this gap.

Given the disproportionate number of women earning advanced degrees in computer science and the number of women attenuating away from science jobs, Dawson, Bernstein and Bekki (2015) highlight the criticality of mentoring as a tool for helping women progress in STEM fields. With the growing number of women continuing to cite lack of support and guidance as the reason for leaving, Dawson et al. (2015) suggest that a greater level of effort must be initiated in understanding how effective mentoring can address these issues.

In the obstacle course for women in STEM as described by Dawson et al. (2015), highly talented and academically advanced women are leaving the field due in large part to obstacles created by their male counterparts. Faced by intimidation and fear, women often suffer from a drop in confidence that is triggered by a range of experiences which may include isolation, intimidation and implicit or overt biases (Dawson et al., 2015). The experiences of women are exaggerated by common occupational identity struggles that young adults often experience. Kram (1983) suggests that questions about individual competence, effectiveness, and ability to achieve dreams becomes salient.

Where opportunities for success are not provided, women report ill-treatment and an erosion of confidence, prompting them to stand down to pursue more female dominated careers. Given the perceived difficulty for women to enter into and develop tenure in science fields, and

the need to have adequate representation of women in science jobs, it is critical that institutions find ways to help women achieve success. This effort must include opportunities for mentoring.

Mentoring relationships offer young adults the opportunity to connect with the organization. By learning the ropes, requisite knowledge is gained that enhances technical and political skills and bolsters interpersonal competencies (Kram, 1983). According to Kram (1983), these relationships enhance career development and psychosocial development in both parties. Through a variety of sponsorship, coaching, exposure, and challenging work assignments, mentees learn how to adapt to the organization and later learn how to prepare themselves for advancement.

Although mentoring provides vast opportunities for advancement and greater career satisfaction, women do not have the same level of access as men (Ragins, 1997). Ragins (1997) points out some of the barriers of major and minor group relationships. In some situations, for example, a white male may be reluctant to mentor a woman or minority for fear of scrutiny from their inner groups. Other difficulties may include an inability to develop a rapport due to differences in backgrounds and the mentor's inability to understand situations that are unique to women (Ragins, 1997).

Based solely upon the belief that minority groups (including women) have different developmental and career needs, Ragins (1997) suggests that the majority of mentors would have to tackle huge barriers such as discrimination in order to be of any service to their minority protégés. Performing in this manner would require mentors to become buffers to discrimination by playing supporting roles in tailoring career paths, building self-confidence, and sharing information that is often made available only to members of the "old boys" network. Because of

the need for diversified and homogenous mentoring relationships, Ragins (1997) believed that it would be difficult to find a suitable match.

The "old boy" network in itself has contributed to creating environments where women feel isolated, disrespected and objectified. Women report not feeling comfortable and having to constantly defend their own ideas, which are most often given no validation (Dawson et al., 2015). In science fields, Dawson et al. (2015) report that women are greatly outnumbered making it even more difficult to succeed in highly charged masculine environments where competition is fierce.

The difficulty of gaining access to the computer science environment is often associated with exposure. Shein (2018) stresses that people who do not receive support for computing at an early age do not see themselves as fitting in. And though women may engage in computing at the college level, there is still a "weeding out" process (Shein, 2018). Shein (2018) adds that as a society we still harbor stereotypes about who should do certain types of work. Unfortunately, these stereotypes begin in childhood and are instigated by parents and counselors.

Further research suggests that the degree of diversity between a mentor and protégé can have an adverse relationship (Ragins, 1997). Researchers suggest therefore, that mentoring and psychosocial associations should be limited where greater ranges of diversity exist as a means of minimizing detrimental effects.

Some of the most notable effects of mentoring are the direct and positive improvements shown in a protégé's academic success, productivity, positive attitudes, professional identity development, and career outcomes or intentions (Hernandez et al., 2017, p. 2). Women benefit the most from having a broad network of mentoring relationships, especially in scientific careers. Hernandez et al., 2017) emphasize that women find greater value in having multiple

developmental relationships, and also found greater benefits when these relationships were with same gender mentors. Same-gender role models can be especially useful in reducing perceptions of barriers (Hernandez et al., 2017). Because few women advance into senior roles, it is often difficult to pair a protégé with a female mentor.

According to Thomas et al. (2014), few studies have focused on the characteristics of a mentor relationship such as how gender impacts the effectiveness of relationships. Ragins and McFarlin (1990) determined that protégés were more likely to succeed when paired with same-gender mentors. With same-gender pairings sharing more commonalities, they are more likely to engage in social activities together and to experience more of a mentor-protégé relationship. In addition, deeper trust and mutual understanding is developed where greater homogeneity exists. Dawson et al. (2015) argue that role modeling along with friendship and acceptance are especially critical elements to women in STEM mentoring relationships. The psychological support is a necessary element in helping women combat stress and discouragement from experiences along the path. Most importantly psychosocial support helps mentees achieve resilience and career satisfaction by increasing positivity, cognitive flexibility, sense of meaning, empowerment, and active coping strategies (Dawson, 2015, p. 55).

In many scientific careers senior positions have been held for so long by males that it becomes difficult to create same-gender pairings. Hill and Vaughan (2013) illustrate this example in a study of female surgeons and their quest to gain respect in their communities of practice. Beyond the struggle of achieving professional identity, these intern surgeons faced the perpetuation of old thinking regarding women in the field of medicine.

Hill and Vaughan (2013) portray the educational experiences of women versus men as being vastly different. The cumulative effect of sexual harassment even when minor can result in a feeling of not belonging (Hill & Vaughan, 2013). Career choices pay the ultimate price.

Consideration should also be taken for the structure of the relationship in terms of how it is formed. The nature and duration of relationships can be positively or negatively impacted by the format of the arrangement whether formal or informal. Some mentees prefer relationships that develop spontaneously, while others benefit more from matched assignments in conjunction with organizationally sponsored programs. Thomas (2014) reminds us that the goal of formal relationships should be defined by the organization's objectives, while informal relationships develop goals over time. In this regard, mentoring may be more advantageous to the mentee when relationships are allowed to develop overtime and take their own structure.

In a study conducted by Noe (1988), participants of a formal mentoring program were interviewed sometime after being in the program. Participants reported the program as offering helpful psychosocial assistance however, career development opportunities were limited. The results from the study support the case for informal mentoring and its positive benefits. The study also revealed that women obtained greater psychosocial benefit than men. Noe (1988) asserts that organizations should not expect mentees to obtain the same type of benefits from an assigned mentoring relationship as they would receive from an informally established mentoring relationship (Noe, 1988, p. 473).

Some of the most notable advantages of mentoring include positive changes in the areas of goal setting, success beliefs, self-concept, attitudes and stereotypes, and most notably changes in academic and professional STEM choices (Stoeger, Duan, Schirner, Greindl, & Ziegler, 2013). Mentees also benefit from the counseling, advice, instruction and knowledge-sharing by

mentors (Stoeger et al, 2013). Mentors also help by exposing mentees to knowledge that increases their ability to make smart STEM choices and improve achievement opportunities. These relationships can substantially increase a woman's chances of succeeding as these relationships evolve. Hill and Vaughan (2013) argue however, that women overwhelmingly are not met with the same opportunities to be mentored as their male counterparts. Instead of being allowed to find their identities in these new environments and immerse into their career fields, many women get caught in the cycle of challenging societal expectations and facing off ill treatment.

Gaps in Literature

Several gaps in literature exists as it relates to STEM in the United States. One of the most important areas that should be addressed in the future relates to low math proficiency scores. The United States is currently ranked 48 in the quality of mathematics and science programs. As one of the world's leading economic forces, the United States lags behind 31 other countries in mathematical proficiency (Lehman, 2013). Uncovering the underlying reasons why the United States is performing so poorly may contribute information to the STEM body of knowledge and reveal ways to remaster programs that benefit both boys and girls bring the greatest value in STEM proficiency and effectiveness. Research indicates that girls should be exposed to computer science in middle school to best pique their interest. Other research suggests that computer science should be offered in high school in the same manner as other courses such as English, math and science (DuBow, by Shein, 2018, p. 1).

Other underexplored areas include interest and choice. With the volumes of data addressing the underrepresentation of women in STEM and the prevalence of young men in the industry, few or none address the fact that not all young children with high aptitudes in math and

science have an interest in pursuing STEM careers. Boys and girls should be given free will to select career fields of their choice instead of the presupposed conditions under which many young men and women begin their journeys in STEM (Wang & Degol, 2013). Researchers should be asking the question "What would it look like if boys and girls were given the free will and same opportunities for success?" Perhaps there would be more interest generated if pressure to conform to old stereotypes were removed. There is also the possibility to reduce the pressure felt by girls to fit into stereotypical molds. Perhaps the world would consider that a young person who does not have great math ability at a young age could be taught and developed over time, hence changing the playing field all together.

Additional studies are needed to understand how to change attitudes and perceptions about women in STEM. There is great acknowledgement about the "good ole boy" network, the prevailing power of men and that women continue to overwhelmingly lack support in these STEM networks (Ragins, 1997) however, there is little discussion regarding efforts to dismantle or shift these networks away from behaviors that are damaging to this world's economy and to women as a whole. Studies related to these issues are fiercely needed to support this effort.

Finally, more long-term ethnographic studies are needed to understand the perspectives and experiences of women over extended periods of time. By exploring the life experiences of women and young women from an ethnographic perspective, researchers can study the social interactions, culture groups, communities, organizations and teams involved in the lives of young women from an everyday context (Reeves, 2013). As a research methodology, ethnography facilitates an inductive and iterative approach that allows for exploration as the social phenomenon is being studied (Reeves, 2013). More of these studies are necessary as a means of

charting the real-life experiences of women and young women and key to establishing new theories to explain this phenomenon.

Summary

Despite significant investments made by the U.S, in science, technology, engineering and math, there continues to be a lag in the number of qualified candidates to fill these positions. Wang and Degol (2013) report that there were 7.4 million stem positions in 2012 and in a few short years that number has risen to 8.65 and 2018. Although girls and boys take the same amount of math classes, graduate levels of women continue to fall behind their male counterparts. Wang and Degol (2013) and other researchers assert that some of these differences in career choices can be linked to various psychological and contextual factors. EVT provides an opportunity to evaluate these differences and to determine how gender differences play a role in career choices.

The underrepresentation of women in STEM has been studied and reported on by various researchers and government agencies. With most studies falling under the general umbrella of STEM, few place focus or emphasis on more concentrated areas such as computer science. In addition, these reports provide few explanations about the dearth of women in STEM and computer science jobs other than gender ideology and employment expectations. Other factors that influence girls and women include role models and mentors have not been studied in detail (Sassler et al., 2017).

Studies included in the literature review offer differing points of view and provide a contextual basis for evaluating the importance and value of mentoring programs for women. These studies validate the need for psychosocial support during the formative years as a foundation for making important career decisions in life. Most importantly, many of these

studies draw a connection between self-efficacy and the need for successful support systems for women pursuing careers in computer science and STEM.

One of the most popular misnomers surrounding information technology is that women are less interested than men in computer jobs. Working towards the detriment of women, this perception is damaging. What comes across as a lack of interest on the part of women, is the result of being alienated in a field where women were once the majority. Women face a range of barriers in their progression toward degree completion and careers in STEM Dawson et al., 2015, p. 53).

In contrast to men who report leaving their jobs due to lack of enthusiasm and boredom, women face a multitude of issues to include isolation, discouragement, and intimidation (Dawson et al., 2015). Although many steps have been taken to improve the STEM environment for women, the cumulative effects of years of mistreatment and what Dawson et al. (2015) describe as a chilly climate continue to prevail. Dawson et al. (2015) note that given the lack of female faculty in STEM, it is important to find alternative means to support women.

It is important as suggested by various groups of women to find mentors who understand the unique aspects of both men and women (Dawson, 2015). An important measure of providing psychosocial support demands that mentors have a clear understanding about the circumstances surrounding these issues in order to help protégés find effective strategies for minimizing stress and for finding ways to boost confidence. Support given by mentors moderates the effect of barriers faced by women and provides psychosocial mechanisms for dealing with stress while increasing resilience and career satisfaction Dawson et al. (2015).

Jaeger, Hudson, Pasque, and Ampaw (2017) explain that career decisions for women are shaped throughout their lives to include school and home and that a holistic approach is needed

to understand how lifespan decisions come about. For women, Jaeger et al. (2017) suggest that there is no single career "path," and that to acknowledge the construction of a woman's career, a more advanced model is necessary to capture the trajectories that take place based upon career choices and learning experiences. This group of researchers suggests that it is necessary to focus on women's worldviews and to research the daily lives of women and their diverse experiences in STEM. The next chapter will explore the research methods, design and data collection and detail assumptions and limitations identified by the researcher.

Chapter 3: Research Method

Women are underrepresented in the STEM workforce. Although graduation rates have increased over the last three decades with women earning as much as 37.2% of Bachelor's degrees in science and engineering fields (Sassler et al., 2017), women face continued challenges in the workforce. Proportionally the number of women in science and engineering jobs has not changed since the 1980s (Sassler et al., 2017).

Although various explanations have been offered to explain this phenomenon such as gender ideology, personal priorities, and a general lack of support, women continue to face isolation and overt biases (Dawson et al., 2015). Feelings of not being supported are reinforced when women are not given the same opportunities to receive mentoring and coaching as their male colleagues. Even with a 20 - 40 % representation of women in the workforce accounting for jobs in computer science, many leave due to a lack of mentoring and networking opportunities (Main & Schimpf, 2017).

