Author: **Wagner, Tonya M.**

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STUDENT:

      NAME: Tonya Wagner   **DATE: 12/17/19**

ADVISOR:

      NAME: Dr. Urs Haltinner   **DATE 12/13/2019**

Committee members (other than your advisor who is listed in the section above)

1. **CMTE MEMBER'S NAME:**   Dr. Roger Stanford   **DATE: 12/13/19**

2. **CMTE MEMBER'S NAME:**   Dr. Sylvia Tiala   **DATE: 12/13/19**

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This section to be completed by the Graduate School

This final research report has been approved by the Graduate School.

Director, Office of Graduate Studies: **DATE:**

Wagner, Tonya, M. *Advancing the Talent Pipeline for Women in Information Technology through Increased Enrollment in Middle-skill Information Technology Degree Programs*

Abstract

The digital revolution has fueled enormous job growth in information technology and computing. The current talent pipeline, largely dominated by men, will not produce enough workers to meet industry demands. Increased global competition requires innovative technological solutions and products to meet the needs of an increasingly diverse population of users. Women are an under-tapped resource for both meeting employment demand and helping to increase innovation through increased diversity. A significant amount of research has been dedicated to the small number of women who decide to begin down the information technology career path. Most of the research has focused on university computer science programs. The university programs attract largely middle- and upper-middle-class white women. Community and technical colleges are an essential training ground for middle-skilled information technology careers. The colleges traditionally attract a more diverse student body and are primed to help train the future computing workforce. In this exploratory study, four women who are current or recent students in two-year colleges in the Upper Midwest and who vary in age, socio-economic status, and racial/ ethnic identity were interviewed to better understand their lived experiences and perceptions that have helped them envision themselves in careers in information technology.

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Chapter I: Introduction

The digital revolution has fueled huge job growth in information technology and computing (ITC). The Bureau of Labor Statistics (2015) projects nearly half a million estimated new jobs created by 2022 and nearly 1.1 million job openings by 2024. Currently the United States talent pipeline will not be able to keep up with demand to fill open positions, affecting companies' bottom lines and causing ripple effects in the nation's economy (Torres, 2017).

Popular culture and the media have noted the important role information technology is playing in cultural and economic shifts. The technological advances that have marked our era have accelerated over the last three decades, causing disruption and change akin the shifts of the Industrial Revolution (Dees & Saint-Guilhem, 2011). According to bestselling author, innovator, and consultant Greg Satell writing for *Forbes Magazine*, the Digital Revolution has just begun, with monumental shifts in the structure of the economy and nature of work yet to come (2014). In order to remain a global leader, the United States will need to utilize more of its human capital to innovate on new products and services.

Information technology and computing has been a driver in the United States economy. In recent years, policy decisions have constrained the current information technology and computing labor force. The strained existing talent pipeline is under threat. Over the last few decades, many technology companies have relied on the H1-B visa program to import middle-skill information technology, or IT, professionals from oversees (mainly from India). H1-B visas are the largest category of guest worker visas designed to fill gaps for employers for specific roles that they say cannot be filled by an American worker (United States Citizenship and Immigration Service, 2019). Up to 65,000 visas are issued each year. The roles require a minimum of a bachelor's degree and are predominately in the fields of science, technology, and

healthcare. In the technology industry, Torres, referencing a February 2017 report by Goldman-Sachs Research, stated that H1-B visa holders fill an estimated 12-13% of the positions (Torres, 2017). Torres (2017) notes that some have criticized the H1-B visa program for overlooking domestic talent. President trump noting this frustration, has spoken about dismantling the program in his "Buy America, Hire America" initiative (Torres, 2017). Many companies, because of the low number of US graduates, say that they need more people in the pipeline, regardless of where they come from.

Women are an under-tapped resource, making up only 25% of the computing and technology workforce (Ahuja, 2002; Ashcraft, McLain, & Eger, 2016). The number of women entering the information technology and computing field has declined over the last 30 years (National Center for Women in Information Technology, n.d.). To meet employer demand, more women and other under-represented minorities will need to enter training programs (Forbes Insights, 2011). A large share of the growth in information technology and computing will be middle-skilled workers, or those with less than a bachelor's degree and more than a high school credential (Harvard Business Review, 2015).

Training more women for careers in information technology and computing can do more than simply help fill the talent pipeline. Women earn less than their male counterparts, and black women fare even worse. Training more women for careers in information technology and computing can help more women find work with family-sustaining wages. (Barroso, 2018). Although it is widely cited that women on average earn 20% less than their male counterparts, a new study looking at lifetime earnings shows that women, over their careers, make just 49% as much as men (Rose & Hartmann, 2018). Recent data show that the wage gap between women of color and white men is increasing (Barroso, 2018). Even though women in science, technology,

engineering, and math (STEM) fields earn 33% more than comparable women in non-STEM fields, women are choosing not to pursue careers in science, technology, engineering, and math, particularly computer science (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011). With their higher-than-average wages and projected growth, information technology and computing careers could help bridge the gap and lead women and children out of poverty.

Companies that employ more women from more diverse back grounds will benefit from more women in the occupation. Gender diversity positively affects innovation, bottom line performance, and competitiveness (Barta, Kleinne, & Neumann, 2012, Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011). Companies in the top quartile of gender diversity are 15% more likely to have earnings returns above the mean (Hunt, Layton, & Prince, 2014). The more types of diversity—race and gender, for example—there are in a company's workforce, the greater is the impact of diversity on innovation. Hewlett, Marshall, and Sherben (2011) surveyed 1,800 companies and found that companies with multiple forms of worker diversity, such as race and gender, had a 45% higher likelihood of an increase in market valuation. The higher the number of diverse members on a team, the greater was the impact. Diverse teams launch more-innovative products and meet the demands of new markets. The perception of the majority of Fortune 500 leaders aligns with the research: they believe diverse workforces can create a competitive advantage (Forbes Insights, 2011).

In the highly competitive information technology sector, maintaining a competitive edge through innovation is essential. In a 2016 study by Arroyo et al., gender diversity positively correlated with innovation, specifically within the technology sector. The lack of diversity among the information technology and computing workforce negatively impacts bottom-line success in fields in which innovation matters (Forbes Insights, 2011). Diversity positively

impacts company reputation by demonstrating that the company is working to address societal issues in an industry that is under increased scrutiny from lawmakers and the public (Bear, Raman, & Post, 2010).

      A single solution for meeting the growing need for information technology workers will not meet the emerging needs. Traditionally, most information technology and computing roles were filled with highly skilled workers with advanced degrees. In recent years, the entry-level requirements for a career in the field have changed, and now are much more focused on soft skills, company fit, and willingness to learn. Many information technology workers have degrees in the liberal arts and are self-taught or learned technological skills on the job. A number of alternate skills-training programs have emerged to meet the demand (Chapple & Zook, 2002). Many of these training programs are in non-traditional educational settings (Chapple & Zook, 2000). Some of these programs, so called "boot camps," typically are short and intense, often running for a few weeks at nearly full-time hours (Chapple, 2006). Noting the massive lack of diversity in technology fields in both gender and race, many organizations have a social justice focus that seeks to equip women and minorities with the skills they need to enter the field (Chapple, 2005). Code Fellows, for example, opened a training center in Chicago, and claims that Silicon Valley, with its "high rent" and "lack of diversity" is losing its place as the premier place for technology (Code Fellows, n.d.). In addition, Code Fellows started a foundation to pay the tuition for the program for women and minorities (Code Fellows, n.d). Other organizations are geared specifically toward developing under-represented talent, including Girl Develop It, a not for profit with chapters in 54 cities, whose mission is to provide "affordable" and "judgement free" training for women in tech careers (Girl Develop It, n.d).

Although alternative training programs have gained popularity in recent years, the value of short-term, skills-based credentials is up for debate (Dadgar & Trimble, 2015). Short-term credentials can be very effective tools for those with formal educational experience, such as an earned college degree, looking to add job specific skills, but may not help those who have fewer experiences in higher education (Chapple, 2005, 2006). For many others, especially those who lack other significant higher-education experiences, longer-term credentials and associate degrees consistently correlate with job attainment and higher earning.

Community and technical colleges often have both computer science transfer-focused associate degrees and occupationally specific applied associate degrees that train students for entry-level information technology careers in programming, computer support, network administration, and web development. The nation's community and technical colleges are essential players in their communities. Community colleges help move women and men from poverty-level wages into living-wage jobs. They are accessible in communities all over the country and often are very tightly aligned with the needs of industry through advisory committees, co-ops, internships, and apprenticeships. Community and technical colleges likely will bear the responsibility for training the next generation of workers in computing and information technology (Harvard Business Review, 2014). The two-year college system has a unique opportunity to train a more diverse workforce (Bailey, Jaggers, & Jenkins, 2015). They attract a more diverse population on average than do their four-year counterparts, have fewer barriers to entry, and offer a more personalized learning environment (Denner, Werner, O'Connor, & Glassman, 2014). With nearly 1,000 campuses nationwide in urban and rural communities, flexible scheduling, and online training, public community and technical colleges

are within reach for most Americans "geographically, financially and practically" (Cohen, Brawer, & Kisker, 2013, p. 38).

Community and technical colleges are uniquely suited to equip students with the middle-skill careers with high growth potential in information technology and computing (Cohen, Brawer, & Kisker, 2013). Although some of the growth will be at the top end of the skill distribution, much of the growth in these fields does not require an advanced degree or even a bachelor's degree (Shanholtz, 2019). Many of the emerging and growing occupations in information technology and computing are "middle-skill" jobs (Chapple, 2005). Middle-skill jobs typically require more education than a high school credential and less than a four-year degree for entry (Harvard Business Review, 2014). A middle-skill job has a decent starting salary, typically is hard to fill, and provides significant value for the employer (Harvard Business Review, 2014). The policy organization Jobs for the Future (n.d.) has advocated for a policy focus on equipping under-skilled workers for middle-skill careers as a key strategy for helping build impoverished communities and helping disadvantaged women and minorities escape the low-wage cycle by creating economic resilience and stability. A recent Pay Scale study of pay and hiring trends across industry analyzed the top ten occupations at the as sociate degree level for income potential. The list includes computer engineering and related occupations, computer network technician and computer support specialist, and computer programming and software development (PayScale, 2019).

Even though more women than men earn associate degrees and more women than men attend community colleges, the increased access has not led to a higher percentage of women choosing to study information technology or computing. Despite the opportunity, community and technical colleges have not produced and are no better at creating a diverse pipeline of

graduates for work in information technology and computing than are traditional four-year universities. Only 25% of associate degrees in computing are earned by women (Dowd, 2012). This number is down from a decade earlier (Dowd, 2012). Without the participation of women in these degree programs, employers will not be able fill the talent pipeline and demand for qualified workers. The total number of associate degrees in information technology and computer science has increased over the last ten years, but fewer women completed associate degrees in information technology and computing degrees in 2012 than a decade earlier (Dowd, 2012).

The research is clear: women are not choosing careers in information technology and computing not because they are not able, but because they either never consider it or actively decide against it. The issue is not one of ability, aptitude, or skill. High-math-achieving women chose other careers (Ceci & Williams, 2010; Cheryan, Master & Meltzoff, 2015; Doerschuck, Bahrim, Daniel, Kruger, Mann, & Martin, 2016). Many women never even consider entering the talent pipeline (Cheryan, Drury, & Vichayapai, 2013). They do not see careers in information technology and computing to be for them (Cheryan & Plaut, 2010).