The purpose of this qualitative study was to explore the experiences of women in computing jobs from a life course perspective to gain a better understanding of how those experiences impacted their attitudes, beliefs, and values. This study also explored the connection between EVT and support systems. This study used a phenomenological approach to gather information about lived experiences. Through the use of interviews detailed information was gathered that provided personal insight into women's perspectives on support systems and expectations for success.

The phenomenological first-person approach, allows the researcher to stand imaginatively in someone else's shoes and to see the world from their point of view (Churchill, 2000; Duus, 2017; Lingis, 2007; Rosan, 2012, by Churchill, 2018) The first-person approach

allows the researcher to shift the focus away from personal intuition to that of others as expressed by the experiences and encounters shared through words (Churchill, 2018). By partaking in this journey, the researcher begins the reflective work of revealing the "what" and "how" which as described by Husserl (1994, by Walsh, 2017) is the process of "Intentional Analysis." Intentional analysis is aimed at revealing lived experiences of what was perceived, felt, remembered and imagined (Churchill, 2018).

Research suggests that women in science and engineering jobs do not achieve career longevity largely due to a lack of mentors and role models (Cheryan, Ziegler, Montoya, & Jiang, 2017). Within these male-dominated environments where competition is often high, women who exhibit low confidence and lack support face the highest risk of burnout and high attrition rates. It has been suggested that STEM cultures can be different when it comes to gender because of the highly masculine culture and prevalent gender stereotypes, prescriptions and practices that are counter intuitive to the needs of women (Cheryan et al., 2017). Women are less likely to persist in these environments even when these behaviors are not overt (Cheryan et al., 2017). Unfortunately, these types of organizations tend to attract men causing a disproportionate number of men to women.

Research Questions

This study determined how the presence or lack thereof of support systems played a role in the success of women in computing jobs. The following questions were used as a roadmap in this study:

RQ1. How do women between the ages of 22 and 35 describe their recruitment and onboarding experiences entering the field of computer science?

RQ2. How do women between the ages of 22 and 35 describe their developmental experiences to include support from management and peers?

RQ3. How do these experiences influence their decision to remain in the field long-term?

RQ4. Why do women abandon computer science jobs within the first few years of employment?

RQ5. How do women between the ages of 22 and 35 describe their decision-making experiences relative to work with various agencies?

Research Design

The problem being addressed in this study was the underrepresentation of women in computing jobs. The industry of STEM as a whole has suffered for several decades from a lack of qualified workers to include women. Stem jobs are an important element of increasing economic prosperity. As many countries continue to achieve gains and make significant investments in STEM, there are growing concerns over the shortfall of qualified professionals within the United States and other nations (McDonald, 2016).

Even though the number of women in the fields of biology, chemistry, and mathematics has been on the uptake since the early 2000s, the field of computer science, engineering and psychics still remain low (Cheryan et al., 2017). Beyond the economic value gained from having a more robust workforce in technology, the fields themselves are missing out on gender diversity, including greater innovation, creativity, and collective intelligence. For women, missed opportunities to achieve career tenure, inequitable salaries, lack of job development and mentoring are some of the greatest losses preventing them from achieving executive and high-level management positions.

A phenomenological research method was the desired approach in this study as it provided the observer with an opportunity to evaluate something that was happening at the

moment. Husserl (1994, by Walsh, 2017) was a huge proponent for conducting research in the natural setting. In doing so, we have the benefit of tapping into our own intuitive abilities to analyze and describe what we are looking at (Churchill, 2018). By immersing ourselves into the lived experience we are forced to rely upon a range of emotions that help us discern what we are looking at and eventually with mixed feelings, make sense of the phenomenon. These emotional experiences force the researcher to choose an emotion, describe the experience and later create themes that can be used to frame the analysis.

A phenomenological design was selected for this study due to its philosophical underpinnings and inquisitive nature (Creswell, 2014). Unlike quantitative research where scientific methods are relied upon to test theories, qualitative research relies upon humans to describe their experiences and develop subjective meanings (Creswell, 2014). Among the various qualitative methods, phenomenological research was most appropriate because of its ability to capture the lived experiences of individuals. Ethnographic design was considered however, it is generally used to study groups of people and their cultural interactions and behaviors versus the lived experiences of individuals. Capturing the lived experience is essential to understanding the life stage experiences of women, therefore phenomenological was selected.

A phenomenological study using semi-structured interview questions was used to gather information. The research interview is one of the most important qualitative data collection methods (Qu & Dumay, 2011). Interviews are a useful way for researchers to understand a phenomenon that they are not familiar with (Qu & Dumay, 2011). There is often an unspoken language that evolves as the result of an interview that creates a connection between the researcher and the participant (Qu & Dumay, 2011). Churchill (2018) explains that the

development of a personal relationship is a critical step in a phenomenological study, as it allows the researcher to transcend their own point of view.

Using phenomenological descriptive principles involves the clarification of research questions and the division of narrative data into meaningful units (Churchill, 2018). This information was then used to derive deeper levels of psychological insight to gain understanding of the lived experiences of participants. Women participating in this study were asked to answer a series of open-ended questions aimed at understanding how their individual life experiences impacted their trajectory in STEM work.

Setting

The research population consists of members of professional and non-professional groups on Facebook, LinkedIn and Instagram. Facebook and other social media applications are useful tools for recruiting difficult to reach populations (Barratt et al., 2015). Facebook is a place where many young people meet to discuss important issues and share information. Many young people make themselves known in their profiles, and are very willing to share their ideas and opinions (Sikkens, van San, Sieckelinck, Boeije, & de Winter, 2017). Social networking sites can be very useful when searching for finding people who belong to marginalized groups (Sikkens et al., 2017). Because many people in these groups are seeking to keep their opinions out of main stream attention, social networking sites are often a good place to gain trust and encourage people to share their stories. The internet also proves to be attractive to young people who want to maintain control over interaction with others by limiting access (Turkle, 2011).

A general invite was announced in several professional women's groups on Facebook, Instagram and LinkedIn soliciting participation from women who meet the criteria. Individuals received my contact information and were asked to complete a short questionnaire to ensure that

they met the eligibility requirements for the study. A list of qualified candidates was constructed. The first qualified 10 candidates from the list were selected.

Participants

Thanks largely in part to the massive size of databases scientists and researchers can tap into social media sources to target study participants in large numbers. With nearly 1.4 billion users, Facebook is often overlooked for its powerful research abilities (Kosinski, Matz, Gosling, Popov, & Stillwell, 2015). Due to the use of social networking, it also makes it possible to target prospective participants. An additional benefit of using social media is the ability to create homogeneous groups.

Several companies are currently making use of Facebook's participation tracker. This privacy protected tool provides research with volumes of longitudinal data accessible through the site. It is estimated that participants have taken the survey nearly 1.5 billion times (Kosinski et al., 2015).

Facebook, Instagram and LinkedIn were used to solicit participants in this study. Invites were sent using Facebook, Instagram and LinkedIn however, questionnaires and consent forms were sent via email. Specific women's groups have been identified as useful networking outlets for soliciting women in computing who fit the criteria identified in this study. These social network sites were used as an inexpensive way to gain access to populations that would otherwise be too difficult and expensive to reach (Alase, 2017).

A sample of 10 participants were selected from the responses received within the population. In a phenomenological study, the recommended size is usually between 2 and 25 (Alase, 2017). This small size is to account for the homogeneity that exists within the sample pool (Alase, 2017, p. 13). The benefit of homogeneity among study participants are the

commonalities and the ability to corroborate stories. Alase (2017) makes the point that in qualitative research small homogeneous samples are selected purposively so that convergence and divergence can be observed in detail (as cited in Smith, 2009). When creating a homogeneous sample universe, specificity is key in terms of outlining inclusion and exclusion criteria (Robinson, 2014). Within phenomenological studies, maintaining homogeneity improves the chances for generalizing later based upon the local sample, (Robinson, 2014). A clearly defined sample universe provides boundaries to the sampling process by specifying the origin of the sample and the nature of the study (Robinson, 2014). The more clearly a study is defined, the more credible.

Because participants were selected from a homogeneous pool, if more participants were needed, a snowball strategy could have been used to solicit additional participants (Alase, 2017). Snowballing is one of the least expensive yet most effective means of recruiting participants for a study (Kosinski et al., 2015). By simple word of mouth, study participants invite their friends to join a study. If the recruiting effort does not produce enough candidates, it is possible to rely upon this feedback loop to help generate more interest.

Those selected for this study were women within the age group of 22 to 35 who have worked in the field of computing for a minimum of three years. The goal of reaching this sector of the population was to generate responses that are somewhat recent in terms of the number of years in the field and the ability of participants to recall the details. Qualitative research relies heavily upon the ability to chart the lived experiences. Since this study places heavy emphasis on the life experiences of women entering the workforce, it was beneficial to speak with women with recent work experience the field.

Approval from the Institutional Review Board (IRB) was sought for approval before the study began. Informed Consent was also obtained from participants prior to the study. In selecting participants and understanding the nature of a phenomenological study, Creswell (2014) states that it is important to solicit help from people who are closest to and understand the central phenomenon, but even more important to gain permission first.

Materials

Unlike quantitative research, qualitative research does not rely on instruments to collect data (Creswell, 2014). Qualitative research relies on the researcher to use their own skills of observation, intuition, examination of documents, observations of behavior and interviewing (Creswell, 2014). The researcher in this study was the primary agent conducting all of the data and later completing the analysis.

An interview guide was used as a tool to navigate through the interview process. In qualitative studies the interview guide links the interviewer to the interviewee. The guide helps the researcher stay on task by supporting consistency in the interviews and linking the research problem, research questions and former literature that may have been reviewed prior to the collection of data. The first question is generally very informal such as an introductory question. Others are followed by questions that are more probing and direct. Questions should arise from familiarity on the part of researchers with the topic and previous experience and conceptual knowledge about topic (Alase, 2017).

In these semi-structured interviews with women the interview guide focused on factors related to EVT and how women perceived their own ability to succeed based upon experiences with technology at various life stages. Gender socialization and cultural norms influence values, interest, and beliefs about STEM careers (Wang & Degol, 2013). The goal of qualitative research

is to capture the essence of the question being asked. Research questions when asked in the correct format should espouse the values, worldview and direction of an inquiry (Trede & Higgs, 2009).

The interview guide was reviewed by a colleague who is in the field of computer science to ensure that the interview questions relate to the research questions and general inquiry. The reviewer is a trusted member in the field of computer science who has been a programmer for at least ten years. Her technical background and personal career path qualify her to fulfill the role as technical expert.

Data collection

Unlike quantitative research, qualitative research does not rely upon random sampling or large numbers of participants (Creswell, 2014). The number of participants in a qualitative study are generally kept small so that researchers can adequately interact with them to learn about their personal experiences and make observations. Creswell (2014) recommends drawing from a purposefully selected site or individuals as a means of providing clarity to the researcher about the problem and research questions.

Another important issue related to the data collection process is the number of participants to be involved in the study. Although there are no specific rules, as a guideline, it is generally recommended that sample size not exceed ten where phenomenological case studies are concerned (Creswell, 2014).

During the data collection process, it is essential that researchers bracket or keep personal preconceptions out of the process. Creswell (2014) states that a degree of open-mindedness is necessary to prevent preconceptions from entering into the data. Participants should be allowed to express their own concerns and to tell their version of their own truth.

As such, during the interviewing process, researchers should be allowed to engage in dialogue with participants for the sake of addressing questions and making relevant inquiries however, a format for the interview must be developed. The general outline involved semi-structured interviews with a duration of 30 - 45 minutes. Each interview involved only one participant at a time. Interviewees had the option of selecting a time and date. Participants were able to negotiate interview times and dates with the researcher based upon their schedules. The location should also be one that is selected by the interviewee (Creswell, 2014). With the nature of this study aimed at selecting participants on social networking, telephone interviews were used as a mode to address the geographical disbursement.

Data Analysis

Data analysis is one of the most important yet difficult aspects of the study process. Data analysis inevitably involves some form of reviewing transcripts and coding data. Under normal circumstances, the researcher would be required to read through all of the notes post interviews and look for common themes that will allow for coding. Intensive coding requires several cycles that require making notes about phrases, narrowing down words, creating meaning units and later providing rich textual descriptions that provide descriptions for the "how" (Alase, 2017).

Because of the time it takes to interpret and code manually, many researchers are turning to computer aided programs. Hand coding can be a time-consuming and laborious process (Creswell, 2014). New software programs are very advanced and provide the capability to store, organize, and search text related to specific codes (Creswell, 2014). These programs allow researchers to focus on other aspects of the study while generated reports detail thematic analysis that can be used later on by the researcher to develop conceptual sense of the data (Tai &

Ajjawa, 2016). Computer programs are also equipped to assist with data management and analysis.

For the purpose of this study QDA Miner Lite was used to transcribe the interviews into text. There are many reasonable services available. QDA Miner Lite is unique in its ability to manage the entire process after interviews. This dynamic data analysis system aids researchers by providing transcripts, interpreting text, coding and creating reports that can later be used to draw conclusions about the data.

Information gleaned from the coding process in this study was used to build a more complex analysis with layers that helped establish a timeline for understanding how life stage experiences impact lifelong choices and value systems. Creswell (2014) establishes that coding provides the opportunity to use themes cross individual cases to build general description that describes the phenomenon at greater length. These descriptive chains begin to lay out the narrative for a chronology of events and later lend to interpretive findings. Sometimes meaning diverges from the original question and other times new questions are spawned (Creswell, 2014).

Assumptions

Assumptions made in this study were that women would be willing to come forward and share their stories. On occasion, individuals who have suffered some sort of trauma or been marginalized are not willing to share their stories because of the painful memories or fear of being scorned. It was especially important during the course of this study to be completely transparent every step of the way to ensure that participants were comfortable and to create an atmosphere of trust.

Limitations

Limitations of this study included the method of data collection. In the absence of face-to-face interviews, there are limitations in terms of the researcher's ability to read nuances and observe behaviors. When possible, it is best to interview participants in their natural setting (Creswell, 2014). Interviewing in the natural setting allows the researcher to observe various nuances that may not otherwise be captured. Because of Husserl's (1994) firm belief that phenomenological research was deeply rooted in capturing the "lived" experience, he advocated for conducting research at the participants location (as cited by Walsh, 2017).

Other limitations related to the geographical disbursement of participants and the inability of the researcher and the participant to form the natural connection and develop a common language spoken about by Qu and Dumay (2011). In the absence of this type of interaction, the researchers often miss out on important cues that would otherwise bring value to the interview. The researcher made sure that all other factors associated with the interview were aligned to minimize the impact of these limitations.

Delimitations

Delimitations in this study include women younger than 22 and women older than 35. The reason this sector of the population was not included was because of the importance of capturing information within a ten-year time frame. This time frame brings relevance to the narrative about life stage experiences by demonstrating differences between young women in computing versus women further along in their careers and will hopefully highlight some differences between how educational systems are doing now versus then.

Ethical Assurances

Ethical considerations need to be taken seriously to protect the interests of participants. The main ethical concerns that researchers should be especially vigilant about include the avoidance of harm, ensuring that participants are fully informed and consent, and the need for privacy and confidentiality (Reeves, 2013). Researchers must ensure that full approval from the ethics committee is received before the study begins. After approval is received, it is the responsibility of the researcher to follow guidelines to the letter Reeves (2013).

Despite the advantages of using social media to solicit participation in studies, there are disadvantages. Easy access to large volumes of date can pose a risk to participants and bring rise to ethical issues. Many of these issues are yet to be resolved according to Kosinski et al. (2015). A variety of databases however, have been made available to the public that have already been sanitized and have volumes of data for public consumption (Kosinski et al., 2015).

There were few concerns regarding ethics and the use of Facebook, LinkedIn and Instagram, since data was not collected, stored or replicated using these social media databases. To ensure that every consideration was addressed, this information was reviewed by the IRB along with any other ethical considerations during the review process. Participants were informed of any and all risks during the "inform" and "consent" process.

Summary

The purpose of this study was to gain an understanding about the life stages that women experience as they relate to computing. With the goal of exploring in depth, this research was aimed at understanding how individual life stage experiences impact the trajectory of women and how their own individual perceptions often become reality.

The results of this study were reviewed through an EVT lens to determine if the values, goals and aspirations of women are impacted over the long haul by the gender maltreatment that they experience and to determine what factors contributed to their success. EVT holds that women's interests, motivation, self-efficacy, and utility value are directly linked to the socialization and practices of parent's teachers and others (Wang & Degol, 2013). This study examined more closely how mentor and role model interaction impacts long-term success and self-efficacy. The next chapter provides summarized results of the study to include the development of themes and findings.

Chapter 4: Findings

The purpose of this qualitative phenomenological case study was to investigate the experiences of women between the ages of 22 and 35 who overcame barriers that often prevent women from making long-term careers of their education in computer science. According to Sassler et al. (2017), women continue to be underrepresented in the field of computer science and are more likely to depart the field within two years of graduation.

The purpose of the study was to gain a greater level of understanding about the obstacles and barriers that prevent women from securing long-term careers in the field of computer science. Data for the study was collected by means of personal interviews. These interviews were conducted by telephone. Candidates were first provided with surveys to determine eligibility for participation in the study. Based upon the returned surveys, the first 10 women who met the study eligibility requirements were selected to participate. These women were provided with informed consent forms via email. Interviews were then scheduled and conducted over a three-week period.

Per the study protocol and the eligibility survey, participants were required to be (a) between the ages of 22 and 35 (b) female (c) working in the field of computer science, and (d) have a degree in the field. In total roughly 50 women exhibited interest in the study. Some women met more than one or almost all of the criteria however, only ten met all and were eligible to move on and participate in interviews.

Telephonic interviews with participants ranged from 30 to 45 minutes. At the beginning of each interview a verbal reminder about consent was given, the researcher introduced herself, and notified the participant that the voice recording would begin. Participants were also made

aware of what to expect in terms of privacy with any data that was collected. Interviews then commenced.

Pre-defined interview questions were asked of the participants. This panel included a range of questions related to obstacles and barriers for women in the field of computer science. After interviews were completed, they were transcribed into data format and labeled by participant number.

This chapter will begin with a discussion about the trustworthiness of data and how this impacts a study. The following sections will include the summary of results which will detail ethical considerations, data analysis review, demographics and information about the occupations of participants. In the third and final section, results of the main study and major themes will be discussed leading up to the summary.

Trustworthiness of the Data

According to Cresswell (2014), the concept of validity is often confusing for novice researchers, due to many interchangeable terms that are used such as authenticity, goodness, verisimilitude, adequacy, trustworthiness, plausibility, validity, validation and credibility. Despite the many differences of opinion surrounding the topic of trustworthiness, the concept of developing valid and trustworthy studies is paramount in qualitative research (Ravitch and Carl, 2016). In this final study consisting of 10 participants, various methods were actively incorporated into this study to ensure trustworthiness.

One of the most fundamental aspects of ensuring validity in this study was the use of open-ended questions. Open-ended questions allowed participants to share information that would otherwise not be gleaned such as feelings, attitudes and personal experiences. Information about personal experiences provided in a natural setting allowed the researcher to convey rich

thick descriptions of findings. By transporting readers to the setting and giving them direct access to experiences, researchers provide validity to their findings (Cresswell, 2014).

Ravitch and Carl (2016) provide that the goal of qualitative research is not to produce true statements that can be generalized, but rather to develop descriptive, context-relevant statements that readers can make comparisons to other contexts. The goal in qualitative research is to provide transferability. Readers and other researchers can therefore, use this study as a baseline or a tool when conducting other studies that may be similar or relevant.

Reflexivity is another core component of qualitative research. Cresswell (2014) states that good qualitative research contains comments by the researcher about how their interpretation of the findings is shaped by their background. In this study, the researcher took notes to detail personal biases and kept them close by while conducting data analysis as a reminder and tool to prevent the possibility of personal bias from leaking into data.

As a mechanism to ensure reflexivity, researchers must resist positivist assumptions and place a primary interest on the contextual and interpretive aspects of the research (Ravitch and Carl, 2016). This can only be accomplished by engaging in an unlearning process whereby researchers are intentional in their efforts to set aside hegemonic tendencies and to seek authenticity. Ravitch and Carl (2016) purport that methodologically, quality rigor can only be achieved when a reclaiming and reframing takes place. In this study, the researcher used memos and notes throughout the design and research process to capture ideas, thoughts and beliefs that were relevant to this topic of study. These memos and notes were referred to repeatedly to build on thoughtful reflexivity. During the data analysis process these notes were especially useful when sensitive issues were discussed. These tools were used by the researcher as a check-in and to place a primacy on the fidelity of the participants' experiences.

Summarized Results of the Field Study

Participants were asked a panel of questions about their experiences entering the field of computer science. This group of computer scientists shared a variety of stories related to their entry into the career field to include programs that help them gain entry such as internship programs and government sponsored programs. Women in this group also described some of the support systems or lack of support systems they experienced in various positions. They spoke about mentorship and support in addition to sharing experiences that were relative to women entering the field of computer science. Finally, a great deal of information was offered about experiences that caused them to depart positions or those of their friends or colleagues who abandoned their positions very early in their career field. This open dialogue format of interviewing was useful because participants had the opportunity to provide historical information which brought great value to the study through rich narratives (Cresswell, 2014).

Ethical considerations. Before transferring data into QDA Miner for analysis all identifying information was removed. Cresswell (2014) states that it is important to mask the names of participants at the earliest point possible to protect their privacy and also suggests creating composite files to prevent accidental disclosure of identifying information. For the purpose of protecting identity participant names were replaced with a generic name and number. Data was then manually read and re-read to identify any necessary edits to ensure proper analysis.

Data analysis.

Ravitch and Carl (2016) remind researchers to be structured yet fluid and flexible in their analysis. They point out the distinct difference between interpretation and analysis. We as humans learn a great deal through interpretation, we do it every day. Interpretation helps us

understand our surroundings and situations. Interpretation does not require a lot of thought or planning. Analysis on the other hand requires thought out intentional processes. Intentional, systematic data analysis is crucial to conducting valid and rigorous qualitative studies that present findings that uphold a fidelity to the data and therefore to people's experiences and perspectives (Ravitch and Carl, 2016, p. 219).

It is important to understand that during the interpretative process personal reactions can often threaten the objectivity of the study. Ravitch and Carl (2016) suggest that although there will always be some subjectivity involved in all qualitative research, it is important to parcel it out where possible. In this study therefore, bracketing was used as a tool for visualizing tracking and managing personal opinions, and other information that could impact the study as much as possible.

As the researcher began to analyze the data many notes were taken noting similarities, differences and themes as they began to emerge. The researcher read the transcripts over and over again to try and gain a thorough understanding and relate to the stories that were shared. By reading the transcripts multiple times Agar (1980, by Cresswell, 2014) suggests that researchers can gain a sense of the whole before breaking it into parts.

Copious notes were then taken to begin to synthesize observations into higher level analytic meaning (Saldana, 2014, p. 95). Cresswell (2014) notes that memoing allows the researcher to make meaning out of data and to capture emergent ideas as they surface. Memoing adds credibility to the qualitative research process as information previously looked upon through a speculatory lens is confirmed by participants (Janesick, 2011, by Cresswell, 2014).

As the researcher transcended from the memoing phase, the classification and coding began. The coding process began with only three codes. As the researcher continued to analyze

the transcripts the list expanded to six categories with a total of 23 sub-categories. Lean coding is recommended especially for beginners (Cresswell, 2014). Large lists are created and eventually narrowed down to five or six themes. The use of code analysis in QDA Miner later assisted the researcher in reducing the list of codes to account for redundancies, overlapping themes, and codes revealing minimal significance. This analysis allowed the researcher to make a determination of which codes were most often mentioned and the recurrence across cases.

While analyzing, various data reduction tools were used to reduce the amount of data and to remove repetitive statements and data that were irrelevant. Ravitch and Carl (2016) point out that data reduction should involve comparing codes and categories to determine themes right up front. The data reduction and re-organization process should be iterative involving various cycles of checking and rechecking themes to identify alternative explanations where relative (Ravitch and Carl, 2016).

Using QDA, a within-case and case-based analysis was used. Cresswell (2014) states that researchers will develop additional layers of complexity into their analysis when they analyze individual cases and across cases.

The following research questions were used as a template for the study.

RQ1. How do women between the ages of 22 and 35 describe their recruitment and onboarding experiences entering the field of computer science?

RQ2. How do women between the ages of 22 and 35 describe their developmental experiences to include support from management and peers?

RQ3. How do these experiences influence their decision to remain in the field long-term?

RQ4. Why do women abandon computer science jobs within the first few years of employment?

RQ5. How do women between the ages of 22 and 35 describe their decision-making experiences relative to work with various agencies?

Demographics.

Later in this section results from the cross-case analysis will be discussed to reveal recurring themes and emergent data. From this point forward participants will be referred to as computer science (CS) and coded using numbers 1 through 10. This measure was taken to protect privacy and ensure anonymity.

Table 1

Participants Demographic Details

Participant	Current Occupation	Current Position	Age	Sex
CS1	Computer Scientist	Software Engineer	26	Female
CS2	Computer Scientist	Digital Services Analyst	28	Female
CS3	Computer Scientist	Cyber Intelligence Associate	31	Female
CS4	Computer Scientist	Front-End Engineer	31	Female
CS5	Computer Scientist	Full Stack Developer	35	Female
CS6	Computer Scientist	Software Engineer	26	Female
CS7	Computer Scientist	UX Designer	29	Female
CS8	Computer Scientist	System Administrator	26	Female
CS9	Computer Scientist	Software Developer	24	Female
CS10	Computer Scientist	Software Engineer	28	Female

Current Occupation.

All 10 participants were women between the ages of 22 and 35 working in the field of computer science. Of the 10, only three women still occupied their very first positions in the field. Other participant career experience ranged from 5 to 12 years of experience. The average and median age of women in this group was 28.

Profile information was collected for the sole purpose of understanding the background and life experiences of each of the participants. This information was collected during the survey phase. After the survey phase, non-descript data was maintained for the purpose of analysis only.

Narratives.

Computer scientist 1.

CS1 one is a 26-year-old software engineer. Her experience transitioning into her career field straight out of college was a bit different because she was a part of a leadership development program. Because of the structure and organization of this program, she had access to a significant number of resources. She attributes her smooth transition into the workplace to the leadership development program. Even during her first year or two as an engineer she had access to technical leads who dedicated their time to helping her grow.