Deeply ingrained societal and social factors related to gender stereotypes and expectations are impacting women's interest and willingness to enter the computing field (Cheryan & Plaut, 2010). Information technology and computing has been gendered societally as a male occupation with male work values and male rewards (Chow, Eccles, & Salmela-Aro, 2010; Diekman, Brown, Johnston, & Clark, 2012; Diekman & Eagly, 2008). Gendered expectations, beliefs, and structures keep women from seeking training. Gender is complicated by race, class, and socio-economic background, creating unique barriers for different women.

Negative stereotypes related to work culture and identity of the type of people who are in information technology impact the number of women recruited into training programs (Cheryan, Handron, & Hudson, 2013). All else being equal, Meltzoff (2013) found that negative stereotypes about who works in information technology and computing significantly influences women from ever considering a career in the field. One stereotype is that only "geeky" students and "gamers" enter the field. Women simply do not see themselves in the stereotype (Cheryan & Vichayapai, 2013).

Purpose of the Study

The purpose of this study is to better understand the life experiences and personal stories of women who have decided to enter training programs in information technology and computing in community and technical colleges. In telling their career stories, women have crafted identities that are aligned with their perceived future selves. By understanding the stories that have worked for women, colleges can craft interventions and strategies for recruitment.

This researcher's work relies on the social cognitive theories of self-efficacy and the future-self, which acknowledge the dynamic interplay between individuals and the institutional constraints of the social system. The theories acknowledge the complexity of the individual and their circumstance and consider that the individuals seek to exert some influence over their lives (Bandura, 1997). A person's self-concept is dynamic, changing over time and influencing their motivation and willingness to change their present self. Self-efficacy asks "Am I capable of accomplishing this goal?" Future-self theory asks "Can I see myself as a person who would accomplish this goal?" The future self is a mix of aspirations, goals, motives, fears, and threats. Context matters, and career identity is mutable. Social cognitive career theories are narrative based and nuanced. They change as culture and an individual's experience change. Stereotypes

and expectations impact both the beliefs of the field of choices for someone like them and what an individual is capable of accomplishing.

Over the last few decades, new models have emerged in career theory that engage with the complex and dynamic career world. The complex career world includes technological changes that require workers to continually re-tool; automation that is taking the place of some workers; and less certainty and stability, caused by the decrease of long-term employment and an increase in short-term and contract employment (Wright, 2018). In this research, the researcher employs the Chaos Theory of Career model to examine career progression. The Chaos Theory of Careers (CTC) was developed by Bright and Pryor (2005) in the early 2000s to address the evolving career landscape that was ever-changing and contingent. In complex systems, both internal and external influences and small events can have large impacts. Less emphasis is placed on rational choice and individual action, and failure is normal and to be expected. Careers are often non-linear, full of fits and starts and turns. Nonetheless, career narratives emerge.

Research Questions

The overarching research question for this study is: What perceived and or lived experiences supported women entering and persisting in **information technology and computing training** programs of study? The following sub-question further illuminate the research design:

a. What are the perceived and/or lived experiences that led them to declare, choose, and enter the ITC program of study?

b. What are the perceived and or lived experiences that supported them within their ITC program setting?

c. What experiences do they expect in their future ITC profession?

Importance of the Study

A significant amount of research has looked at increasing the number of women in information technology and computing. The majority of the research related to why women do not choose careers in information technology has been conducted at competitive four-year research institutions, and mostly has involved the participation of white women of middle or higher socio-economic status. This study seeks to address this gap and account for the variety of lived gender experiences that intersect with race and class. Community and technical colleges will play an important role in equipping future workers in information technology and computing. These institutions have traditionally been more open-access with fewer barriers to entry, but fewer women are entering these programs than the four-year university programs (Dowd, 2012). If community and technical colleges can attract more women to their programs, they could have a huge impact on the talent pipeline. This study, examining those female students who chose a community or technical college route to a career in information technology, could help institutions better understand female students motivation and craft marketing and outreach materials accordingly.

Assumptions

The research assumes that each individual experiences the world in their own unique way. The hermeneutical approach developed by Martin Heidegger examines the individual and their perception of reality in a given time and place. The individual's perception is based on their cultural space; their socio-economic background, gender, race, and experiences all contribute to the way that they view the world. The person, culture, and context all come together to form the individual's truth of their experience.
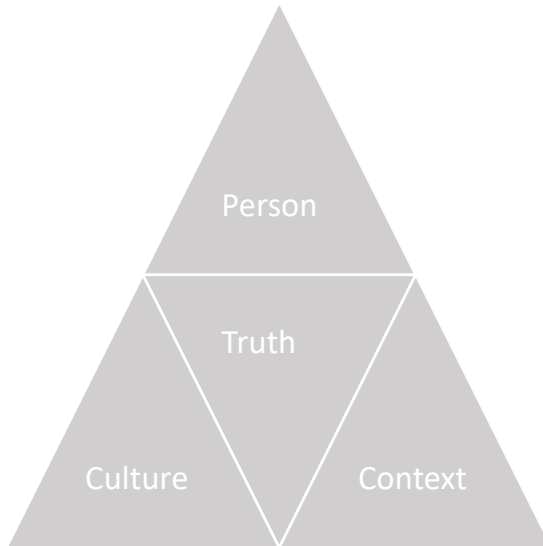
Figure 1. Martin Heidegger's hermeneutical triangle. This figure illustrates the interplay between the person, culture, and context in constructing reality.

Limitations

The phenomenological study is not intended to be generalizable. The goal of the study is to be exploratory and to better understand a complex phenomenon in order to ask better future questions. Women are not monolithic. They have unique experiences that are complicated by race, age, and socio-economic status. Two-year college students are more diverse than their four-year counterparts, and this exploratory approach to understand a variety of experiences could help guide future research.

Definition of Terms

Associate degree. A two-year college degree. Typically half the duration of a bachelor's degree. Two main types: 1) applied in a technical field; and 2) general education.

Community college. A public two-year college with a core mission of awarding associate degrees. In many cases these colleges focus on associate degrees in liberal studies for

transfer; in many instances they also offer career-oriented associate and certificate programs (Cohen, Brawer, & Kisker, 2013).

Middle-skill career. A career that at entry requires more than a high school diploma but less than a bachelor's degree. The career has a family-wage entry salary, is hard to fill, and has a high value for the employer (Harvard Business Review, 2014).

Middle-skill career—IT and computing. Careers in the information technology career cluster area, including 1) web and digital communication, 2) information support and security, 3) programming and software development, and 4) network systems that often are filled with associate degree holders in a technical field. Examples include computer support specialist, quality assurance analyst, business analyst, network systems administrator, and web and software developer.

Middle-skill gap. A mismatch in the labor market based on skills, in which too many people are not skilled and are qualified only for low-skill work, and employers have openings that cannot be filled by the existing labor market (Harvard Business Review, 2014). This is exasperated by demographic shifts, including the retirement of the Baby Boomer generation and economic change.

Technical college. A type of community college that emphasizes technical or occupational training for middle-skill careers (Cohen, Brawer, & Kisker, 2013).

Chapter II: Literature Review

Growing a diverse talent pipeline for careers in information technology and computing is a crucial area of study. The current pipeline of workers is not able to meet current demand or the growing demand for future workers (Bureau of Labor Statistics, 2015). Not only will companies not be able to fill positions, they will lose out on the innovative edge created by a diverse workforce. Companies from Louis Vittan (Friedman, 2019) to Johnson & Johnson to Mastercard to pharmaceutical giants are recognizing that diverse organizations are recruiting diverse talent in a high-profile way in order to be more adept at meeting the needs of customers and users (Taylor, 2019). Diverse teams help with new product development and help ensure that products developed meet the needs of a an increasingly diverse and savvy market (Dell'Era & Verganti, 2010). Diversity among teams fosters innovation and can help bottom-line performance (Phillips, 2008). In 2016, Facebook, citing that despite its efforts to increase diversity among employees the company was still struggling, hired a Director of Diversity (Myers, 2018).

Maintaining an innovative edge will become increasingly important to maintain the global standing of the United States (Dees & Saint-Guilhem, 2011, Levine, 2009). Global competition is increasing, with emerging economies once content to build products designed in the United States now focusing on innovation (Awate, Larsen, & Mudambi, 2014). The future technology landscape will require the United States to compete with increasingly savvy global competitors (Awate, Larsen, & Mudambi, 2014). The full societal and business impacts of a heterogeneous workforce are yet to be seen. Researchers have looked to all levels of the talent pipeline to remedy the disparity, including interest, recruitment, retention in training, completion, and persistence in the career field.

Although the computing and information technology sectors have a problem with all types of diversity, this paper specifically is concerned with the role of women in these sectors. Women are an underrepresented demographic in computing and information technology roles (National Center for Women in Information Technology, n.d.). This literature review addresses the barriers to increasing the diversity of the fields of information technology and computing with women from a variety of socio-economic, racial, ethnic, and sub-population identities.

This literature review addresses the following key variables: the role of gender in society; the role of gender in the information technology and computing sector; the role of gender and work identity; the role of diversity in the workplace; community colleges as training grounds for middle-skill careers; recruitment of female students in information technology training programs; retention of female students in training programs; career retention of female graduates in information technology and computing careers; and self-efficacy theory, future-self theory, and the Chaos Theory of Careers.

Diversity in the Workplace

In a survey of 321 executives of large global companies in 2011, 78% of respondents indicated that in the coming year diversity would have somewhat or significantly more focus in their organizations. Key themes emerged from follow-up interviews, including diversity as a key driver in fostering an environment of innovation through increased representation, perspective, and approach (Forbes Insights, 2011). Hewlett, Marshall, Sherbin, and Gonsalves (2013), researching on behalf of Intel, found that hiring a diverse workforce is especially important for technology firms in an era of global competition and global markets. The researchers analyzed 170 companies in tech and found a positive correlation between revenue, profits, and market

value and diversity. Their findings indicate that increasing diversity could add over $500 billion in valuation to United States–based companies.

Although companies are investing significantly in creating diverse talent pipelines, the research is mixed as to how and when diversity at the senior levels drives bottom-line performance. Miller and Del Carmen Triana (2009) found that corporate board diversity was positively related to both innovation and company reputation. Hunt, Layton, and Prince (2014) analyzed 366 companies and found that companies in the top quartile of racial and ethnic diversity have returns 35% above the mean in their industry. Companies in the top quartile of gender diversity are 15% more likely to have returns above the mean. The amount of diversity had to be above the level of tokenism; 22% of the executive team had to be female before a statistically significant relationship emerged. Van der Walt and Ingley (2006) found that beyond numbers of women or tokens, the greatest impact of diversity occurs when women have the skills, abilities, experiences, and talents to contribute in an environment in which they are heard. Nili (2019) also found that numbers are not sufficient, and that women with more clout and influence had a greater impact on firm outcomes. Barta, Klienner, and Nuemann (2012), on behalf of the consulting firm McKinsey, found that bottom-line performance increases with board diversity. Barta, Klienner, and Nuemann (2012) analyzed company valuation based on the leading stock market indices and found that companies with the most diverse boards have statistically significant higher earnings levels and shareholder returns. Hamdani and Buckley, in a 2011 meta-analysis, found that the emphasis on bottom-line impacts of diverse boards have been overemphasized and that the results are mixed. The researchers note that what success looks like on diverse boards has been too narrow, and recommend broadening the goals that companies have for creating a diverse leadership team to include goodwill and social impact.

Bear, Rahman, and Post (2010) found that having more women on boards increases a company's score on the Corporate Social Responsibility Index and impacts firm reputation in the marketplace.