CS1 also attributes her early success to having a peer network. While being a part of her school's leadership development program she was afforded the opportunity to associate with and develop a peer network during the transition period into the workplace. Having a peer network gave her broader support in terms of development and career opportunities and provided access to various tools to help her grow.

CS1 contends that she would not be on her current career trajectory had it not been for the tremendous amount of freedom she was given and the opportunity to exercise her own creativity. She does not believe that she would be on her current career trajectory had it not been for the support received. During her first few years she was provided with the opportunity to work on projects that would normally be considered high risk. She stated that her level of confidence in succeeding in these projects was directly linked to the support she received.

CS1 one believes that women often abandon their jobs because they feel marginalized. Also, men in the workforce, particularly in computer jobs tend to speak a different language. CS1 believes that because men are socialized differently, their communication styles are different, which makes it difficult for women to relate and understand. In response to these communication mismatches women often feel intimidated. She asserts that men are more blunt

and straight-forward where women tend to take a more emotional approach. This can present obstacles for women according to CS1.

CS1 states that the primary reason she has remained in the field is because of the opportunities that she's been given to be involved in cutting edge technology and to try new things that pique her interest. Prior to beginning her career as a computer scientist, she worked in several different fields. She did not find the level of motivation and excitement that she has found in computer science and is tremendously excited about the resources and opportunities that she has been given.

Computer scientist 2.

CS2 is a 28-year-old digital services analyst who works for the local government. She entered the government via an internship program. The program for local government professionals offered a bridge from her analytics and data science study program directly into the government.

Upon entry into the government her very first supervisor was a woman. She attributes the ease-of-transition and success to this relationship. She believes that had she entered the program at a different time and been assigned a different supervisor, the outcome may have been drastically different. She stated that the government much like private industry has a "Good Dude" club, and that you see begin to see the same kind of men working in those jobs.

From day one CS2 was afforded the opportunity to discuss her professional goals and to work with her supervisor to establish a development plan. Her colleagues across the organization provided her a great deal of support by making sure that she understood the work to be done and that she was well-equipped to manage the technical aspects. And while she did not have a formal mentor, she stated that she has received a tremendous amount of support from her colleagues.

Having a decent number of peer members and female technical professionals around her have contributed to her success. She believes that women in private industry struggle in this area because they do not find many women within their networks. One of the things that encourages her to remain in the field is having access to a female network and colleagues that she can communicate with who openly support her. Had she started in a corporate or private business, she was uncertain how long her career may have lasted.

She believes that women do not remain in the field of computer science because they feel marginalized. She stated that although she has many friends that have remained in the field, they describe a sense of not feeling like they belong. And although this may not be the case for her, she understands based upon her experiences how some women might choose to abandon their positions.

The motivating factor that keeps her in the field of computer science is the feeling of accomplishment and of providing a good service to the public as a government employee. CS2 states that she feels a strong connection to the mission of the organization and that's what gets her excited. She also feels extremely happy about opportunities to develop and is looking forward to a huge opportunity to advance to another level in computer science. Additionally, working for the government has been more rewarding than she believes working for a corporation would be where the entire goal is to boost the bottom line. She garners more enthusiasm from her work in public service.

Computer scientist 3.

CS3 is a 31-year-old cyber intelligence associate. She was offered the opportunity to participate in an internship program very early on. This internship program offered two phases. The first phase allowed her to gain on-the-job experience. Upon completion of her four-year

degree, she was then allowed to join the pool of candidates for a possible extended internship opportunity. She was then selected and sent to London to participate in the program.

Once she was seated in a permanent position in cyber security, she was then given a baseline position. Her manager immediately recognized her skills and matched her up with a mentor. The mentor relationship did not provide the support initially expected. She stated that the mentor did not help build her career path therefore, she was forced to forge the path alone.

Before long she determined that cyber security was not her preferred position and decided to pursue digital Forensics. She ran into a bit of a road block when she learned that her male manager did not support her desire to pursue digital forensics. She was given little support when trying to navigate the process of gaining access into the training program.

Eventually she was able to attend a training course and later secured a position in digital forensics. She noted that had it not been for her own tenacity, the chances of securing a position in the field would have been unlikely. She learned that she had to create her own career path.

CS3 believes that women will remain in the field of computer science if they enjoy the work that they are doing. Women will also remain in the field if they feel comfortable in the space that they are in. She noticed that many people remain in certain production areas for five or 10 years. She suggested that people get comfortable and do not try to move. Her perspective was that she had to keep on moving to grow therefore, she badgered her manager until additional opportunities were given to her.

She stated that the most unfortunate part is that women receive little support because no one wants to help a woman in this field. Women are often left to their own devices to navigate their career paths and move in different directions. She was nearly dissuaded from going into the internship program to pursue cyber security because of what she had seen on the landscape. At

that time, it appeared that jobs were few and far between for women in the field. The internship program provided a path because it offered her a full-time position with opportunities for growth.

As compared to her colleagues, CS3 feels that she had to work really hard to gain entry into the program. Even after demonstrating a strong work ethic, she had to sell herself over and over again. And although she was willing to learn, she also had to demonstrate time-and-time again that she was a good fit for the program. In the end her strong work ethic and her ability to learn things on the fly landed her a job in cyber security.

When asked why women abandon positions, CS3 said that men in computer science tend to be very protective of their work and their space. They will help others to a certain extent, and usually not women. She found it difficult to convince her male counterpart of her sincerity in wanting to learn her job versus trying to compete with him or impinge upon his work.

After speaking with a female colleague from the internship program, she expressed the desire to leave the field because of the same type of treatment. CS3 worked hard to encourage her colleague to stay in the field. She described that there are many different paths that one can take in the field of computer science however, many of those paths are difficult for women to gain access to. She expressed also that many men in the field are prior military and have been doing the work for at least 10 years. Within this group of men there appeared to be a boy's club of sorts, making it even more difficult to break down barriers and to overcome obstacles.

She has experienced a lack of comradery from this group and found them to be less than friendly or collegial. In addition, she attributes some of the pay and salary disparities to men with prior military service who were somehow allowed to set the bar. CS3 suggested that men with prior service transition straight out of the military into private sector jobs where they expect the

same level of pay and are accommodated, which greatly exceeds that of their female counterparts.

She also stated that although competition can be healthy, the competition she experienced was mostly corporate level camaraderie from individuals who wanted to be boastful versus helpful. Individuals were often trying to make a mockery of others. In these communities, women are not respected.

Computer scientist 4.

CS4 is a 31-year-old front-end engineer. Her entry into the field of computer science began by way of a recruiter. She first began as a web developer and later through the process of several developmental positions, became an engineer. She describes her first position as a steppingstone into the field. She was well-supported and assisted by her manager in helping her find suitable roles that she could grow into and advance.

And although her manager/mentor was supportive, CS4 said that most of her opportunities were the result of her own motivation, research and self-education. She often learned many of the technical aspects of her job by researching independently. She was lucky enough to find a supportive peer network composed primarily of male developers who offered her assistance from time-to-time.

Once she was established, she found that a few of her teammates were willing to serve as mentors to her, in doing code reviews and in answering technical questions. Through her own motivation and initiation, CS4 was able to push the gate down and establish relationships within these groups.

CS4 knows of many women who have departed the field because they are not taken seriously. In her individual experiences she had not encountered that type of treatment because

she was considered to be an expert in her field. It was therefore, easier to evolve. She did understand however that this is not the case for all women.

CS4 expressed the importance and benefits of having a mentor and how she would not be where she is now without the support. Having a strong mentor allowed her to grow and stick with it even when times were tough.

She believes that women abandon their positions in computer science because of lack of positivity in the workplace. Women experience so few professional interactions and often do not see anyone who looks like them, that it causes them to feel alienated. A bit of a Boys Club exists as described by CS4.

CS4 has been in the field for five or six years now, and does see herself having a long-term career. She described some the challenging experiences of not seeing anyone that looks like you or having anyone that you can relate to within your immediate circle. Although extreme, these are some of the everyday experiences that women endure.

Another part of the problem as described by CS4 is the treatment that women receive in these environments. She described the environment as being toxic in some places. For the first time in her life, she felt the need to prove herself time-and-time again. It was often difficult to surpass the gate to receive approval. Working under these conditions often led her to feel that she wasn't good enough, which led to the desire to abandon her job. These feelings were exacerbated by the need to learn a new job with little support.

CS4 described a culture where women are sexually harassed and taunted by inappropriate comments on a regular basis. She herself had not experienced harassment, but described stories of several friends who had experienced harassment.

The motivating factor that keeps CS4 in the field is the exciting nature of the work and the industry. She is fascinated by how quickly things change and the excitement of quickly mastering new skills. Having to learn more and often is a motivating factor for her. The few mentors that she has had have also helped her maintain a positive attitude and the desire to continue.

One of her longtime goals is to build tools for other developers and for the industry is all as a whole that will help others grow.

Computer scientist 5.

CS5 is a 35-year-old full-stack developer. She described her transitional period from college into the work place as disastrous. With very little support from her family and friends and an unclear direction on what path to take, she spent several years trying to decide what to do. Although she knew that she had an interest in computer science, she received very little support or mentorship from her family and those around her.

After pursuing various jobs to include work in the field of law, work as a T-shirt printer and other miscellaneous jobs, she decided to go back to school to pursue here original passion in computer science. It took 10 years for her to redirect her career path and go back to school. After completing a two-year degree in Information Technology, she looked for work in the industry.

She had a difficult time finding work in the field of IT due to a downturn in the industry between the years of 2009 and 2010. In addition, she found that most organizations required a four-year degree, especially for women. Although she had the skills and creativity required to secure a job in web development, she didn't have the background. She found that most of these jobs were occupied by men. She took a job doing freelance work for others just to get into the

field. After a number of years, she taught herself how to program, which eventually led to other jobs in computer programming and jobs requiring more advanced skills.

The majority of her support came from her husband who she relied upon to help her make decisions and to push her to compete for job requiring more experience and technical advancement. Working for a small company she found that most of her training was self-development. Years later when she decided to go back to school to further her education, she received very little support from her organization. Other colleagues who were male were allowed to take time away during the work day to attend courses. She was denied the opportunity. CS5 therefore, had to finish her advanced courses at night or in the evening.

CS5 described the environment as extremely challenging and difficult for women. Most women within the organization felt as though they had to fight to get anything done or to receive any merits as opposed to their male counterparts. She describes being extremely frustrated and demoralized.

There were several occasions when CS5 considered leaving the field. On one of those occasions, her boss changed her job title without even notifying her. Conversations about equal pay proved to be equally challenging. At one point she described wanting to leave the field very badly and not continue along with this career path.

When asked why she believes women do not remain in the field computer science she said that she has heard stories from other friends. One of her female friends who is a software engineer described male colleagues making it very difficult for her. She recounted experiences in college of experiencing difficulty in math and receiving little support, while male students were offered extra assistance. After earning her four-year degree, CS5 described having more

education than some of her male counterparts who had certifications. The male programmers continued to rise above female computer scientists in terms of position title and salary.

CS5 described how women must go above and beyond to make it in this field while earning less than their male counterparts. Women often do exceedingly more than what is required because they feel that their jobs are constantly at risk. Women who complain in the workplace, are asked why they're so angry. She described the level of pressure for women as excessive and that women have to work faster and be overachievers as opposed to their male counterparts. CS5 relayed these experiences as primary motivating factors contributing to the job abandonment rate of women in computer science.

When asked about the motivating factors that cause CS5 to remain in her current position, she offered that flexibility was important to her. She stated that when a job came along that was a better fit, she was certain that she would leave. She did not feel a sense of goal attainment in this position. Furthermore, she does not feel that her pay is equal to her counterparts and yet she is required to work much harder to receive inequitable pay.

Computer scientist 6.

CS6 is a 26-year-old software engineer. CS6 describes her onboarding experience and transition as very smooth. After interviewing with the company, she was offered the position where she was assigned a one-to-one mentor. She works for a very small company with about 60 employees. She described her manager as great to work with and someone who she has a great relationship with. He has supported her along the way and encouraged her to learn new things. When she struggles with new technological concepts, he is always there to help her.

As a junior developer in the company, she has been there a little over a year. In the short period she has been with the company, she has been given greater and greater levels of responsibility. Her entire team encourages her as well.

CS6 says that her mentor is very clued in. He is very adept at identifying the skills and capabilities of his staff and encourages them to progress versus allowing their skills to become stagnant. At times when cross training or cross work assignments are required, he makes sure that opportunities are available for everyone. She is thrilled to have a mentor that encourages her to do different things and to take on different tasks and responsibilities.

When CS6 took on her role with this company she was the only female tech person. Although there were other females in the company, they held roles in the Marketing and Human Resources departments. She was the first female technical person to join the firm. She describes this experience as initially being very daunting.

In the beginning she was afraid to speak up at meetings because she wasn't sure if she really knew what she was supposed to know. She describes herself as someone suffering from imposter syndrome. Due to encouragement however, she has come into her own skills and understands her strengths. She's also able to recognize her shortcomings in areas where she needs to learn and further develop. She does feel a great deal more comfortable now than she did in the beginning.

Mentors and friends in the field have motivated CS6 to remain in the field. Had it not been for these experiences, she may not have remained in the field as long as she has. She has also had some really great experiences living and working abroad. While living in Sweden, she observed very few issues where gender equality is concerned, and reported her experiences gaining access to the field and working in the field as positive.

Computer scientist 7.