Team diversity has been shown to increase innovation, but can be limited by conflict, company culture and/or tokenism. The Forbes Insights researchers found that many executives believe that innovation is driven by diverse values and approaches that can help flip a problem on its head or lead to a new product (Forbes Insights, 2011). One important outcome of diversity is that a larger bank of life experience and perspectives is present in a team and can provide a wider range of possible solutions (Phillips, Medin, Lee, Bang, Bishop, & Lee, 2014). In order for this to be effective, space has to be given for diverse viewpoints to be heard. Wenger (2000) found a trade-off between the diversity of ideas in a diverse team and the commonality of experience in a homogeneous team. Homogeneous teams look inward, whereas diverse teams have been shown to look outward (West, 2008). Dell'Era and Verganti (2010) in a study of 12,811 firms found that diversity can help bring new products to market that meet a niche community's needs. Globalized teams with dispersed workforces have been shown to develop products that better meet the standards, requirements, and needs of their communities. In their comprehensive review of employee surveys and employer data, Østergaard, Timmermans, and Kristinsson (2011) found that racial and gender diversity increase product innovation. Hewlett, Marshall, and Sherbin (2013) surveyed 1800 companies in a nationally represented sample and found that if multiple forms of diversity are present, such as race and gender, the effect of a diverse team has an even greater impact. The impact of two or more diversity types on innovation has a 45% higher likelihood of an increase in market valuation and a 70% higher likelihood that an organization will enter a new market.

Not all work cultures benefit in the same way from diversity. Østergaard, Timmermans and Kristinsson (2011) found that in instances in which organizations had an "open" work culture, the impact of diversity was more pronounced. Lorenzo, Voigt, Schetelig, Zawadzki, Welpi, and Brosi (2017) working on behalf of The Boston Consulting Group, found that open work cultures received the most innovation benefits from diversity. Hewlett, Marshall, Sherbin, and Gonsalves (2013) found that impacts of team diversity on innovation are most pronounced in management structures that seek diversity and embrace openness and innovation. They found that cultures that normalize speaking up and sharing and that embrace disruption have the most positive impacts from diversity. In addition, they found a more significant impact of diversity in large or complex organizations. One key damper on the positive effects of diverse teams is that when a corporate culture is closed or has a low level of diversity, these organizations have higher turn-over rates and lower levels of job satisfaction among members of the under-represented community (Milliken & Martins, 1996). In such situations, conflict and a desire to maintain the status quo can impede the benefits of diversity. When the diversity numbers reach a critical mass, the problems of high turn-over rates and lower levels of job satisfaction disappear. Horowitz (2005) conducted a literature review of diversity in teams and found that when teams are mismanaged, diversity can lead to intra-group conflict. They can show characteristics of lack of trust and miscommunication. When diversity is managed well, in an open setting, and a strong team identity is created based on shared characteristics, diversity can add a competitive advantage.

Gender in Society

In their literature review, Barker and Aspray (2006) describe a landscape in which the study of the under-representation of women in IT is complicated by the complexity of the socio-

cultural categories of gender and biological sex. The complexity of the issue often is glossed over, not giving the appropriate time or space to really understand why so few women are in the field.

Many contemporary researchers understand gender as culturally defined, context based, and mutable (Adams, 2006; Brewer, 1999; Diekman & Eagly, 2000; Eagly, 1999; Eagly and Wood, 1991; McDowell, 2018; McNay, 2013;). Gender is not an inborn set of characteristics, but characteristics that are both demonstrated and idealized to meet socio-cultural ends.

Biological sex traditionally has been constructed as binary. At birth, children were assigned a sex of male or female. In recent years, the limitations of a binary structure of sex have been brought to the forefront culturally and in research. McDowell (2018), noting the complexity and the myriad exceptions, notes that binary gender distinctions limit the richness and variety of human experience. It has never been as cut-and-dried as male or female, and sex still often is used as a shortcut for gender. Both sex and gender are important components of identity. In an experiment conducted by Goodale, Alt, Lick, and Johnson (2018), students quickly assessed the sex breakdown percentages of groups.

Someone who is assumed to be a female or male has been categorized and assigned gendered stereotypes. The construct of gender plays out in society as gendered stereotypes that are based on observations of the roles that women and men perform within a certain context. The stereotypes, like all stereotypes, are used by our quick-thinking brains as a shorthand, a summary of what and who someone is and should be based on an observable characteristic (Kahneman, 2011). The stereotypes are both prescriptive and descriptive; in other words, stereotypes are used not only to say what is feminine but also what should be feminine (Burgess & Borgida, 1999; Heilman, 2012).

Diekman and Eagly (2000) describe gender as a variety of socially constructed "scripts" that prescribe values, attributes, and activities. These scripts are internalized, impact our behavior, and help form our judgements of ourselves and others. Eagly's landmark 1999 study looked back evolutionarily to the socio-cultural characteristics that are preferable in a mate. Others have found that gendered constructs are impacted by the structure of our institutions and our modes of production, and vary by class, race, and socio-economic status (Brewer, 1999; Kite, Deaux, & Haines, 2008; Lyons, Ng, & Schweitzer, 2014). In other words, not all women have or are expected to act the same based on historical or cultural situations. The scripts were influenced by the roles that men and women have inhabited and what roles society believes they "should" inhabit (Diekman & Eagly, 2008). The social roles frame the opportunities that people seek.

In our current global, ever-changing world, we are constantly exposed to new ideas and ways of being and "doing gender" (McDowell, 2018; McNay, 2013). Exposure to new ways of being and doing gender often precede broad social acceptance and can be risky. Acting according to expectations of a role is inherently rewarding, whereas acting against type can bring punishment, or in other words, being a good fit to gender stereotypes leads to social reward (Diekman & Eagly, 2008).

Other advanced Western countries have similar gender stereotypes: men are described as primarily agentic (agents in their own lives), powerful, achievement oriented, and directional, whereas women are described as more passive, benevolent, and concerned for the welfare of others (Costa, Terracciano, McCrae, & Deiner, 2001). Women are considered to be more communal than men; primarily interested in the care of others; and less interested in financial gain, status, or power (Haines, Deaux, & Lofaro, 2016).

Feminist theorist Grosz (2010) suggests the importance of looking past what traditionally have been male and female roles, and to future possibilities. We have lived and worked within structures that benefit men, and feminism is a direct attempt to address the reality of our society and its biases in all of its complexity and mystery. Adams (2006) theorized that in a rapidly changing world, with a lack of social structure and upheaval, in which we are exposed to new ideas, people, and thoughts, people will have increased flexibility to author their own lives and gender identities. McDowell (2018) studied the variety of ways in which gendered boundaries are renegotiated with global migration and across multiple identity spaces. There is a plurality and diversity of gendered experience—not one way of being feminine or masculine, but many. Gender is intercut by other factors, such as class, age, ethnicity, and sexuality.

The stereotypes of a group should change over time as the roles of individuals within a group change, and with drastic shifts in the roles of women in society over the last decades, Diekman and Eagly (2000) hypothesized that female gender stereotypes should change more rapidly than male stereotypes. Even so, many studies have shown gender stereotypes to be very resilient, changing more slowly than the roles that people perform (Abele, 2003; Haines, Deaux, & Lofaro, 2016). Over the last few decades, as the roles of women in the United States and other countries have changed drastically, with increased workforce participation and educational and social attainment, gender stereotypes about what a woman should be and how she should behave have remained largely stable.

Even with drastic societal changes, a number of studies have shown a high level of consistency across time and location. Costa, Terracciano, McCrae, and Diener (2001), surveyed 77,528 participants across the globe and found that men consistently place more importance on power, achievement, and self-direction, whereas women value benevolence and universalism.

Schwartz & Rubel-Lifschitz (2009), in a large global survey, also found that women valued benevolence and universalism more than did men, but as societies became more equal the differences between genders regarding the value of benevolence, universalism, self-direction, hedonism, and stimulation shrank. In the same study, both genders in more-egalitarian societies valued power, conformity, achievement, and tradition less. More-recent studies have shown that women are seen increasingly as agents in their own lives. Kite, Deaux, and Haines (2008) critique much of the research on the stability of gender stereotypes, noting that most studies rely almost exclusively on white, middle-class, college-age, or educated women, and fail to take into consideration the variety of ways in which women are gendered, especially within other socio-economic and cultural milieus.

In an early foundational study, Eagly and Steffen (1984) found that stereotypes about women being communal and men being agentic were not role dependent or were not formed from observing women in lesser roles. Men in lower-status roles were viewed as more agentic than women. Lower- and higher-status women still were more likely to be viewed as communal than were men. A later study showed similar results; in a survey of 2,000 undergraduates at graduation and 1.5 years later, Abele (2003) found that gender stereotypes were consistent despite experience with the opposite gender in non-conforming roles. Men were associated with agency and women were associated with communal and familial roles.

Gender and Work

Belonging is important in career choice (Cheryan, Drury, & Vichayapai, 2013). Research has shown that people chose to engage in activities with people whom they perceive to be like them (Meltzoff, 2013). Young people decide to smoke if they categorize smokers as like them and chose where to live or with whom to live based on perceived similarity to people who

participate in an activity or live in a situation (Niedenthal, Cantor, Kihlstrom, & Sherman, 1985). When selecting a career, people quickly assess both the ideal "type" or archetype of a person in the field and if it is "like or unlike" them. Same-sex identification is one key way people assess "like-ness." College students could quickly assess the sex make-up of a group and assigned gendered stereotypes to a group (Goodale, Alt, Lick, & Johnson, 2018). Groups that had more men than women were assumed to be sexist. People's self-perception is based on how they are and how they think they should be. People opt out of activities that are not "like them."

When selecting a career that is like them, young people look to the gendered stereotypes of the work itself. In the last century, most occupations, with the exception of caregiving and nurturing roles, were gendered masculine. Over the last 50 years, the gender make-up of many occupations has changed dramatically (Diekman & Eagly, 2000). Many roles that traditionally had been gendered male, such as doctor or lawyer, have seen significant numbers of women enter the occupation (Cheryan, 2012). The gendered stereotypes are slower to change than the occupational numbers reflect. An example of this is that a woman in scrubs is assumed to be a nurse, whereas a man in scrubs is assumed to be a doctor.

In their landmark work, Diekman and Eagly (2000) theorized that occupational groups should have dynamic stereotypes that shift over time as the individuals who make up the group change. Occupational categories should change as the roles of women in society change. Gender roles and occupational expectations have not kept pace with the rate of change in society. In their comparative analysis of gender stereotypes comparing 1983 and 2014, Haines, Deaux, and Lofaro (2016) found that although women's occupational roles have changed more than men's have, a high level of stereotype durability has remained. Men are stereotyped as more agentic, or in charge of their own choices and destiny, and women are stereotyped as more communal. In

addition, the beliefs about what traits it takes to be successful in occupations remained salient, even as more women entered the fields.

What it takes to be successful in an occupation is associated with the traditional gendered stereotypes about the occupation. Cejka and Eagly (1999) found that male- and female-dominated fields were associated with stereotypical masculine or feminine characteristics, and that those characteristics were described as essentials for success in the field. Eccles and Wang (2016), in a longitudinal study of 1,200 college-bound 12th graders, found that occupational values, not ability, accounted for gender and individual variability in career choice.

Executive leadership is still highly gendered male, as are some fields including math, engineering, and computer science, and computing roles have had particular gender salience. (Ceci, Williams, Barnett, & Cooper, 2009; Morgan, Isaac, & Sansone, 2001; Wang, Eccles, & Kenny, 2013). Cheryan (2012) found that math stereotypically is gendered male, and suggested that in order to change the gender make-up, the perception of the field must be changed to reflect fewer stereotypically male-gendered characteristics.

Morgan, Isaac, and Sansone (2001) researched the difference between students' work goals and their perceived goal affordance in male and female choices of careers. Women selected "interpersonal" work goals more frequently than did male students, and high pay and status less frequently than did men, and showed preference for selecting careers perceived to be aligned with their values. A large global survey of over 77,000 people revealed that men consistently attribute more importance than do women to power, stimulation, hedonism, achievement, and self-direction values; the reverse is true for benevolence and universalism values, and less distinctly for security. The sexes did not differ on tradition and conformity values (Costa, Terracciano, McCrae, & Diener, 2001).

With the pervasiveness of gender stereotypes, women and men often chose gender stereotypical roles. If women chose to go into a masculine dominated field, they may feel a stereotype threat of conforming to a negative stereotype (Cheryan, Plaut, Handron, & Hudson, 2013). In highly male-gendered careers, women often opt out, not just because of gender balance but also because of perceived values. As groups become more balanced with men and women, all people feel more like they belong (Goodale, Alt, Lick, & Johnson, 2018).

Diekman and Eagley (2008) in a review of the current literature found that social roles frame occupational opportunities for both men and women. Individuals are more likely to seek and attain goals that are afforded by their gender role. Diekman and Eagley found that role congruity between the perceived gender identity and the demands of the role is an important factor. For both sexes, good fit to the opportunities available within their society provides social rewards and aids in building satisfying relationships.

When either gender does not conform to gender role fit, they face negative consequences for role incongruity (Diekman & Eagley, 2008). The effect holds for both genders, but the impact on females in male-dominated roles is more pronounced. Women are treated more harshly than men when they act against type in employment evaluation, hiring, and perceived "likability." Kaiser and Spalding (2016) found that women who have a low gender identification in a male-dominated field tend to support men over other women with high gender identification. In a non-male-identified field or a neutral field, the effect disappears. Women who do not conform to gendered female stereotypes were shown to be evaluated more harshly in the hiring process (Koch, D'Mello, & Sackett, 2015; Rice & Barth, 2016), whereas the same was not true for counter-stereotypical male candidates (Rice & Barth, 2016). In male-gendered jobs, women who are successful are more often derogated than men (Heilman, Wallen, Fuchs, & Tamkins, 2004).

Women often face a "damned if you do, damned if you don't" double bind: if they act according to gender stereotypes they are dismissed as dumb, and if they act counter-stereotypically they are punished for acting "against type" (Heilman, Wallen, Fuchs, & Tamkins, 2004) Gender stereotypes are both descriptive and prescriptive, indicating not just how women are but how they should be. When women act against the gendered stereotype (or have less role congruity), they are seen as less likable (Heilman, 2012).

Women in Information Technology and Computing

Although women hold over 50% of professional positions in the United States, in 2015 they held only 25% of the positions in computing (Ashcraft, McLain, & Eger 2016). The number of women in computing peaked in 1991 and has been declining ever since. Although the number of women overall in computing is concerning, the number of women of color in computing is abysmal, with black women making up only 1% of programmers and 2% of systems analysts (Ashcraft, McLain, & Eger, 2016). Women who do enter computing can find the work culture especially punishing. Male-dominated work cultures, such as most computing work places, have more stereotypical views of women, higher rates of implicit bias, and more incidences of micro-aggressions (Ashcraft, McLain, & Eger; 2016, Ellemers, 2018; Maddock & Parkin, 1993; Reuben, Sapienza, & Zingales, 2014). In male-dominated work cultures, women are limited in the ways in which they are allowed to express themselves, and are put in the position of reinforcing masculine norms (Padavik, 1991). Women are punished when they break with gender norms (Heilman & Parks-Stamm, 2007).

Fewer women choose computing and information technology degrees than any other STEM career field (Ashcraft, McLain, & Eger, 2016). More women leave computing occupations than other professional fields. Glass, Sassler, Levitte, and Michelmore (2013)

analyzed records from the 1979 National Longitudinal Survey of Youth and found that over time, more women leave computing fields than other occupations, and most frequently when they leave they do not exit the workforce but continue working in a different career occupation. Young women do not see a future for themselves once they enter the field and jump ship (Ashcraft, McLain, & Eger 2016). Although many technology companies have family-friendly policies, informal structures and expectations make it difficult to attain work–life balance (Ashcraft, McLain, & Eger, 2016). Women in technology find it difficult to advance into leadership roles (Ahuja, 2002). Performance appraisals often are subjective and male-centric (Ahuja, 2002). Many leadership roles value technical competence, and women are stereotyped as less technologically capable than their male counterparts (Simard, 2008). Although workplaces often describe themselves as meritocracies, in a survey of women in technology, more women said that the way to get ahead was through relationships and connections to power and influence (Simard, 2008). Women often lack role models or sponsors and are not tied in to the informal networks that lead to promotion (Fernandez & Campero, 2012). Finding a mentor may be more difficult in technology fields than in other occupations because mentoring is not as valued in technology as it is in other fields (Simard, 2008).

Women in Information Technology and Computing Training

The number of women who enter, are retained in, and graduate from computer science and computing training and degree programs is too small to address the gap in numbers between men and women in the related occupational fields. Many women who enter the computing field come from non-traditional pathways, including the humanities and on-the-job training after starting in an adjacent career field (Chapple, 2006). A significant barrier for some women in occupational career growth and management tracks in computing may be a lack of formal

training or having the "technical chops" believed to be required for such roles (Jesse, Cohoon, & Aspray, 2006). They may enter the field later in life or without as clear an objective for career growth. In order to balance the numbers of women who excel and grow as leaders in the industry, more women will need to have formal computing training (Jesse, Cohoon, & Aspray, 2006). This research examines three key areas that influence the small number of women who enter formal educational programs: early career interest, recruitment, and persistence.

Early Career Interest

Research on developing early career interest for young women in computing careers includes the importance of role models, camps and other exposure to the career field. Parents, teachers, and counselors have large influences on girls. Teachers' beliefs about appropriate behaviors for boys and girls can subtly influence girls' interest in computers (Bamburg, 1994). Often, computer science is an elective or after-school activity that must be chosen; if the curriculum were mandatory, more girls would have exposure to it (Barker and Aspray, 2006). Both girls' and boys' familial cultural beliefs about appropriate gender roles guide their career explorations (Farmer, 1995). Women who entered careers in computer science and IT report having mothers with non-traditional gender views (Ogan, Robinson, Ahuja, & Herring, 2006). Eccles, Jacobs, and Harold (1990) demonstrated that a father's encouragement to a daughter to pursue a computing career was impactful. According to Ogan, Robinson, Ahuja, and Herring (2006), women working in IT and Computer Science said that both their mothers and fathers were an influence but that the influence of fathers was more pronounced. Girls are being encouraged to pursue computer science fields through job shadows, websites, and other interactions with females in the field. In their analysis of media material presented to girls, Cheryan, Drury, and Vichayapai (2013) found that the females portrayed in the media conformed

to many negative stereotypes surrounding careers in computing, including being "geeky," obsessed with technology, and not very good at relationships. They concluded that the issue was that the media were incongruent with female gender norms. The team performed an experiment to determine if brief exposure to a person in computing who conformed to the negative stereotype would negatively impact the potential student's interest in the field. In the study, 100 women college students interacted with both male and female conforming and non-conforming computer science students, then their interest in the field was assessed two weeks later. The study found that women who interacted with the stereotype, regardless of gender, were less likely to be interested in the field. Cheryan, Master, and Meltzoff (2015), summarizing their work and other research, wrote that girls' underrepresentation in computing is not due to their intractable lack of interest in these fields, but instead that their interest is constrained by societal factors, including the stereotypes about the kind of people in, the work involved in, and the values of these fields. The researchers concluded that simple environmental interventions in the media could change the messaging for girls to get them interested in the field at a younger age.

Recruitment

The recruitment of female students to computing training programs is complicated by self-efficacy (I am not good enough), stereotype threat (I do not want to be perceived as geeky), gender role congruity (it is more of a guy thing and I will not belong), and occupations that are perceived to better align with occupational work values (I prefer better hours and a more family-friendly workplace, and I want to do good in the world, not just make money).

In terms of self-efficacy, female students underestimate their science and math ability and the likelihood that they would be good at a field like engineering or computer science (Ehrlinger, Dunning, & Devine, 2003), even though female students are no less good at math than their male

counterparts (Ceci, Williams, Barnett, & Cooper, 2009). Correll (2001) found that cultural beliefs about gender impact female students' self-assessments of their math abilities. Male students had more confidence in their ability with computers than did equally competent female students (Beyer, Rynes, Perrault, Hay, & Haller, 2003; Ogan, Robinson, Ahuja, & Herring, 2006). Creamer, Burger, and Meszaros (2004) found that although female students were as confident as their male counterparts in their beliefs in their abilities, male students overestimated and female students underestimated their abilities when it came to more-complex computer related tasks. Cheryan and Plaut (2010) found that female students report less confidence in their intellectual ability than do their male counterparts. Cheryan, Siy, Vichayapai, Drury, and Virya (2011) investigated whether manipulating people's perceptions of their general ability changed their estimations of how well they thought they would perform on a task. Although both male and female students who interacted with the stereotype described themselves as dissimilar to the stereotype, only female students thought they were less capable of success. Self-views are not always based on personal experience, but on beliefs people hold about themselves or "chronic self-views" that often do not change over time. Ehrlinger, Dunning, & Devine (2003) found that college students exposed to stereotypical information regarding computer science students did not believe that they would be successful in the field; when exposed to non-stereotypical beliefs, the male students changed their perspective, but the female students did not.

Chassin, Presson, Sherman, Corty, and Olshavsky (1981) discovered that self-to-prototype matching is a common social strategy in making complex life decisions. Their three studies show that an individual's self-knowledge and their beliefs about their perceived fit with an idealized prototype of someone else in a particular domain influence the individual's likeliness of choosing that domain. Cheryan and Plaut (2010) found that an individual's

perception of similarity to the "ideal" or prototypical person in the field significantly impacts the person's interest in pursuing a career. Cheryan and Plaut analyzed one male-dominated (computer science) and one female-dominated (English) career field to understand the role that perceived similarity to the prototype plays in an individual's choice to enter a career domain. Two surveys were conducted at two West Coast universities. The first, with a smaller sample size ($N = 62$), found that female students were less interested in computer science than were their male counterparts and that their perceived lack of similarity to computer science majors accounted for the difference. The same pattern was not found in male students; males were no less interested than female students in majoring in English, but male students who saw themselves as similar to other English majors where more likely to pursue English degrees. The study hypothesized that a larger sample size would yield different results. The second study was performed with 675 students. The larger study found that for both male and female students, their perceived similarity to people in the field was a predictor of interest in the respective fields, even after controlling for other social-identity threats and a student's expectation of success. Building on this work, a 2017 study conducted by Ehlinger, Plant, Hartwig, Vossen, Columb, and Brewer of 269 United States college students used an open-ended questionnaire and a set of trait ratings to describe a computer scientist or engineer and then to rate their similarity to the prototype. The study found that, like the one conducted by Cheryan and Plaut, female students perceived themselves to be less similar to the prototype than did men, and the lack of similarity contributed to the gender difference in selecting the major. In addition, the researchers found that female students reported a more extreme, stereotype-consistent perception of computer science and engineering.