CS7 is a 29U year old UX designer. CS7 did not initially go to school for computer science. When she decided to go back to school to study computer science. it was a bit of a challenge for her and she found out that she was one of the few women in her schools' program. She initially started off as a Visual Designer and worked her way up to become a UX designer.

When reflecting back on her college program she described having an instructor who was particularly sensitive to the challenges of women in STEM programs and that he took extra time out to make sure that she felt comfortable and supported over the duration of her studies. She stated that she believed that he understood things about the female perspective a little bit more than some other men.

In her first position, she worked as a graphics and a web developer in a small company. This was a good experience because the gender perspective had very little impact. She was the youngest person in the company by quite a margin and often was often a lot savvier than her colleagues. She eventually moved on to another organization working for the Department of Defense. In this position she first became more serious about being a UX designer and went back to school to learn advanced skills in visual concepts in the Seattle area. Oddly, she noticed that the majority of her UX design school colleagues were women.

Although CS7 did not experience many situations in her previous position where she felt that gender was an issue, her supervisor expressed to her that she questioned the chain of command. More specifically her supervisor pointed out that she thought that people did not give her opinion consideration or value her opinion because of her gender. She felt that she was further discriminated against because she was a little bit older and working in the tech community.

CS7 also pointed out that in the design field you see many women designers, but n who actually lead departments. This has been a major discouraging factor for CS7. She described positions where it became evident from the initial interview that there were no women in the organization. As she entered various facilities, she noticed a lack of photographs of women in the company directories. In addition to a lack of women she noticed that women were occupying fewer leadership roles.

She described times when she was among colleagues working on different projects and taking notice of the fact that she was the only woman there. This issue has not been significant enough to push her towards leaving the field, but has been more curious than anything. Currently there does seem to be more women in the field of design.

CS7 states that she received a significant amount of support from her supervisor and assigned mentor when entering into the position. The environment was slightly different because most understood that this particular position was a temporary position and that staff would eventually be moving on to other careers. Her mentors were very supportive and willing to give her feedback and helped her in every way possible.

The majority of the issues encountered by CS7 as a UX designer have been related to relationships that designers have with developers. She describes that designers often find it difficult to make developers listen to them which can make things messy at work. Many of the challenges in her opinion are linked to creative differences.

CS7 described the culture in computer science as one where she always had to fight to defend her reputation as a professional. Over a period of time she learned which individuals to avoid. For example, there was a male counterpart who she felt picked a fight with her on a fairly

consistent basis, some having to do with professional decisions others for random reasons. Although she liked the person, he was very combative.

She chronicled the culture in computer science as a different type of culture. In this culture people feel free to say anything and justify it by saying they are just words that don't mean anything. She did not appreciate that environment and would prefer one where people are more sensitive.

She described a situation where a male counterpart did something that was highly inappropriate. When she confronted him about it, he became defensive and accused her of making a big deal out of nothing. She felt some level of remorse for not reporting him to management but, at the time felt that her story may not have been taken seriously and that minimal punishment would due to the reputation of her male counterpart.

Financial benefits are the primary reason that CS7 remains in the field of computer science. Job security is another important aspect of working in the field. The jobs are plentiful and the risk of computer jobs going away is very limited and not likely to happen. The job demand is strong. Those jobs will continue to be around and they will continue to pay well.

She also enjoys her work because it is user focused and a job that requires human creativity which provides her with an opportunity to fix things. She enjoys the problem-solving aspect of this type of work as well and considers herself to be a good designer. And finally, she really enjoys the people aspect because she gets to communicate and speak with people.

Computer scientist 8.

CS8 is a 26-year-old system administrator. She describes her on boarding experience as being very stressful. She on boarded in a group of 200 people all having relatively the same amount of education and skills seeking a handful of positions. During this recruitment process

each person was asked to display their knowledge, skills, and abilities to be considered for the position. They also had to demonstrate that they were technically sound before being considered for an interview.

When CS8 was selected for the position, she was supported by management, although minimal. She initially applied for and was selected to be a java developer. Upon entry however, she was placed in a helpdesk position. She describes this reassignment as highly undermining and detrimental to her development.

During her first two years of employment she worked very hard to be the best at her helpdesk job and to be humble, polite and respectful to her leadership. After a few years of no movement however, she decided to become a little bit more aggressive and addressed her leadership to ask for greater opportunities and for more mentorship and development. It would take several more years before she was given opportunity to move up the chain and to actually gain access into a development position.

In this position CS8 described a company where employees were expected put organizational goals first and personal development second. It was an environment where not much consideration was given for personal development, especially where women were concerned. After some time, she was selected to be a team lead and was able to have some of her concerns heard and given time to work on personal goals.

CS8 asserts that communication was not a strong point for her. Had she communicated properly earlier; she believes that better opportunities would have been made available much sooner. She believes that people do not often advocate for themselves due to fear of reprisal.

From her experiences, newly graduated students often settle because they are not entirely sure what they are looking for. They are often just happy to have a job and do not advocate for

themselves. This is why many people get stuck doing odd jobs that do not align with their education or experience.

Having the opportunity to work a job that is of interest to CS8 is a primary motivator for her. When came on board with organization and was put into the helpdesk position it was very demoralizing and deflating to her. She was looking specifically for a work in development and a job that provided growth. For the two years that she worked help desk she felt stagnated. During these two years, she was not given the opportunity to develop her skills and as a result fell behind some of her colleagues.

Additionally, CS8 stated that she wants to grow professionally and continue develop her skills as a developer and is hopeful that her organization will give her the opportunity to advance to more complex projects.

Computer scientist 9.

CS9 is a 24-year-old software developer. When CS8 was in college an instructor provided a lot of support and saw great potential in her. He knew that she was interested in learning more about the python language and hired her to work on a project. This work advanced her skills. The project that she worked on with the professor was delivered to some very high schedule agencies like NASA. This opportunity to work with a professor in a mentoring capacity motivated her to continue along the path of computer science.

CS9 eventually went on to learn Java and C+ programming. These skills have been especially useful in making her transition into the work field. She takes pride in learning and does not waste time learning things that will not help advance her career.

She characterized her father as her greatest supporter and mentor. Her father who is also a computer scientist, is currently working in network engineering. Much like her father, she enjoys reading books that increase her knowledge, and is currently learning Cisco.

She observed some of the difficulties her father has encountered along the way working in the field as a person of color. He has shared his point of view with her and described some of the struggles that he endured while encouraging her to remain vigilant. He reminded her to do her best at whatever she endeavors to do.

CS9 described the short-lived careers of women in computer science as a lack of support and the absence of supporting networks. She explained that most computer science organizations have a tremendous mismatch ratio wise of men to women. She immediately picked up on sexist things that were taking place in the workplace. When she brought up these issues to her colleagues and management, nothing was done. She says that it is hard for women to remain in the field because of the sexism in the environment. She described her initial experience as walking into an office and not seeing anyone who looked like her. The welcome board in the main office was filled with photos of white males in their 50s with only two females in the entire organization. Even the bathrooms were an issue. There was only one female bathroom in the entire facility.

The acknowledgment and respect that she has garnered over time have motivated her to remain in the field. She stated that people are actually starting to acknowledge her which makes her feel validated. She would like to continue coding for the experience and then potentially move on to more advanced work.

Computer scientist 10.

CS10 is a 28-year-old software engineer. CS10 entered the career field as a Software Development intern. She describes her experience as rewarding and one where she did not experience any sexism or ageism. When she was in college, she received a lot of support from her colleagues and school administrators.

When she entered the work field things changed drastically for her. This was the first time that she began to question her own skills. She was put under a lot of pressure to prove herself and to constantly demonstrate her ability to provide solutions. She felt that even with her solid toolbox of technical skills, she was constantly being challenged.

She felt like she was walking on eggshells every day because one small mistake would cause her skills to be questioned, and colleagues would try to expose her. She felt the burden of constantly proving herself, which created a tremendous amount of stress.

Even with the support of a mentor, the guidance and support offered did not offset the feelings of low self-esteem. The culture in which she worked was characterized by the attitude that every man should fend for himself. Having to be on defense all the time did not aid in building her confidence. She continued to feel less adequate than her colleagues as time passed.

CS10 eventually moved into a different position where she found a culture of supporting caring colleagues and managers. In her current position her manager supports her desire to grow and offers opportunities to attend training and work on more complex projects.

Out of her eight years in the field, she shared that her current job stood out the most. She has been allowed to flourish in this position and to pursue her own personal goals. The relationships and experiences that she has encountered on this job have encouraged her to remain in the field of computer science.

Another reason that she continues to remain in the field is that she wants to prove people wrong. She believes that women cannot let ignorance or sexually driven comments deter them from pursuing their dreams, especially in this industry. She stated that she was proud to be a software engineer, and that she would not allow anybody to change that or to drive her away from the field.

CS10 believes that women abandon work in computer science because they do not feel like they belong. She believes that many women have experienced the same self-doubt that she has and questioned themselves along the way while experiencing biases, which ultimately led them to give up. Another issue is how women's qualifications are rated as compared to men. CS10 described experiences with hiring committees who favored men over women on a consistent basis. When questioning members of these committees in the past, she has been told that men are more knowledgeable than women in this field even when the resumes lined up skill-for-skill. This can be very daunting and difficult for women to overcome. She stated that women who deal with this type of discriminatory practices, often suffer from imposter syndrome. It can be very daunting and exhausting. "Women leave because they don't want to deal with this type of stuff anymore (CS10, personal interview, 2019)."

CS10 reminds the researcher that people don't leave their jobs because of the work, they leave because of bad bosses. She identifies with this statement based upon her personal experiences. Her current boss is very understanding and probably the best boss in her entire career.

CS10 appreciates her current boss because she knows how to lead a team and is a great person. She states that she may never leave this job or at least it would take a great deal of

thought for that reason alone. She expects to stay or remain in this position for at least the next several years.

Developing Themes

One of the most essential elements of qualitative research lies in the element of emergent design. Unlike quantitative research where the parameters of the study are very descriptive, emergent design allows the researcher to utilize a more fluid approach. As opposed to strict parameters that limit communication, the researcher has the opportunity to engage with participants in a more meaningful manner. Most importantly qualitative research and emergent design shows fidelity to the participants and their experiences and pays careful attention to the realities in the context of their lives (Ravitch & Carl, 2016).

As a qualitative researcher it is important to recognize and resist pre-formulated approaches. Ravitch and Carl (2016) remind researchers that the use of oversimplified understanding prevents the researcher from recognizing emergent ideas and from engaging in the true complexity of life, people and their settings.

The results of this study follow later in this section. Descriptions and analysis are also provided. During the coding process, the researcher constructed broad categories to capture the essence of participant responses. After reviewing several times and re-checking data, the researcher then synthesized categories to account for patterns and data sets that were mutually agreeable. Five codes were identified by the researcher as the most prevailing themes.

In this section we will explore the major themes that developed as a result of the data collection and analysis. These themes include role models, mentoring, training opportunities, lack-of-support and sexual harassment. We will learn about the experiences of various participants as it relates to these themes.

Major themes.

Role models. When asked the question of why women do not remain in the workplace one of the primary answers presented by various members of the group was that women do not have role models in the computer science environment. Coming into the field in a structured program was a benefit for CS1. She stated:

Having a peer network and others around to help me made me feel like I wasn't on an island. I had support and someone who checked on me regularly.

Several participants agreed that having people around that they could relate to was important in the workplace. CS1 also stated:

> Having people around you who have the same interests and styles is important. I frequently go days without seeing other women in meetings or other professional settings. I do not work with any women currently, so I am frequently in meetings with ten to fifteen men.

CS4 described her greatest challenge as making personal connections with men. She stated that it would be easier to make a connection with a woman if there were any in her office. CS7 very rarely sees women in her professional setting either. She reflected back to a time when there were two women working on the development team however, they were not there for long before they were let go for reasons unknown. The supervisor described the removal as the need to reduce staff and that the two women were the newest on the team, therefore the first to go.

Contrary to what we've heard so far CS2's first job was with a company where there were many female technical professionals. She felt very lucky for the experience and shared that she has friends who work for corporations who did not have the same type of experiences. Within this company she also had the benefit of having female mentors as-well-as. She stated:

> I have a decent peer network of other female tech professionals. I don't think that's necessarily the case in other private industry tech fields. In fact, I have friends who work for corporations that do not have the same experiences there. In most cases, there are few women in their offices. Knowing that I have a few thousand that I can communicate with inspires me to stay. I can't say for sure, but if I started at a place as the only woman and I didn't have female peers that I could relate to, I don't know if I'd feel welcome. (CS4, Personal interview, 2019).

Mentoring.

The theme of mentoring was spoken of most passionately among this group. Out of the ten women participating, five reported having mentors. Of the five only one mentor was assigned by way of a formal process. The remaining four were managers and peers who offered assistance on a casual basis.

CS1 shared that although she did not have a mentor, she did have a peer support network. Coming directly from an internship program provided her with that distinct advantage. When she ran into difficulty or needed help with a work assignment, she could always turn to a peer within her network for assistance. She stated:

> I felt more comfortable taking on high-risk work given the support resources. I was given the confidence needed. People were showing that they had confidence in me, which gave me mental freedom. Even if I was scared, I was willing to give it a try (CS1, Personal interview, 2019).

CS4 also reported having a strong peer network. Some of these peers performed in a mentoring role as well.