Individuals are motivated to formulate plans, achieve outcomes, and chose activities that support and reinforce their perceived identity (Burke & Reitzes, 1981). Brown, Thoman, Smith, and Diekman (2015) and Diekman, Steinberg, Brown, Belanger, and Clark (2017) examined the motivational factors that impede female students from pursuing degrees in STEM in general, and especially in computer science. According to the findings, it is not that female students are *not able* to be successful in the fields, it is that they simply are *not interested*.

Social-identity threats are a possible explanation for female underrepresentation in STEM fields, computing, and information technology (Cheryan & Plaut, 2010). Social-identity threats are potential threats to an individual's identity in a certain domain. These threats can take a variety of forms, but include a fear that one may play in to a negative stereotype about the group, that one might be discriminated against, or that one's identity will not be valued (Cheryan & Plaut, 2010). Cheryan, Plaut, Handron, and Hudson (2013) found that media sources impact the perpetuation of stereotypes. The researchers first asked students about their stereotypes regarding students interested in computing. Both male and female college students held similar stereotypes. The stereotypes tended to be more masculine and included descriptions such as technology oriented, singularly focused on computers, lacking in interpersonal skills, and focused on masculine features such as pale, glasses, unattractive, "genius," and male. In their second study, published in the same paper, the researchers tested the hypothesis that exposure to a fabricated newspaper article that students do not fit the stereotype increased interest in the field. The hypothesis held for women but had no effect on male students. Cheryan, Plaut, Davies, and Steele (2009) conducted an experiment with 39 mixed gender participants in a room filled with either stereotypical or non-stereotypical objects. The students completed a survey in the room about their "current feeling" about computing, including their level of interest in the field, how

likely they were to consider a degree, how similar they were to the students, and how confident they were in their abilities. The study concluded that people can make decisions to join a group based only on exposure to that group's physical environment. The objects in the room were considered by both genders to be masculine. Female students felt less interest in the field, saw themselves as less likely to pursue the field, and were less confident in their abilities than were the male students.

Eccles and Wang (2016) followed the motivational beliefs of 12th graders and their future career choices at age 29 and found that among science- and math-prepared students, individual and gender differences in altruistic occupational values accounted for differences in selecting health, biological, and medical sciences (HBMS) versus mathematics, physical, engineering, and computer sciences (MPECS). The occupational values differences accounted for the differences in number of female students selecting MPECS at lower numbers than HBMS. One barrier to seeing yourself in a field is when your future goals are not aligned with the perceived goals of the career field. Diekman et al. (2011) hypothesized that students perceive computing and information technology careers to be aligned with agentic goals, or goals that are associated with power and status, and not associated with communal goals, solving problems or helping people (2011). Female students had higher levels of association with communal goals and males with agentic goals (Diekman, Brown, Johnston and Clark, 2011). Diekman et al. found that a high endorsement of communal goals exists across the sexes but is higher among women, that STEM careers impede communal goals, and that stereotypical assumptions are higher among women than men. When communal goals were highly activated, both men and women decreased interest in STEM. The team tested an intervention, in which the goal affordance was shifted toward communal goals, and all students who valued communal goals

were more attracted to the field. Diekman et al. (2013) researched the impact of changing the communal aspects of the field to align with female's career preferences instead of trying to change female self-efficacy or science or math interest. Diekman et al. (2013) concluded that 1) social roles influence what goals individuals chose to pursue at a particular time, 2) social roles can impact what types of goals an individual looks for and avoids, and 3) female students are more likely to look for opportunities that have communal goals and there is a stereotype that STEM careers are not communal. The authors recommend recruitment changes to highlight the communal aspects of the field, computer science in particular, in order to attract more female students.

Brown et al. (2015) conducted three studies that showed that regardless of gender, major or college, when students were given messaging regarding the communal goal affordance and societal impact of STEM, both male and female students were more interested in pursuing a career in the field.

High-math-achieving women have more career options than equally high-math-achieving male students. One longitudinal study of 1,490 high school students in the 12th grade and then at age 33 found that the high-math-achieving female students had more career choices than the high-math-achieving male students because they had higher verbal skills. The female students chose career fields that they perceived better aligned with their values, had better work life balance, and were more inclusive of women, including law and medicine. The male high-achieving math students, on the whole, were limited by their verbal acuity in ways that female students were not.

Drury et al. (2011) found that male and female role models were equally effective in attracting female students to STEM as long the role models were seen to be like them. A key

motivator for students in both recruitment and retention is a sense of belonging; this is even a larger issue for minority, first generation, and female college students studying computing (Doerschuk, Bahrim, Daniel, Kruger, Mann, & Martin, 2016).

Retention

Early research, including Adelman's landmark 1998 study, concluded that fewer women persist in computer science courses than men. The early research did not conclude that women were not prepared to complete the courses, but that they chose to drop out of the field. Adelman analyzed data from 14,825 high school students from the national High School and Beyond survey for a longitudinal analysis. The study examined the 11-year period from 1982 to 1993 to track students from high school to college or university and career. The study concluded that there is a 20% gap between female and male student completion percentages for those who reached the threshold in the engineering path even though male and female students had similar grades in engineering courses. The highest-achieving students based on standardized test scores and high school math preparation succeeded at nearly equal rates as the male students. The biggest difference in retention between male and female students was in the middle level of achievement. Male and female students were middle achievers in equal numbers, but the middle-achieving female students left in significantly higher numbers, whereas the male middle-achieving students stayed. The female students who left cited dissatisfaction with their education as the key driver in their leaving, not poor academic performance. In a 2014 large longitudinal study of students in the California community college system, female students enrolled in an introductory computer science course were less likely to pursue degrees or transfers to computer science than their male counterparts (Denner, Werner, O'Connor, & Glassman).

The study examined three widely held beliefs—lack of math preparation, family and peer support, and self-efficacy—and found that all played some role. The most significant differences between male and female students were the lack of positive experiences and interactions with faculty in the classroom and a lack of confidence based on fewer gaming and geeky experiences (Denner, Werner, O'Connor & Glassman, 2014). Although Denner et al. examined why students who select into an introductory class in computer science opt out of pursuing it further, they did not address the lower enrollment of those who never even consider taking a course in the field.

de Cohen and Deterding (2009) found that women persisted in nearly equal numbers as men. de Cohen and Deterding, analyzed over 400,000 engineering and pre-engineering students (the majority of whom were in computer engineering). The enrollment and degree data used in the study were compiled from three primary sources: the American Society for Engineering Education (ASEE), the Engineering Workforce Commission (EWC), and Engineering Trends (2009). Institutional-level data were obtained from the Integrated Education Data System (IPEDS) at the National Center for Education Statistics and the National Science Foundation (2012). Their findings demonstrated that there is not a significant difference between the retention of male and female students in engineering fields (de Cohen and Deterding, 2009).

Community and Technical Colleges

Many women entering new computing jobs do not hold a bachelor's or master's degrees (Chapple, 2006). Between 1990 and 2000, women filled 440,000 new computing jobs, whereas universities produced only 100,000 new female graduates during the same period (Chapple, 2006). Although many jobs in computing are very highly skilled, many entry-level computing positions have been down-skilled from once highly technical positions to positions with technical requirements but more of a focus on soft skills such as critical thinking, teamwork, and customer

services, such as computer support specialists, network administrators, and web developers (Chapple, 2005; Chapple, 2006; Chapple and Zook, 2002). Although at one time some of the entry-level positions in computing occupations may have required advanced degrees, with shifting requirements and an emphasis on interpersonal and communication skills, now many community and technical colleges are meeting demand through shorter-term credentials and degrees (Chapple, 2006). Many women who chose to pursue educational opportunities in computing are non-traditional students; they may start their careers in an adjacent field and later decide to pursue formal education to support or grow their careers (Jesse, Cohoon, & Aspray, 2006). Although computing has many educational entry points that range from on-the-job training to community and technical colleges to top-tier universities, Bartol and Aspray in their 2006 literature review note that there is a gap in the research regarding the role of each for women looking to enter the field.

Community and technical colleges play an important role in educating the American citizenry for work and further education (Cohen, Brawer, & Kisker, 2013). Community and technical colleges award more degrees than their four-year counterparts and represent nearly half of the nation's undergraduates (Bailey, Jaggers, & Jenkins, 2015). In the 2009–2010 school year, for example, nearly one million degrees and certificates were awarded (Dowd, 2012). Of the 630,000 associate degrees awarded, only 40% were transfer-specific liberal arts or sciences degrees; the rest comprised vocational-specific training (Dowd, 2012).

The open-access institutions serve a disproportionate number of low socio-economic status, minority, first-generation, and immigrant students (Bailey, Jaggers & Jenkins, 2015). The rising cost of higher education, increased debt loads of students, and increased economic

requirements that need more students with post-secondary credentials has placed community and technical colleges at the center of much of the public attention (Cohen, Brawer, & Kisker, 2013).

Many community and technical college students face significant economic, academic, and social challenges. Although community and technical colleges play a large role, challenges remain to serve these students in a way to prepare them to transition to further education or the workforce. Dowd (2012) examined recent literature and government data and noted serious concerns regarding the debt load of community and technical college graduates, higher loan default rates, and low completion and graduation outcomes. Minority students with similar college entrance test scores do worse at community colleges than at more-selective institutions (Carnevale & Strohl, 2013). Goldrick-Rab (2010), noting the low completion rates for all students, but particularly for disadvantaged students, calls for a significant, nationwide emphasis on completion. In recent years, reform movements such as Achieving the Dream have looked to overhaul the effectiveness and graduations outcomes of two-year colleges (Bailey, Jaggars, & Jenkins, 2015). One such reform is helping to design clear pathways to high-demand occupations that allow a student to complete a degree as quickly as possible, with work experience and with little debt (Bailey, Jaggars, & Jenkins, 2015; Van Noy, Trimble, Jenkins, Barnett, & Wachen, 2016).

Career Theory

In 1909 the first career theory approaches were created in the Unites States to select appropriate occupational roles for military recruits (Nauta, 2010). Parson's career theory was based on traits and factors to place soldiers into groups. In 1959, Holland published a landmark career theory article, "A Theory of Vocational Choice," that innovated on Parson's theory by creating broad occupational categories over narrow job bands. The idea behind both career

theories is that when the traits of a person and an occupation have a high degree of congruence, it is likely that the person will find satisfaction and success within the occupation. The theory morphed and changed over time, but continued to have an impact in subsequent decades and well into the new century as the basis for career thought. Holland created personality assessments and extensive occupational codes. In 1973, Holland coined the codes Realistic, Artistic, Investigative, Social, Enterprising, and Conventional (RAISIC) that are still in use today. Looking back 50 years after its original publishing, Nauta claims that much of the theory's salience is due to its ease of use and its empirical nature.

In recent decades, noting the amount of change, flux, and complexity of the modern world of work, a number of theorists have looked beyond the traditional models. The modern economic reality of work has shifted toward temporary, casual, and contractual workers (Kalleberg, Reskin, & Hudson, 2000; Savickas, 2012). As a result, many modern workers who are less able to depend on the stability of their employment demonstrate anxiety. The divide between the haves and have nots has become greater, and those traditionally marginalized have been disproportionately affected by the changes (Sweet & Meiksins, 2015). In an attempt to better help the workers of today, constructivist and narrative methods have emerged in the 21st century. Career theory has become less about selecting an occupation, and has moved into the paradigm of "life design," in which one constructs a career through small stories, reconstructs the stories into a life portrait, and co-constructs intentions that advance the career story into a new episode (Savickas, 2012). Figure 2 summarizes the theoretical influences of this study.

THEORY	ASSUMPTIONS	PHILOSOPHY	CAREER PRACTICE	SOURCE FIELD
CHAOS THEORY OF CAREERS	The world is uncertain, change is inevitable	Experience is based on chance and non-linear experience, and is emergent	Narrative career coaching to make sense of story	Theoretical physics, math
SELF-EFFICACY	Agency is a relational triad of behavior, personal factors, and external environment	Believing that you are able to achieve an outcome impacts your willingness to pursue the outcome	Efficacy beliefs predict the slate of options, and entire classes of occupations often are eliminated. Coaching to change efficacy beliefs can change options.	Social cognitive theory, Psychology
FUTURE-SELF THEORY	Future selves are constructed from personal experience, symbolic models, and socio-cultural influences	Envisioning positive and negative future selves can help a person make choices to move toward a desired self and away from a feared self	Narrative coaching to view novel future selves can expand career options. Negative future selves can lead to avoidance of careers.	Social cognitive theory, Psychology
PHENOMONOLOGY	Each person experiences the world in a unique way.	Experience is a hermeneutic or triad of self, experience, and culture	Narrative lends insight into trends or threads of experience	Biblical studies, textual analysis

Figure 2. Summary of influence on the research approach to career theory. This figure illustrates the assumptions, philosophical underpinnings, application in career practice, and primary source field of the theory.

In this career model, the three career models are mapped onto the philosophical approach of Martin Heidegger and his hermeneutical triangle. Figure 3 uses the hermeneutical triangle as a model for mapping the career theory components. An individual's truth at that place and time is in the middle and is informed by their life experiences, internalized stereotypes, biases, their current time of life, priorities and economic reality, and the socially embedded cultural scripts, economic structures and employment trends.
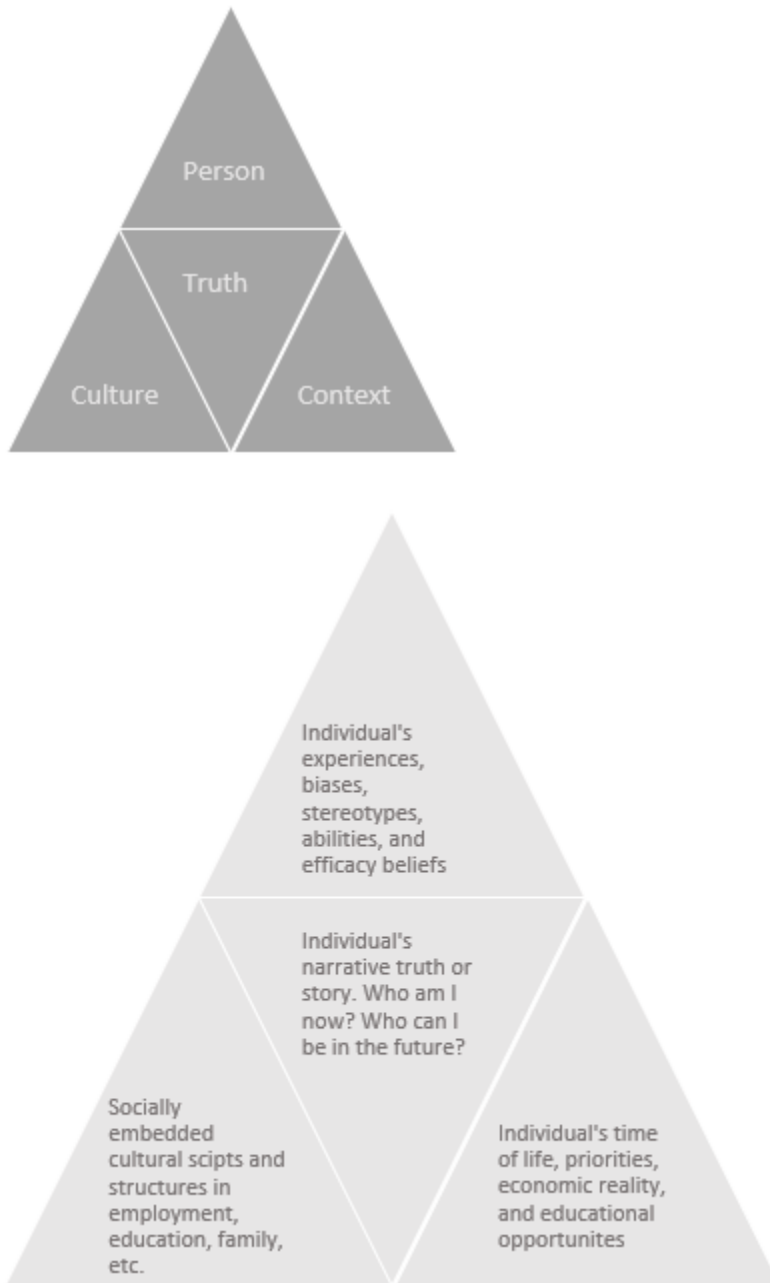
Figure 3. Martin Heidegger's hermeneutical triangle and career theory. The figure represents Heidegger's philosophical approach to understanding truth and its relationship to the career theory influences. This figure illustrates the relationship of the career theories to each other and to the underlying phenomenological philosophy.

The Chaos Theory of Careers originally was coined by Pryor and Bright in 2003 because the existing theories did not fit the messiness of real life and career choice as lived experience. The theory developed a new vocabulary for career development that recognized the complexity of our occupational systems, chance, and change in our dynamic world (Bright & Pryor, 2001; Pryor, 2005; Pryor & Bright, 2014). One new term, emergence, recognizes a discernable order out of apparently random events (Bright & Pryor, 2011). Fractals are traces and patterns that exist in complex systems. Attractors are patterns that individuals who are used to closed systems seek in trying to come to terms with the chaotic reality. In complex systems, both internal and external influences and small events can have large impacts. In complex, chaotic systems, less emphasis is placed on rational choice and individual action, and failure is normal and to be expected.

In *The Handbook of Career Development,* McMahon (2014) describes the Chaos Theory of Careers as one of a few emerging theories that attempts to engage the rapidly changing, complex, global world and counter the logical-positivistic and Western bent of most career theory. Although the theory can address some concerns regarding perspective, McMahon notes the inherent limitations of the theory's Western theorists. Bland and Roberts-Pittman (2014), noting the limitations of the career fit model, state that both CTC and existential career theories are helpful for dealing with the ambiguity of our current world.

Self-efficacy, Possible Selves, and Work Possible Selves

Self-efficacy is one of a number of social cognitive theories that examines the interplay between the individual and socio-cultural influences. Coined by Bandura (1997), self-efficacy is the belief in one's capabilities to accomplish given attainments. Ones beliefs about one's abilities can be socially or culturally influenced and impacted by stereotypes, community norms, and

social exposure. In other words, if people believe they do not have the power within themselves to produce results, they will not undertake the work to do so. People with a high level of agency, or a belief that they can accomplish what they set out to accomplish, are efficacious and quickly take advantage of opportunity structure or find institutional work arounds to get to a sought-after result (Bandura, 1997). Although Bandura has been widely influential in the fields of education and psychology, one common critique and tested limitation is that if self-efficacy impacts motivation to action, do positive outcomes impact self-efficacy (Borkovek, 1978; Williams, 2010)?

Just a few years after Bandura's first publishing, noting the gaps between women and non-minority men in self-efficacy perceptions related to science, engineering, math, and computing, Betz and Hackett (1981) theorized the important role that self-efficacy could play in helping women have agency in their careers. Hackett and Betz (1981) found that women have higher self-efficacy in traditionally female careers and lower self-efficacy in traditionally male careers. Male students did not differ in their level of self-efficacy for either traditionally male or female careers. Betz (1992) encourages counselors who work with women with low career-self-efficacy to practice exposure to ideas of capability and to explore building self-efficacy intervention programs.

The theory of possible selves is a social cognitive theory that examines the socio-cultural and historical context to understand the questions "Do I see myself being a person who?" or "Do I want to be a person who?" (Markus & Nurius, 1986). A person's self-concept is dynamic, changing over time and influencing their motivation and willingness to change their present self. A possible self is constructed from a range of experiences, exposures, cultural boundaries, and real and imagined models (Markus & Nurius, 1986). The images frame our options as we think

about our choices and options, and can create motivation for action. In thinking of our possible selves, we can be hopeful or fearful. Our future self is an imagined mix of aspirations, goals, motives, fears, and threats. Work possible selves (WPS) builds on possible selves but is applied to the domain of work. The clearer the vision and its level of attainability, the more salient are future work selves (Strauss, Griffin & Parker, 2012). Possible selves theory has been shown to be an effective tool in career counseling for women and minorities to help them envision a possible future (Betz & Hackett, 2006; Meara, Day, Chalk, & Phelps, 1995). Strauss et al. (2012) found that salient future work selves increased career motivation. Young adults in particular spend a large amount of cognitive energy developing their self-concept through work. Two types of selves emerge as young adults develop: their hoped-for work self, which is idealized; and the expected work self, which is more realistic and more likely to be aligned with what they become (Denner, Werner, O'Connor, & Glassman, 2014).

Chapter III: Method and Procedures

The purpose of the research is to better understand the complex phenomena of how women choose middle-skill training programs in information technology and computing. In understanding how they choose, strategies could be developed by others to strengthen the talent pipeline for in-demand fields, build diversity in a field that could benefit from increased diversity, and prepare women for career opportunities with earning and growth potential. The research could help determine approaches to encourage more women to enter training programs in computing and information technology.

The overarching research question for this study is: What perceived and or lived experiences supported women entering and persisting in information technology and computing training programs of study?

In exploring why women as a category are not choosing careers in information technology and computing, the research assumes that a "women's" experience is context-specific and impacted by race, class, socio-economic, and other identities. Perceived and lived experiences are multi-faceted and messy. Although both qualitative and quantitative approaches have their place in educational research, the research question is best addressed from a qualitative approach. Qualitative research approaches are best used when trying to understand complex phenomena (Vaismoradi, Turunen & Bondas, 2013). The approach asks questions without hypothesizing an answer. It is exploratory and is intended to help bring themes to the surface for further examination.

Sound qualitative research is internally and externally valid; it asks meaningful questions and is relevant, detailed, clear, and reflexive (Malterud, 2001). It is internally valid when it addresses the questions it sets out to address. Research that is externally valid may not be

generalizable, but it is meaningful within a clear context. The research is relevant when it seeks to find the answers to meaningful questions. The research is reflexive when the researchers understand their place in the research process, are transparent and vulnerable and reflective about how who they are is impacting the questions asked and answers received.

Research Methodology

In order to best understand the perceived and lived experiences of women who have entered information technology and computing programs, the research was conducted with a phenomenological approach. Phenomenological approaches examine lived experience in order to understand complex phenomena (Lichtman, 2012). When researchers talk of lived experience, the phenomenological perspective looks to both the participant and the researcher (Giorgi, 1997). The participant lives in a particular place and time with unique experiences (Giorgi, 1997). In phenomenology, researchers do not examine only what is said, but also what is behind what is said (Giorgi, 1997). The approach typically consists of interviewing participants in order to ascertain themes or threads woven through out a participant's story. After gathering the raw data, or capta, the information is reduced and reduced further to arrive at themes.

Reflection

Quality qualitative research is reflexive and looks to the researcher to understand their role in the research process. The phenomenological approach acknowledges the role of the researcher in the telling. The researcher is asked to describe or bracket their experience and set it aside. Some, such as Lichtman and this researcher, believe that researchers can never truly set aside our own experience, even if it is acknowledged. Instead of bracketing, researchers declare and enter into authentic reflection regarding their positionality (Lichtman, 2012). The process of deep reflection adds rigor to the work (Tufford & Newman, 2012).