CS3 recounts being assigned a mentor upon entry into the company. The mentors provided were to be used as a resource to help new employees navigate their way through the company. In addition to her assigned mentor, her manager took on a supportive role in making sure that she had a plan and the tools needed to succeed. CS3 revealed that although she had a mentor, when she needed personal assistance or attention, neither of her mentors were available. At this point she became very self-sufficient and begin to pave her own path by learning about the work and volunteering to take on progressive assignments to prepare herself.

CS9 had at least three mentors however, none provided the assistance needed in terms of development. When CS9 sought out support and approval to learning new programs, there was no support. When she needed assistance on the day-to-day work however, it was not a problem. CS8 and CS10 experienced a similar environment in which management prioritized agency objectives, but did very little to support personal growth. When CS10 first started with the company for example, she was thrown into a help desk job versus Java, which is her area of specialty and the job that she was selected to perform (CS10, personal interview, 2018).

Training opportunities.

One theme that was fairly consistent with this group of participants was training. When CS3 displayed interest in moving up the chain to positions of more responsibility and greater interest, she was not supported by management. She later found the support needed within her peer network and decided to pursue upward mobility on her own. She went about this by connecting with people she knew within the agency who were connected to the field of digital forensics or those who could help her network. She eventually secured a position in digital forensics.

When CS5 decided to pursue her Bachelor's degree, management did not approve her request to take classes during the day. She instead took evening classes until it was completed. Two years later a male colleague made the same request and received approval. When she brought it to the attention of her manager, he stated that he could not remember having the conversation with her about completing her degree.

CS2 on the other hand had this to say:

> I think it's really cool to have a job where I can be professionally developed.
>
> I feel like I have a connection to the mission of the organization. Having an opportunity to develop excites me. I get to grow, and also see how the fruits of my labor directly in impact the community (CS2, Personal interview, 2019).

Lack of support.

In terms of support 70% of participants site lack of support as a concern in their work environment. CS1 shared stories about the intimidation factor in her workplace. When she needed feedback or support, there was nowhere to look. She felt the need to constantly make mental adjustments just to try and survive in her work environment. CS1 stated that although she would like to take on jobs with greater level of responsibility, that she lacked the support and resources and therefore did not feel confident. She wanted to ask for assistance but was fearful of a negative response.

CS10 contends that she never knew where she stood and felt that she had the burden of constantly proving herself, which caused her to feel stressed. "Working in this culture where you have to prove yourself is difficult because there seems to be no system of merit and you never know where you stand" (CS10, Personal interview, 2019).

CS10 felt that it was every man for himself literally. She stated that it was very daunting because she worked so hard to find a place to belong and a place where she could use her special skills, only to find out that she didn't belong. CS2 stated that she has never felt not supported and has felt marginalized compared to her peers. CS9 reported not feeling like anyone took her seriously on the job.

Sexual harassment.

CS10 spoke of a situation when she shared a picture of her Instagram profile picture with a colleague. In the picture, she was wearing a dress. The coworker said to her "Nobody dresses like that who is a programmer" (CS10, Personal Interview, 2019). At the time she stated that she thought it was a tactic to get her to leave.

CS4 described the mistreatment as typical to "this culture." She stated:

"You hear horror stories about how women who receive this type of treatment. You know sexual harassment and inappropriate comments are some of the things going on. Although I am lucky enough to have not encountered any of those situations, to be honest if I had gone through something like that, I would very likely not be in the field anymore" (CS4, Personal interview, 2019).

CS7 shared a story of about a friend who while engaging in conversation with a male counterpart brought up the topic of social justice. The male colleague said to her "That stuff doesn't matter people need to focus on what does matter." In a separate conversation the same counterpart shared a story about a girl acquaintance of his who works in computer science who was quitting her job because another male acquaintance started sending naked photos of himself. As the conversation continued, the male counterpart relayed that the girl was very attractive and

that she should dress differently if she did not want the negative attention. The friend scolded her male colleague and reminded him that "she may be attractive, but she did not invite any of that."

CS9 described a work environment wrought with inappropriate behavior. She said that it was difficult for women to stay in the field especially when so many sexist things were happening all at once. Most women were too afraid to say anything, so they leave their jobs rather than try to fix the issue.

Evaluation of Findings

Research question one of this study was: How do women between the ages of 22 and 35 describe their recruitment and onboarding experiences entering the field of computer science? Most of the women participating in this study described their recruitment and onboarding experiences as positive. Out of ten participants, three entered by way of internship programs. One participant was sponsored through a government developmental program and another worked with a recruiter. Others pursued employment opportunities using their own resources.

The study revealed positive recruitment experiences for most. The data gathered in this study is supported by research (Dawson et al., 2015). Women have not lost interest in computer science moreover; they have faced insurmountable obstacles that often deter them from either pursuing computer science jobs or remaining in the field for any length of time. In contrast to men who often become bored or disappointed, women experience isolation and intimidation (Dawson et al., 2015).

Although some women faced challenges obtaining jobs in computer science, data collected supports an overwhelming desire to pursue careers in computer science despite the obstacles. For example, CS1 shared this statement:

> It was difficult getting ramped up and I had a lot to learn, so I basically educated myself about the field (CS1, Personal interview, 2019).

CS3 shared this:

> It has been my goal to get into computer science. Once I was able to achieve this, I was happy (C3, Personal interview, 2019).

CS10 stated:

> You feel like you are walking on eggshells because you have the burden of proving yourself. Once you learn and know what you are talking about, its is not so stressful and you become a part of the team and feel more satisfied (CS10, Personal interview, 2019).

In addition to the challenges women faced securing employment, women reported challenges in college with instructors showing favoritism to their male counterparts and difficulties getting help when needed. Despite known challenges women continue to pursue computer science jobs. As demonstrated by Jaeger, Hudson, Pasque, and Ampaw (2017) in their research, these experiences that often begin at a very young age for women have the potential to completely derail them and play a negative role in determining their career paths and the decisions they make.

The second research question was: How do women between the ages of 22 and 35 describe their developmental experiences to include support from management and peers? The data collected for this question indicates that women receive very little support and that even when mentoring programs are offered, support was very infrequent and offered minimal assistance. Participants in this study understood the importance of having mentors, especially for developmental purposes however, most were driven to self-directed development due to the lack

of mentors. Many women reported building their own networks for support and independently driving the process where career progression was concerned. CS3 stated for example:

> It was like I had been sitting on a team and then one day my manager came up to me and randomly assigned me with a mentor. The only thing my mentor did was show me around. There were not many times when I had any real special attention with helping me build my career, so what I did was start network with people who had the jobs that I wanted (CS3, Personal interview, 2019).

Mentoring relationships are vital to the employee and the organization. Research by Kram (1983) supports the data collected in this study. Kram asserts that through a series of sponsorship, coaching and challenging work assignments, mentees flourish. In addition to learning the organization, they learn how to be their own proponents for growth, which in turn benefits the organization.

Several women in this study reported having mentors who supported their daily work, yet no support for additional training or development. Many women were dismissed when seeking opportunities to work on more advanced projects. Research by Hill and Vaughan (2013) purports that exposure to a field of profession is a paradigmatic trajectory that will be the most influential factor in terms of creating possibilities. Women who do not have mentors or who are paired with mentors who do not fully engage, miss out on opportunities due to lack of growth.

The third research question was: How do these experiences influence their decision to remain in the field long-term? Women who felt supported and engaged were more likely to remain in the field of computer science. In this study many women reported feeling underqualified. Even with the same education levels as their male counterparts, they felt incompetent. The term most often heard during these interviews was “Imposter Syndrome.” Data

collected in this study is supported by research conducted by Main and Schimpf (2017). Women suffering from low self-efficacy consistently perceive themselves as underqualified.

CS10 stated:

It is very dauting to overcome the imposter syndrome that everybody feels in this field. There is so much to learn and to keep up with. Feeling as if you have to prove yourself is a stressful part of this culture (CS10, Personal interview, 2019).

CS4 had this to share:

I was extremely nervous looking for that approval. I could totally turn around and say that I am not good enough and walk away, but I choose not to. It is a difficult hurdle to jump over especially when you are the only one (CS4, Personal interview, 2019).

Having a connection of mentors and supporters has motivated other women to remain in the field because of the support they received. Women who had mentors/support networks reported having someone to look to in times of difficulty and someone to inspire them to keep going after their goals. Although few reported having mentors or peer networks, those that did reported positive results in terms of their desire to persist in the field.

Conversely, a few women in this study have remained in the field because time and increased skills have allowed them to finally feel validated. Several women computer science professionals shared stories of feeling more valued and accepted after proving themselves and gaining notoriety as technical experts in the field. Research conducted by Atkinson (1957) on motivation and EVT theory support this study.

Atkinson (1957) believed that individuals made choices among alternatives based upon the complexity of those alternatives. Atkinson further asserted that individuals make choices among risky alternatives based upon perceptions about the chance of failing. When an individual

expects to succeed, motivation is high. When the opportunity to fail is high, motivation is low. In this study, women continued to be motivated to perform work in their respective computer science positions when they experienced support and motivation from mentors and peers. This theory is especially useful in the case of new employees who do not clearly understand the risk factors involved in their work. Atkinson (1957) demonstrates that choices among alternatives are based upon the level of vigor and expected outcomes. As individuals come to understand and develop their skills, the probability of success improves thus shifting the needle in strength of motivation.

When individuals expect to succeed, they are more likely to remain motivated. The principles behind expectancy theory provide that individuals choose tasks based upon the values associated with those tasks and how closely they relate to personal values and goals (Atkinson, 1957). These values include intrinsic value, utility value and cost. Ultimately, individuals place the highest value on those aspects that generate the greatest returns on happiness and joy. Per the findings of the study, participants gained motivation through the validation and expectations of others.

Research question four was: Why do women abandon computer science jobs within the first few years of employment? Personal connections continued to be an important theme according to participants in this study. Women participants reported not feeling connected in the workplace. They reported feeling alienated and excluded from the omnipresent “boys club” to which women could not gain access. Because of the isolation and alienation experienced, participants reported feeling void of a career path and uncertain of their desire to persist. Although many reported the desire to pursue jobs at the management level, these positions continued to be held by men.

CS5 shared this story about a friend:

I've heard some stories from my coworker, she's an engineer in the field of computational fluid dynamics. It's all high level like rocket science type stuff. She said that people were trying to push her out of the field. They tried to make it hard for her in college, and now in the workplace. They were trying to motivate her to quit. In addition to all of the training and other challenges presented, she had to fight for her management position for two years (CS5, Personal interview, 2019).

Other reasons causing women to abandon computer science jobs as reported by participants include exposure to and being victimized by sexual harassment and inappropriate comments. Various women reported either being personally exposed to this type of treatment or having at least one friend or counterpart who had been exposed to harassment or inappropriate comments. Women who complained were moved to other units or dismissed.

At some interval, almost every participant in the study exhibited a general lack of support. Even though many of these women entered the field with the expectation that there would be challenges, the experiences detailed by many were far greater than expected. Faced with this type of treatment many participants described making themselves invisible as a means of survival.

Research conducted by Dawson et al. (2015) supports the chilly climate that women are faced with every day in computer science where they are largely excluded from opportunities to be mentored, and are subjected to intimidation, implicit or overt bias, isolation and a general sense of not belonging. Participants in this study reported the same across-the-board experiences. Although every participant in this group remained well past the typical two-year abandonment

period, they each described reasons why leaving was once a consideration or known reasons why other women did abandon their jobs.

Research question five was: How do women between the ages of 22 and 35 describe their decision-making experiences relative to work with various agencies? Participants in this study described varying degrees of satisfaction or dissatisfaction with choices made in regard to agencies. Most attributed their experiences to the nature of the industry versus the specific agency. At least one participant displayed significant loyalty to the organization to which she was employed.

At least four women participating in the study shared information that demonstrated the desire to leave their current agencies to seek out more comfortable work environments. Most felt that they did not have the necessary work skills necessary to pursue future employment. All participants were working to further their skill levels in preparation for a move. Unfortunately, all four felt that management was holding them back by not providing the additional training needed to advance.

CS5 had this to say:

I have had trouble getting classes. I have male counterparts that receive approval, but for me it's a challenge (CS5, Personal interview, 2019).

Research has demonstrated that women who do not receive mentoring lack the confidence, skills and ability to compete in the field of computer science (Dawson et al., 2015). Furthermore, theories in EVT posit that women are often hindered from receiving promotions based upon perceptions about their competence and commitment (Sassler et al., 2017). Women are often held back and eliminated for opportunities to advance due to gender ideology. There is

often a misconception that women will not remain in the workforce longer than five years due to family expectations (Sasser et al., 2017).

Summary

The purpose of this qualitative case study was to gain an understanding of the lived experiences of women in the field of computer science and to explore factors contributing to the job abandonment rate. This study used semi-structure interview questions to collect data from participants. The basis for this study was EVT.

The findings for question two strongly support Kram (1983) and the assertion that women need mentors to be successful in the field of computer science. When women have mentors or support networks they flourish. Research has clearly demonstrated that men are receiving the mentorship needed and that as a result they continue to be successful.

To some degree the findings in this study agree with Atkinson's theory on EVT. The findings for question three support the idea that women do better when they are supported by mentors and peers who believe in their ability to be successful. The findings of this study demonstrated however, that women are finding ways to be successful in the absence of strong support. Women who are determined to be in the field are single-handedly navigating their career planning and job placement with little assistance. They are conducting their own research to explore the landscape and creating road maps for their own professional development and career progression. Furthermore, women are being more demanding where equality is concerned. This does not account for all women of course, but women in this study were taking a bold stance and making a choice to persist.