In approaching this research, this researcher brings a wealth of lived experience regarding gendered experiences in society and in a profession that could affect their interpretation. As a woman and as a leader, the researcher has faced many gendered challenges related to gendered expectations of who women are as leaders and who they should be. The researcher has had doubts about whether the researcher belongs in a mostly male space. The researcher has been disregarded or has not been taken seriously in professional settings. In addition, the researcher has experience leading information technology training programs. She has worked as an associate dean of business and information technology at a technical college. In one role, the researcher was to help develop recruitment strategies for information technology degree programs. She has seen first-hand the challenges of recruiting a diverse candidate pool for careers in information technology and computing. She was the grant lead at her college for the third Trade Adjustment and Assistance Community College and Career Training (TAACCCT 3) grant. The focus of the grant was on increasing access to careers in information technology and computing and the creation of tiered and latticed credentials.

Data Collection Procedures

Raw data were gathered through a semi-structured interview process. Each participant was recorded during the interview. The recordings were transcribed via online service Rev. All participants were asked to agree to release their data for study. The interviews took place in a conference room on the campus where the participants are students, with the exception of one participant, with whom the interview took place in a conference room at her place of employment. The data were anonymized and every effort was made to protect the identity of the participants.

The interview started with the prompt "Describe your current program." The interviewer drew out specifics that helped elicit rich information by asking questions that started with "Tell me more about…." The subsequent questions were not scripted, but covered the following themes: the people, events, beliefs, and assumptions about their future career and their own identity. For example, when a participant mentioned a person who influenced their career choice, the researcher responded with "Tell me more about how this person influenced your decision." The subsequent prompts asked the interviewee to think back to when they first thought about a career in information technology or computing, and moved forward in time with prompts until the researcher arrived at present day.

Subject Selection and Description

The data were gathered from students currently enrolled in an information technology and computing programs in the two-year technical college system in the state of Wisconsin, with the exception of one of the four interviewees, who had graduated the month prior from a two-year technical program in Wisconsin. To increase relevance, the four selected participants varied in gender, socio-economic status, and location in the state. The selection was not random. In qualitative research, "good specimens" are selected who can positively contribute to the research question. The four selected participants were identified by their instructors and had the opportunity to decline participation.

Instrumentation

The instrument used to collect the capta, or data, was a 60-minute semi-structured interview. After receiving consent, the semi-structured interview was conducted with a guide and included the women's interest in information technology, their career stories, their gendered experience, and how the interviewees see themselves now.

The researcher followed best practices in semi-structured interviews. The researcher relied on a pre-set list of topics to be addressed, or an interview guide (Appendix A). Each participant was interviewed once. The structure was flexible and allowed for themes to emerge and for the interviewer to follow the story. The instrument was used as intended—to be exploratory and to allow for the story to be told in a way that is full and meaningful. The participant had the latitude to tell their story in a way that was meaningful to them.

Data Analysis

To analyze the raw data, or capta, a four-step process of data reduction was employed in a reduction table (Figure 4). Capta is a term used in phenomenology and other social research that acknowledges the researcher's role in taking in the oral words, and not just the participant's role in giving the response to a prompt (Lanigan, 1994). The process was created by Haltinner and was adapted from the leading work of Giorgi (1997), van Manen (1997), and Lanigan (2013). The goal of the process is to provide a clear, transparent, and consistent method for determining the key concepts or threads of experience that underlie a phenomenon in order to better understand the lived experience of research participants.

previously developed theme. Content validity of the survey was established through the thorough review of the literature. Appendix B is a sample data set reduced by the researcher.

Limitations

In seeking to understand the lived experiences of particular women, the research does not purport to speak for all women. The variety of experiences, backgrounds, and cultural backgrounds make every story unique. The hermeneutical work of Martin Heidegger and his belief that each individual creates and lives their own reality undergirds this approach. Individuals frame their life events. Instead, the research sought to find themes and threads of common experience that can shed light on the complex decision-making regarding selecting a career.

Summary

Women who have entered information technology and computing training programs have rich stories to tell. The themes that emerge from their lived experience can help us better understand complex phenomena. The complex phenomena of why women choose training programs in information technology and computing at two-years colleges is not well understood. This research is intended to guide further research questions and to guide others in developing strategies for recruiting a more diverse group of students into the training programs.

Chapter IV: Presentation of the Findings

The purpose of this study is to better understand the lived experiences and personal stories of women who have decided to enter training programs in information technology and computing in community and technical colleges. The majority of existing research related to why women do not choose careers in information technology has been conducted at competitive, four-year research institutions, mostly with white women of middle or higher socio-economic status participating. In this study, four women from a variety of socio-economic, racial, and ethnic backgrounds currently enrolled in or recently graduated from technical colleges in the Upper Midwest were interviewed. The promise of the community and technical college is to provide access. Community and technical colleges serve diverse learners and have fewer barriers to entry (Dowd, 2012). The reality is that these colleges are doing no better than their university counterparts in attracting women to information technology and computing careers. Community and technical colleges play an important role in equipping future workers in information technology and computing (Dowd, 2012). If community and technical colleges can attract more women to their programs, they could have a huge impact on strengthening a diverse talent pipeline. This study seeks to address this gap and account for the variety of lived gender experiences that intersect with race and class. In telling their career stories, these women have crafted identities that are aligned with their perceived future selves.

Research Questions

The overarching research question guiding this study is: What perceived and or lived experiences supported women entering and persisting in information technology and computing training programs of study? The following sub-questions further illuminate the research design:

a. What are the perceived and/or lived experiences that led them to declare,
   choose, and enter the ITC program of study?

b. What are the perceived and or lived experiences that supported them within
   their ITC program setting?

c. What experiences do they expect in their future ITC professions?

Research Question 1: What Perceived and or Lived Experience Supported Women Entering and Persisting in Information Technology and Computing Training Programs of Study?

The narratives crafted here were drawn from the interview transcripts. Each participant has been given a pseudonym in order to maintain confidentiality. Every effort has been made to allow the participants to speak for themselves, and direct quotes are used to convey the tone and feeling of the statements. The goal of the stories is to frame the themes that emerge from the interview transcripts within the context of each woman's lived experience.

Julie. Julie spent her early career pursuing a dream of being a professional musician like both of her parents. She went to a prestigious university and then entered the Navy as a musician. She pursued higher levels of education, earning her MA in music while she was in the military. After leaving the military, she struggled to find meaningful work. At first, she obtained a job as a musician. When she lost that job, she was lost. Julie described the time as a "desperate situation where I had gone from having a pretty good salary to my resume wasn't getting me into any jobs other than entry-level, and I was struggling to support myself and trying to side hustle." She described the reality of the job market for musicians as "not great," and she tried a number of different career options.

Julie was very educated but qualified only for low-wage work. She was discouraged and knew that making a good wage was important for her in her research of potential careers. Financial security for Julie meant opportunities to change and grow within a career. She wanted to be like the women who inspired her online who found ways to build the type of financial security that allowed them freedom to live the lives they wanted.

When Julie began her job search, she wanted to find work that would be flexible. For Julie, balance was more important than the technical opportunities of a position. She described her ideal workplace as one where she felt "aligned with what the company is doing and the way they treat their employees." Her driving question was "Do they have a work-life balance?" Julie loved the idea of possibly working from home. Even though she does not have children and is not married, she saw this future self as one who would want that when she was in that future place. Julie said that not only is this her desire, but she believes it to be the desire of many people. She thinks that flexibility "is something a lot of women, in particular, are looking for. Everyone is nowadays. That's more on people's mindset, but for women who potentially want to have children and be able to have some flexibility when they're with their children." She wrote content for the web and tried to teach herself new skills from online tutorials. She started trying to teach herself to code from the videos. In looking for a career, Julie wanted to have a greater impact on the world. She wanted to do more than just impact her own life, but also impact the lives of others. At the age of thirty-two she decided that she had to choose something, and she chose to study computer programming.

Julie wasn't excited to start back to school, but found learning to program on her own a daunting task. She looked at the local university, but thought the technical college would better meet her needs. The students were a little older, which felt more comfortable, and the thought of

returning to the university was daunting. Julie quickly found a place in her program. Her faculty were "her people." She understood the way they looked at the world and solved problems. In describing the difference between her university experience and her experience at the technical college, she said "I felt more at home with the people, my classmates now, and the people that I met and especially one of my professors. I just like to work the way that he works and I liked the way that he teaches, and see those kinds of people as being someone that I get along with easily."

Julie helps lead group projects in class and helps ensure that the products the groups create are excellent. She loves combining her technical skills with her developed interpersonal skills. She described how she likes "to oversee everything and touch base with the different teams and see what's going on, but I also really like to get in and build things. So I like both." She could see herself being a consultant or a manager of a technical department. She started an internship at the local symphony to help maintain and update their website. She does the work independently, communicates with the symphony via phone and email, and feels as though she is positively contributing to a cause she cares about.

Julie has slightly more than one semester left in her program. If there had been a technical-only track, she would have finished by now. The extra time has been okay, but she is eager to get going with her new career. When she finishes her degree, she imagines she may stay in the small city where the college is, or she may move to a larger metro are with bigger companies and more opportunities.

Clara. Unlike Julie, Clara did not grow up in a supportive family. She grew up in a "chaotic" household with an addicted and mentally ill mother. She was a passionate student who loved learning. The structure of schoolwork and the rewards it provided added some stability to her life. She moved around frequently and did not have much support. She left high school early

and "rode the trains," living in unstable situations all around the country. She developed her own substance-use issues.

Clara met her husband and started to settle down, and things started to "make sense." At the age of 24, she earned her GED. She worked as a caregiver and in a factory. As a young child Clara had thought she might be a doctor. Doctors help people and helping people is good. As she grew older and worked in a caregiving position, she felt burnt out. Even though life was getting better, even after the birth of her first child, she struggled. According to Clara, she "got depressed really bad and then got a DUI and then had to go through all this stuff" with a counselor. The counselor suggested she think about going back to school. Clara decided to pursue a course of study so that she could become and addiction specialist.

A few problems arose for Clara. First, with her criminal background, she would have trouble finding work in the field, and second, she really did not enjoy the work. Clara said "I did not like it at all, I just didn't. I didn't want to work with people that may or may not want to get better, and it just sounds really depressing. And for not very much money." Clara wanted to help people by helping people solve problems instead of physically caring for their needs.

Clara left school when her house flooded and she and her husband and daughter were left without a place to live. Clara described the time after the flood as a turning point, she withdrew from classes. She and her family were staying at a friend's house for several months. She came to a point where she said, "I don't ever want this to happen again." Clara "started looking up high-paying jobs, stuff like that, and it all just kind of went from there."

She did not want to go back to the type of work she had done before; she and her husband had dreams, and they did not want to have to "break their backs." Clara described it this way: "I just knew I didn't want to work in a factory, because I had been doing that. And I just didn't

want to do it anymore. Or be a caregiver for barely any money when you're doing so much to keep people alive. It's just so much, there's no compensation for what I was doing.... And then I'd have to come home and do all that stuff, and it's just.... So, I definitely wanted to better that situation." Clara had only worked low-wage and low-skilled work. She was eager to change her family's financial trajectory. She and her husband had experienced financial hardship, and they were eager to return to school and turn things around.