The findings for question five provide a solid contextual backdrop for explaining why women abandon jobs. There is a strong agreement with data collected by Dawson et al. (2015),

which unveils the level of fear, anger and desperation that women face while desperately trying to maintain careers in computer science. Despite the passion women in this study shared about the work, many women in the industry have been tolerating unfair, unethical and immoral treatment for many years.

In this study, the researcher revealed the lived experiences of ten women working in the field of computer science. Some of their stories were uncomfortable and embarrassing. What was learned by the researcher however, was that no matter what end of the spectrum in terms of age, these women were determined to persist. They love computer science work and very much enjoy being on the cutting edge of technology.

Chapter five will center around the implications, recommendations and conclusions of this study. In this final chapter, we will examine some of the challenges going forward and discuss the implications for women in the field of computer science. Chapter five will round out with recommendations for practice and future research.

Chapter 5: Implications, Recommendations, and Conclusions

Women continue to lag behind men in the field of computer science. Compared to the number of women who enter the field, few achieve lengthy careers. While women continue to pursue careers in computer science, very few overall gains have been made (Mansfield, Welton, & Grogan, 2014). These gaps play a pivotal role in helping the U.S. remain competitive (Mansfield et al., 2014).

The problem researched in this study was the shortage of experienced women in computer science jobs. Even with notable increases in women obtaining education and training in the field, they continue to lag behind men in terms of establishing and maintaining lengthy careers (Mansfield, Welton, & Grogan, 2014). Despite government intervention in the 1950s designed to address the STEM crisis, the United States continues to lag behind. These gaps play a pivotal role in helping the U.S. remain competitive (Mansfield et al., 2014). If these jobs are not filled at the national level, the demand for labor will drive wages down, potentially triggering an economic crisis (Sassler et al., 2017). One possible cause for this problem is the lack of support that women receive while pursuing their undergraduate degrees and when transitioning from college into technology jobs.

The purpose of this qualitative phenomenological case study was to investigate the experiences of women between the ages of 22 and 35 who overcame barriers that often prevent women from making long-term careers of their education in computer science. Data surrounding individual backgrounds, educational experiences, opportunities to be mentored, EVT intrinsic values, and success expectancy was collected. Researchers were able to glean information from interviews about the lived experiences of women that often prevent them from persisting in the field of computer science. This study used EVT as a lens to evaluate how individual beliefs

regarding the ability to succeed at given tasks impact long-term success (Wigfield & Cabria, 2010). Methods of inquiry for this study included interviews with 10 participants. All interviews were conducted via telephone. Participation was limited to women with a formal education in computer science and those working in the field of computer science within the last 10 years.

The phenomenological design allowed the researcher to explore perceptions about women in computer science and the treatment they receive. One of the most significant benefits of phenomenological design is that the researcher is able to study the phenomenon without being bounded by space and time (Ravitch and Carl, 2016). Researchers are able to "identify phenomena through the perceptions of the actors in the situation" (Lester, 1999, p.1)

To gain the most knowledge about the lived experiences of participants, interviews using open-ended questions were conducted by phone. Participants were women between the ages of 22 and 35 who hold degrees and work in the field of computer science. Interviews focused around five semi-structured questions aimed at exploring the career paths of women in this demographic.

Data was collected and analyzed abiding by the rules of the Institutional Review Board of Northcentral University. Researchers ensured that all data collection, analysis and documentation adhered to the principles of the Belmont Report and NCU Code of Ethics.

This chapter will include a review of the implications associated with each of the five themes identified in the data analysis, followed by recommendations for practice, recommendations for future research and the conclusion. The conclusion will include a summary of the study.

Implications

This study included five research questions aimed at gathering detailed information about the underrepresentation of women in computer science jobs. Research questions were designed to explain how women were treated over the life cycle of their work in the field relating to recruitment through job maturity and in some cases abandonment. The results were supported by literature outlined in Chapter two which identified some of the perceptions and barriers that women currently face in the field (Hill and Vaughan, 2017; Sax et al., 2017; and Sassler, 2017).

Five themes were identified in the data analysis review. These themes were role models, mentoring, training opportunities, lack of support and sexual-harassment. From the standpoint of implications, all five of the research questions fall under the umbrella of a general lack of support to women in the field of computer science which yields shared implications. These implications are explored separately in each section.

Role model.

Women in the field of computer science do not have role models. Research indicates that same-gender role model relationships may be more beneficial to women in terms of changing perceptions about barriers (Hernandez et al., 2017). As previously indicated however, the scarcity of women in the field prevents many women from gaining access to same-gender role models.

Overwhelmingly, women in this study did not have role models. In many cases, participants were the only women within their entire group or organization. Role modeling and counseling, along with friendship and acceptance are important aspects of growth and psychological balance (Baranik, Roling, & Eby, 2010; Rayman & Brett, 1995, by Dawson et al., 2015).

One of the most important aspects of having a role model is the support it provides women in developing their own career maps (Jaeger et al., 2017). Where gendered experiences are concerned, especially for women in STEM jobs, being able to "see" other women succeed in the field is vital. Women who see others succeed understand what it will take for them to be successful (Hill and Vaughan, 2013). It is difficult for women to navigate the industry without someone to look upon as a role model. Women who have role models are more committed because they see the possibilities and can more clearly visualize a path for success where their own careers are concerned. The most vital aspects of these relationships are the tools provided by role models that set outcome expectations and helps women manage anxiety and mitigate stress (Jaeger et al., 2017).

Nine out of 10 participants expressed the desire for and necessity of a role model. They understood clearly and gave various descriptions of scenarios in which having role models would have been beneficial and brought value and balance to their experiences. Role models are needed to help women navigate through difficult situations and to help eliminate or reduce barriers. These support systems are of particular importance to women working in STEM fields where masculine stereotypes and culture dominate (Cheryan et al., 2017).

Implications.

Responses related to recruitment and onboarding play a critical role in understanding the overall experiences of women in the field of computer science. Recruitment plays a vital role in determining the direction and level of support women receive over the course of their careers. Role models are instrumental in helping individuals understand job-related functions and activities, providing opportunities for coaching, assistance with career direction, training,

feedback on performance, access to resources and most importantly sponsorship within the organization.

New employees require a significant amount of guidance. Role models play a pivotal role in helping employees achieve balance and find direction. Many participants indicated that having a mentor would have made their immersion into the organization much smoother.

Aggravated by these barriers, women in this study detailed feelings of isolation. Forced to chart their own paths with little experience and minimal support, outcomes were rarely favorable. Most women who participated in this study reported difficulty charting their career paths and multiple setbacks in their careers, especially during the early stages.

Mentoring.

Women continue to receive very little mentoring as compared to their male counterparts. Mentoring is a critical component to the professional development of women and minorities (Dawson et al., 2015). This critical component is especially important to the progression of women in STEM fields.

Women who receive guidance and support are more likely to persist in the field of computer science. In a study conducted by Preston (2004, by Dawson et al., 2015) research indicated that six out of seven women left the field of science for lack of guidance. Mentoring has been identified as a strong determinant of whether women persist or depart the field of science.

Many of the women participating in this study described frustration over the lack guidance and support. The few women who were provided with mentors, received few benefits from these relationships. Effective mentoring requires instrumental advising and mentoring

(Dawson et al., 2015). Since women continue to be greatly outnumbered in science fields, opportunities for mentoring are few (Dawson et al., 2015).

Implications.

As a result of missed opportunities, women experience developmental challenges and career stagnation. Career stagnation causes women to be overlooked when opportunities for advancement arise. These missed opportunities have a domino effect on future opportunities to advance into management positions. One of the most beneficial direct effects of mentoring is positive career outcomes and experiences (Hernandez et al., 2017). Evidence from this study indicates that women continue to be vastly overlooked all along the pipeline in the field of computer science.

Training Opportunities.

One of the most significant areas in which women lack support is in training and development. Women participating in this study overwhelmingly stressed the need for training and exhibited stress over being overlooked repeatedly for training opportunities. Men are receiving more opportunities to train and expanded developmental opportunities which often lead to promotions. Several women shared stories of men with less tenure within the organization and less education being selected to attend training courses ahead of them. Discriminatory practices limit women from opportunities play an important role in determining their career trajectories. Differences made between women and men, although often viewed as a very small, can result in big differences down the road in terms of advancement (Cheryan et al., 2017).

Providing women with training opportunities enhances self-efficacy and increases a woman's ability to see herself as successful. Increasing expectations of success for women is an

important aspect of reducing or minimizing stereotypes. Supporting the movement to train women equally and creating developmental paths for women that mirror those of men reinforces the importance of this field for women and men (Cheryan et al., 2017).

University and college administrators from across the nation are recognizing the need and working to give women and minority students more opportunities. These programs are focused on reducing gender disparities by diversifying the student pool in computer science programs. Administrators believe that increased opportunities for women will diversify current stereotypes and provide the best opportunities for women to be successful (Cheryan et al., 2017).

Several women interviewed as a part of this study described participation in some of these programs at the university level. Some of these programs in fact, provided access to the internship programs later introducing them to their first positions in the field of computer science. Unfortunately, many of these gifted and talented young ladies were not given the same opportunities in the workplace to train and develop alongside their male counterparts as they were offered in college.

Implications.

Having access to training is especially important in science jobs. With the quickly advancing rate of technology in computer science and the advancement of software programs and programming languages, training is critical to those who intend to advance in their careers. Even the shortest periods of lag can be damaging to a career in this fast-paced environment. Women therefore, are severely limited in terms of opportunities to develop their skills in alignment with the fast pace of technology. Keeping current with technology is import from a career perspective.

Career development fosters employees' promotability while strengthening their intention to stay (Van Vianen et al., 2018). Promotability and intention to stay are an important aspect of succession planning and career progression for individuals. According to Van Vianen et al. (2018), employee's intention to stay is also a predictor of turnover, which is a strong indicator of financial success and organizational performance. Retaining and keeping women therefore is an economic concern across the board.

Lack of Support.

Question five aimed at understanding how women make decisions relative to job choices revealed an overwhelming lack of support. Responses from participants explained why women do not remain in the field of computer science and provides a broader insight into reasons for high job abandonment, and lack of support. Based upon the results of this study, it would be difficult to characterize the lived experiences described by this group of participants as anything other than lacking support as a whole.

Ubiquitous to these shared experiences were compelling stories of low self-esteem and low self-efficacy. Originating back to college, women in this study described inequitable treatment which involved preferential treatment where mentoring opportunities were concerned as-well-as a general lack of support where math and science courses were concerned. Even when women are provided with opportunities to enroll in computer classes, there is often a "weeding out" process that takes place at colleges and universities. These non-welcoming environments set the stage for biases (Shein, 2018).

Characterizing their experiences as imposter syndrome, many participants reported a lack of self-confidence rooted in isolation and lack of support. Having the ability to relate to others within the workplace and being given the opportunity to learn the norms and procedures is a vital

part of "belonging" and feeling socialized (Lacey and Stewart, 2017). Additionally, lack of clarity in the scope of an employee's position can lead to ambiguity and further feelings of isolation (Lacey and Stewart, 2017). Too often women in computer science jobs are not given the proper tools needed to be successful. They are under a great deal of pressure to do the "right thing," while not clearly understanding what the "right thing" involves. The appearance of intelligence is an important aspect of success, and can lead to increased anxiety and feelings of imposter syndrome when individuals do not feel intelligent in their jobs (Kets de Vries, 2005, by Lacey and Stewart, 2017).

Implications.

The implication of the general lack-of-support that women experienced is a broad-reaching problem that continues to manifest itself in the job abandonment rate of women in computer science. Women are leaving jobs in computer science not due to a deficit in academic preparation, ability or talent (Seymour and Hewitt, 1994; Sonnert and Holton, 1995, by Dawson, p. 54), but due to a drop in confidence triggered by a range of experiences along the STEM pathway. Many women experience intimidation, isolation and harassment along the STEM pipeline.

Women who are not supported, often resort to job abandonment. Those who make it past the two-year average, suffer through many years of misery before eventually abandoning their positions. Many of these women can be found in human resource and accounting jobs.

Sexual Harassment.

Women experience different educational and career experiences than men. Women are more likely to be subjected to some form of sexual harassment or abuse. The cumulative effect of repetitive maltreatment can leave long lasting affects for women. Through these experiences

women often feel like they do not belong. The impact of these feelings can be a determinant of whether or not they pursue careers in STEM (Hill and Vaughan, 2013).

Women in this study were no different. Stories of blatant disrespect and sexual harassment were shared. In every report shared there was no action taken on the part of management to bring resolution. Most women persisted because of their desire to remain in the field. Although the treatment was harsh and unfair in many circumstances, most came to accept these behaviors as part of the culture.

Implications.

As demonstrated by responses to question five, women who experienced sexual harassment were less likely to remain in computer science. Along with diminished self-esteem and the psychological effects of sexual harassment, the implication of sexual harassment is continued job abandonment and the potential for this issue to impact other women as word spreads about the treatment women receive in these environments. Often times women are deterred from jobs in computer science because of the sexism that exists (Sax et al., 2017). As greater numbers of sexism or sexual harassment cases are exposed by the media, the prevalence of women pursuing careers or persisting will continue to diminish (Sax et al., 2017). Women in this study spoke of sexual harassment encounters and of knowing women who abandoned their jobs because of it.

Although women are accepting these behaviors as a part of the masculine environment that surrounds computer science, organizations should not. Society as a whole has a responsibility to correct these behaviors and widely accepted stereotypes before they become a detriment to our workforce and economy.

Recommendations for Practice

The results of the study led to one major recommendation. Per Hernandez et al. (2017), drastic interventions are needed to promote scientific identity motivation and persistence. To be successful in computer science there is a need for women to feel connected. Women are more likely to persist in the field of computer science when they can identify their personal and professional identities with the field. This can be achieved through the use of mentoring.

Mentoring as an overarching theme, plays a vital role in helping women overcome issues related to the other four themes identified. For example, women who were paired with mentors reported greater levels of satisfaction with work immersion. Understanding the culture and social aspects happened much earlier for these women which in turn helped them learn how to navigate the environment much faster.

Mentor relationships provide a framework from which women can map out their careers. Paired with mentors' women quickly understand the organization's purpose, mission, vision and goals and how their individual efforts contribute. Women in this study who had mentors described a connection to the mission. They were more driven to establish their own goals and demonstrated a greater level of motivation and drive.

Mentoring offers a long list of benefits. Role modeling tops off the list. Role models help women achieve goals by modeling the behaviors required to be successful. Role models are the touchstone of mentoring, as they provide a central point of motivation for women.

When goals seem unattainable, role models motivate women by providing vital information. They help women move beyond their own perceptions and focus on being successful (Herrmann, Adelman, Bodford, Graudejus, Okun, and Kwan, 2016). In addition, role models help women reduce concerns about stereotypes by increasing identification, inspiring

career motivation, perceived success and career aspirations. Women who are paired with role models experience reduced stress when working with male counterparts. Most importantly, role models set samples for persevering during difficult times, (Oyersman, 2009, by Herman et al., 2016) which is especially important to women in computer science who are dealing with high levels of stress and anxiety.

Recommendations for Future Research

The findings for this study provided close-up look at the lives of 10 women working in the field of computer science. The results indicate that further research is needed to better understand this phenomenon. The first recommendation for future research is for a qualitative, ethnographic study involving women and girls. The study should follow the lived experiences of girls from grade school through college to gain a better understanding of the STEM experiences over life stages. It is necessary to understand the developmental and growth stages of women as-well-as accessibility and support to have a better understanding of why women do not choose the field of computer science. This study will also help researchers gain a better understanding of the perceptions and motivations of women who enter the field. Future research would also aid researchers in understanding how lifelong perceptions have impacted women's ability to see themselves as Computer Scientists and how self-efficacy has played a role.

The second recommendation for future research would involve a qualitative study to explore colleges and university programs who have a track record of offering successful STEM programs. It will be useful to understand what factors contributed to their success as compared to other organizations. Furthermore, it will be useful to understand the criteria utilized to recruit participants and to create diverse programs. Finally, within this proposed study, it would be

highly useful to understand how institutions managed stereotypes to create fair and equitable programs.

The third recommendation for future research would be a qualitative study involving families of successful women in STEM. This study would be aimed at gaining a clear understanding of the perceptions of these families, the support provided to girls and women and whether or not stereotypes existed within these families. Further research in this area will bring greater awareness to society at large about the determinants to success for women in STEM in regard to their families and support systems.

Conclusion

The purpose of this qualitative study was to explore the experiences of women in computing jobs to gain a better understanding of how their lived experiences have impacted their desire to persist in the field of computer science. This study also explored the connection between EVT and support systems. Through the use of interviews, researchers were able to gather detailed information that provided insight into the perspective of women and their support systems and expectations for success.

Several of the themes identified in this study indicate the need for further intervention into this phenomenon. With lack of support cited as an overarching theme in this study, contributions were made to Atkinson's theory of EVT (Atkinson, 1957). Women in this study shared information that demonstrated that risk plays a vital role in persistence. Where the risk of succeeding is high, individuals were more willing to engage in moderate to high-risk situations. The opposite occurs when the risk of failing is high. Individuals are more likely to choose the least threatening alternative. Where the lack of support is concerned and the need for mentors and role models, women are more likely to abandon computer science jobs for fear of failure.

Atkinson (1957) states that where greater anxiety about failure is found, aspiration levels are defensively high or defensively low. Characteristically, women in computer science demonstrated low aspiration levels where the stakes were high.

Since the end of World War II in 1945, when our nation's men returned from war, women have been discouraged from participating in computer science jobs. Jobs that women once pioneered and dominated were now being taken by men. Ironically, had it not been for women, computer jobs may have not been introduced for quite some time. Women therefore, have played a vital role in the development of advancements in science and technology.

This study aimed at making a contribution to the body of research as it relates to women in STEM, indicated that additional research is needed. Although women continue to abandon jobs in computer science at a rate much greater than men, clearly some women are able to persist. It has been suggested by many researchers that women leave the field of computer science to take care of families. This claim is unsupported however, as other studies indicate an increase in the number of women in the total workforce. Data provided by BLS (2017) indicates that the numbers women in the workforce have shifted to jobs in more female-friendly fields such as Human Resources, Finance, Accounting and others.

One of the most fundamental changes needed to address the underrepresentation of women in the field of STEM is a shift in the culture. Until men get the picture that women are a vital part of the computer science workforce, women will continue to be mistreated and undervalued. Additionally, a visible increase in the number of women in computer science is needed so that stereotypes can be diminished and greater opportunities created for women.

Current studies demonstrate that help is needed to motivate this shift in the culture. It's up to society to demand change. A shift in the culture can only be made by swift intervention.

The government must continue to create legislation that drives change and inspires programs that are more accepting of and promote growth for girls and women. Although it will take some time to see the sweeping hand of change, the results will be worth the wait. The world and nation as a whole will benefit from these changes and the contributions that women have to offer.

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Appendixes

Appendix A: Study Solicitation

Invitation to Participate: Qualitative Study
Study Title: The Gender Gap in STEM and Computer Science Jobs: A Study Investigating Job Abandonment Rates of Women in Computer Science
Principle Researcher: Monica L. Stevenson, School of Business and Technology Management, Northcentral University
Faculty Chair: Dr. Stephanie Menefee

Greetings,

My name is Monica Stevenson and I am a doctoral student in the School of Business and Technology Management at Northcentral University. I am inviting you to participate in my study *titled The Gender Gap in STEM and Computer Science Jobs: A Study Investigating Job Abandonment Rates of Women in Computer Science*. This research study will focus on the lived experiences of women working in the field of Computer Science to gain a better understanding of their expectations for success and how these perceptions impacted career choices.

The purpose of this study is to investigate the experiences of women who have overcome barriers in the field of computing and to provide greater insight into this phenomenon. This study will be conducted under the guidance and supervision of Dr. Stephanie Menefee at Northcentral University. This study will consist of a preliminary survey (6 or 7 questions) to determine eligibility and a 1-hour interview by phone. I am seeking women who meet the following criteria:

- Between the ages of 22 and 35
- Who have completed a four-year degree in a Computer Science related field
- Have been working in the field of Computer Science for 3 to 10 years

If you are interested in participating in this study or have questions, please contact me. If you do not meet the research criteria, but know of someone who does, please forward the invitation within your networks. All information submitted will be kept confidential.
Thank you,

Monica Stevenson
Principal Researcher, Northcentral University
Phone: (360) 789-1869
Email: M.Pacheco2358@o365.ncu.edu

This study has been reviewed and received ethics clearance through Northcentral University Institutional Review Board.

Appendix B: Eligibility Survey

Study Title: The Gender Gap in STEM and Computer Science Jobs: A Study Investigating Job Abandonment Rates of Women in Computer Science
Principle Researcher: Monica L. Stevenson, School of Business and Technology Management, Northcentral University
Faculty Chair: Dr. Stephanie Menefee

Eligibility to Participate Survey

1. Are you between the ages of 22 and 35? ☐ Yes ☐ No
2. What is your age? Click or tap here to enter text.
3. Do you have a degree in Computer Science or a related STEM (Science Technology Engineering or Math)? ☐ Yes ☐ No
4. Do you currently work in the field of Computer Science or a related STEM job? ☐ Yes ☐ No
5. What is your job title?
6. What is the best time of day and day of the week to schedule a phone interview with you?

   Click or tap here to enter text.
7. What is the best email and phone number to reach you at?

Appendix C: Informed Consent Form

My name is Monica Stevenson. I am a Doctoral student at Northcentral University. I am conducting a research study on women in the field of Computer Science. The purpose of this study is to gain an understanding of how women's expectations for success impact their career choices. I am completing this research as part of my doctoral degree. Your participation is completely voluntary. I am seeking your consent to involve you and your information in this study. I am here to address your questions or concerns during the informed consent process.

PRIVATE INFORMATION

Certain private information may be collected about you in this study. I will make the following effort to protect your private information, including depersonalizing all aspects of the information shared by you as a measure to protect your privacy. Even with this effort, there is a chance that your private information may be accidentally released. The chance is small but does exist. You should consider this when deciding whether to participate.

Activities:

If you participate in this research, you will be asked to:

1. Complete an initial eligibility questionnaire.
2. Participate in a 1-hour interview by phone.

Eligibility:

You are eligible to participate in this research if you:

1. Are a female.
2. Are between the ages of 22 and 35
3. Possess a four-year degree in a computer related field
4. Currently or have held a computer job post-graduation

You are not eligible to participate in this research if you:

1. Not a female
2. Do not possess a four-year degree in a computer related field
3. Have never held a job in the field
4. Are not between the ages of 22 and 35

I hope to include (10 total) people in this research.

Risks:

There are (zero) risks in this study. Some possible risks include: (none).
To decrease the impact of these risks, you can: (none).

Benefits:

If you decide to participate, there are no direct benefits to you. (**NOTE** that most studies do not have any direct benefits to participants. If you truly think your study *does* have a direct benefit, change the language in this section. You will need to justify your reasoning in the IRB application.)
The potential benefits to others are: (increased knowledge in this area; benefits to students and potential career candidates).

Confidentiality:

The information you provide will be kept confidential to the extent allowable by law. Some steps I will take to keep your identity confidential are: (examples - I will use a fake name or number to identify you, and/or, I will keep your name separate from your answers, and I will not ask for your name)

The people who will have access to your information are: (myself, and/or, my dissertation chair, and/or, the other researchers, and/or, my dissertation committee) The Institutional Review Board may also review my research and view your information.

I will secure your information with these steps: (securing on my computer in a password protected file)

I will keep your data for 7 years. Then, I will delete electronic data and destroy paper data.

Contact Information:

If you have questions for me, you can contact me at: (M.Pacheco.2358@o365.ncu.edu)
My dissertation chair's name is Dr. Stephanie Menefee. She works at Northcentral University and is supervising me on the research. You can contact her at smenefee@ncu.edu or 480.253.3558.

If you contact us you will be giving us information like your phone number or email address. This information will not be linked to your responses.

If you have questions about your rights in the research, or if a problem has occurred, or if you are injured during your participation, please contact the Institutional Review Board at: irb@ncu.edu or 1-888-327-2877 ext 8014.

Voluntary Participation:

Your participation is voluntary. If you decide not to participate, or if you stop participation after you start, there will be no penalty to you. You will not lose any benefit to which you are otherwise entitled.

Future Research

Any information or specimens collected from you during this research may **not** be used for other research in the future, even if identifying information is removed.

Audiotaping:

I would like to use a voice recorder to record your responses. You (can, or, cannot) still participate if you do not wish to be recorded.

Please sign here if I can record you: _____

Signature:

A signature indicates your understanding of this consent form. You will be given a copy of the form for your information.

Participant Signature	Printed Name	Date
_____	_____	_____
Researcher Signature	Printed Name	Date
_____	_____	_____

Appendix D: Research Questions

RQ1. How do women between the ages of 22 and 35 describe their recruitment and onboarding experiences entering the field of Computer Science?

RQ2. How do women between the ages of 22 and 35 describe their developmental experiences to include support from management and peers?

RQ3. How do these experiences influence their decision to remain in the field long-term?

RQ4. Why do women abandon computer science jobs within the first few years of employment?

RQ5. How do women between the ages of 22 and 35 describe their decision-making experiences relative to work with various agencies?

Appendix E: Interview Guide

Onboarding Experiences:

1. How did your experiences during onboarding impact your ability to become familiar with the organization?
2. What type of assistance or guidance were you given from the start? Did you have a sponsor?
3. Did you feel connected to the organization?
4. Were others given the same types of opportunities?
5. What opportunities have you been given to interact with social groups? How about extra-curricular?

Developmental Experiences

1. Were you provided with a developmental plan?
2. Did your supervisor or someone else discuss opportunities for growth with you?
3. Were others around you provided with assistance along the developmental track?
4. What type of development opportunities were you expecting in STEM? Were you exposed to any of them?

Retention

1. What factors made you stay?
2. What parts of your job are enriching if any?
3. What do you like about STEM?
4. How would you describe your self-efficacy?
5. How do these feelings align with reality?
6. Has anyone influenced you to remain in the field?

Job Abandonment

1. Why do women leave?
2. Do you have friends that have abandoned their jobs?
3. What are your perceptions about how women in computer science are treated?
4. What expectations did they have that were not met if you know?
5. Did leadership do anything to try and convince them to stay?
6. What do you enjoy specific to your current agency that causes you to stay?