As a mother of two young children, Clara also was looking for a balanced lifestyle. Clara described her ideal work environment as "having a balance between work and family. It's not necessarily, like, I mean it's not if it's in an office or at home, it really doesn't matter to me at all. Just as long as there's a balance." Clara and her husband had a friend who worked as a computer programmer and had recently graduated from the local program. Clara's friend had a starting salary of $60,000, which was well above anything Clara had ever made. Clara was excited about the money and the variety of opportunities available, especially if they were to move to a larger city. Clara sees the field and the opportunities growing in the future. Clara became pregnant the following summer, and decided to enroll in the Web and Software program at the local technical college the following fall. When she described her choice, it was pragmatic and aligned with her love of learning and challenges. She said "it wasn't necessarily a passion for computers or anything, but definitely just wanting to do something different that I can always learn with" and the "challenges are never ending."

Clara's program is almost entirely online. Her classes up until this point have been 8 weeks long. The program is rigorous, and she described it as "really fast" and "a lot of work." The flexibility of the online program allows her to balance time with her family. She stays up late and completes her work once the kids are in bed. It is not easy, but it is doable. After she had

her son, she was able to take a few weeks off to bond with the baby. She appreciated the flexibility, caught up on all her work, and managed to complete the term on time with President's List grades. The instructors in her online courses have been helpful, but she is careful not to take anything too personally. Sometimes it is hard to grasp the meaning behind what the instructor is saying. She has struggled to find an internship, with potential sites wondering how she possibly has time to do it all.

Clara worries that she comes across as though she thinks she is "Wonder Woman," but wants to convey to those who doubt that she is capable of handling a range of responsibilities and challenges. She has a supportive husband and extended family that can help with household responsibilities. Clara said it best, that when others doubt her, she knows she is supported: "I definitely know that I have such a supportive family that no matter what, if it was for a job, if my heart was in it or whatever, and it was for the good of everyone, then we would work it out."

Clara has moments of discouragement about entering a mostly male field and overcoming challenges. In those down moments she goes online and seeks out inspirational TED talks, podcasts, and articles. The inspiration helps remind her of her dreams and that she is not alone. Other women have made it and created the lifestyles they want, and others from different racial and ethnic backgrounds have overcome huge challenges. For Clara, the key to success in pursuing a career in information technology is to "be brave" because it will be tough.

Mai. Mai is the youngest of the four participants and is still in her early twenties. She grew up in a traditional Hmong household. Her immigrant parents did not want her or her siblings to struggle financially in the same way they had. Her parents wanted her to pursue her education at a university and pursue a narrow group of occupations, all within the health field. Mai listed pharmacist, nurse, or doctor as the only acceptable occupations. Not only did the

occupations pay well, they also helped support the community of elders. Mai said, "We have like Hmong elders, so then when it comes to hospital, we don't really have any translators. So then it'd be nice for them to have someone that understand them. I understand that, too. Bother, I don't know if that's what I wanted to do. I huh. I don't know. I just, it wasn't, it just didn't really spark my interest into the medical field." She saw the value in doing something that could benefit her elders, but was not sure how to do so. She thought that maybe she would become a psychologist, but that felt far off. Mai described herself as a "clean freak" who was "grossed out" by the reality of caring for people's physical needs.

Mai had started playing online video games a few years earlier, against her parent's wishes. Her parents thought that video games were inappropriate. In her words, "but for my family or for my culture, it's not appropriate for a woman or a girl to play games. That's only for boys." She elaborated that the duties for young women were centered on the family and home. "I guess for our culture there's a set of duties or rules that a girl should and should not do, and a guy should and should not do. Girls technique, basically in a household, it's like they clean, cook, and that's it. That's pretty much what they can do." Despite her parent's wishes, Mai continued to play online games. She made great friends both online and in her high school with a community of people who shared her hobby.

As a senior in high school she was feeling an immense amount of pressure to choose a career path. She had decided to go to the local university so that she could continue living with and helping her family. She felt desperate and decided on pursuing her "hobby," and enrolled in Computer Science.

Online she found a community of friends who supported her through hard times. Mai felt good and relaxed when she was online. She dreamed that maybe one day she could design her

own video games. Mai's parents were not happy with her career choice, but found some comfort in the thought that her pursuing information technology as a career could provide some financial benefits. They wanted her to get a Ph.D. in Computer Science to maximize her earning potential. When Mai struggled academically in the rigorous university Computer Science program, she continued to try to find ways to make it work because of the draw of a lucrative salary.

Mai tried to pass her introductory computer science course for a second time with the same result as before. She felt isolated, had not made friends, and was intimidated by the instructor. The entire class was lecture, and with no application, she struggled. She sought help and asked questions, but only ended up more frustrated when she did not understand. The lack of success left her feeling desperate. She described the time as "I went through…a big hole, reaching rock bottom. I felt like maybe this wasn't what I wanted to do. And I felt like I wanted maybe a different career path." One of her uncles was a mental health counselor at the technical college. She thought that he might help her navigate her situation, but she did not have the courage to reach out until one family event where she worked up the nerve. She said, "I was like, oh my God, he's probably going to think that I'm failing in school. But I was like, maybe, something just kind of urged me to reach out to him." He was a great help in both setting boundaries with her parents and eventually enrolling in the Web and Software program at the technical college.

Mai found a great deal of support during that hard time from her online gaming community. They encouraged her personally and professionally. She had friends who helped encourage her to keep pursuing her dream. One of her online friends who lived in a city a few hours away served a crucial role in her journey. She described the role he played when she said, "He really cared for me and whenever I needed help, he was there, he helped me with my papers,

my scholarships, and then he was there to help, kind of mentor me in a way, too. So he was a really good friend and he helped me get through some dark times, too."

At the technical college, Mai regained her confidence. She was happy to "get to code with the teacher, you do step by step with the teachers. So then when you're stuck or when you need help then he's available, to be there for you. So and then you just don't, I just don't feel judged." Mai felt less alone and more a part of a community. She said of the experience, "While here you, we get to do group work and we get to kind of help each other because when we get stuck or whatnot then he, our instructors tell us to talk to our neighbors. So that's how you meet friends and your classmates and whatnot." She earned good grades, but still felt that something was missing. She was stressed in the field and regularly felt overwhelmed.

Mai decided that even though some fields in information technology were more lucrative than others, she wanted to have a balanced work life, with less stress and pressure. Even though she still decided to finish her Web and Software Developer degree at the local technical college, she also decided to add on a Computer Support degree. She knew that the path likely would lead to less money, but she was drawn to the lower pressure, decent salary, and the opportunity, in her words, "to find a job that I enjoy and a job that I enjoy waking up in the morning to go to, and not, and instead of like hating my job, just feeling miserable, going to work."

Sheila. Sheila, the oldest of our participants, grew up with "tape decks" as entertainment instead of computers. She was raised in a Native community in a large family of ten kids. She had been ambitious as a young person. Sheila was involved in many "different programs." Sheila had an internship at the Smithsonian one summer, and spent a summer learning about finance in California. She would attend the "Native American conference circuits." She often was chosen

as a youth leader to represent the tribe at events. She had ambitious plans and enrolled at the large state university and planned on studying child psychology and business.

Sheila quickly ran out of money and was on her own financially. She started working at a nearby casino. Soon, all her time was spent at the casino doing double shifts. She was making great money, and school took the back seat. She progressed quickly through leadership positions at the casino, becoming cage manager and overseeing over 200 employees. She liked working and felt good about her contributions. When the casino restructured, Sheila lost her job and moved home to care for her mother. Back in her hometown she met her husband at a "traditional" function.

Before Sheila knew it, she was married and pregnant. She describes her situation as "pampered," able to stay at home and raise her kids. She was a leader in the community as a parent, organizing fundraisers and leading functions and events for her kids. As her kids grew older, she decided to go back to school to study nursing. She had completed all her coursework and was waiting on a clinical site.

When Sheila's high school– and college-age kids needed her less, she took a job with the tribal government. Her husband was a leader in information technology for the tribe. Sheila had not realized how much she had absorbed over the years. In her first role, she worked as a gaming commissioner and she "saw the lack of knowledge, especially associated to anything IT." She asked "Why is everything paper? The technology exists where you should be able to go paperless." She hit a wall, very concerned that her people were not keeping up with the times and that they were leaving themselves vulnerable. When Sheila discovered that her tribe really needed help in modernizing their information technology infrastructure, she wanted to be part of the solution.

Sheila wasn't sure how to enact the changes she saw were needed without authority. She had five bosses and became "extremely stressed out" when she did not feel as though her concerns were heard. Her husband encouraged her to go back to school to get the credentials to be taken seriously. He had told her many times that she should study information technology. She resigned from her position and decided to go back to school to get the knowledge she needed to impact change in the tribal government she deeply cared about.

At first, Sheila enrolled at the local university, but on the first day she realized there had been a mix-up and she was in a program that was not what she thought it was. One her way home she stopped by the technical college where she had taken her nursing classes, enrolled in the Network Administration program, and was able to start classes that very day. Sheila had prepped for her first day of class with notebooks and binders and highlighters. She knew how to be a good student, and sat at the front of the class. She was excited and nervous to be back in school. Her first class was overwhelming, and she felt like an outsider. She said, "You walk in, and first, I'm a woman—there are no other women in these classes" and "I'm older, I went back to school at 45 and decided I needed a life change. And then I'm Native American." In her words, "I didn't look at the gender thing, I did not look at the race thing as a barrier. I looked at the age thing as a barrier." She had not grown up with computers and the rest of the students seemed to know all the terminology. They had been geeking out, building computers and creating home networks since they were kids. It was a steep learning curve, but Sheila sought all the help she could, tracking down the teachers, using online tools, and knowing all the tutors on a first-name basis.

Sheila found identity in establishing herself as the class mom. She invited shy classmates to work with her in groups and tried to bring others out of their shell. By the end of the program,

her classmates would tease her with endearment and say things like "Hey Mom, are you coming to lunch with us?" or "Hey Mom, I'm going to go get a soda, would you like one?" Sheila said, "Yeah, at the end of it, it was a lot of fun."

Shortly after completing her degree, Sheila returned to the tribal government as part of the gaming commission. In just a few months she had worked to turn things around. She is one of the bosses now and her colleagues respect her work and her expertise. She is passionate about helping the organization make good decisions about their software implementation. She described how she sought out the users to assess their needs: "I mean literally grabbing some of our end-users by the hand and say, 'Come on, we're going to go talk about what it is that you're using, how you're using it, and how it's not working for you'." She loves contributing in this way, and thinks she may even heed her former instructor's encouragement and return to school for additional cyber-security credentials. In trying to convince her daughter to follow in her footsteps and study information technology she said, "We're [as a people] not going backwards. We're moving forwards."

Themes

In reducing the raw data, or capta, six main themes emerged. Figure 5 summarizes the themes. The first theme, inspired by Dolly Parton's classic song "9 to 5," *what a way to make a living,* is composed of the multitude of ways that the career options that participants had originally thought available to them did not meet their needs. Building on the first theme, *you've got dreams* encapsulates the aspirations and goals of the participants and their attempts to build a better life. The third theme, *show the way*, explores the people, media, and influencers that helped guide participants to the path of studying information technology and computing. The fourth theme, i*t's a man's world*, is composed of the ways in which the participants have

experienced mostly male spaces. *Wide-ranging field*, the fifth theme, summarizes the vast and

varied perceptions of the work life and people involved in the field of information technology.

Finally, the theme *you are not alone* summarizes the variety of help and support that each

participant received along their career choice and educational journey. The main themes are

supported by topics.

Theme	What a way to make a living	You've got dreams	Show the way	You are not alone	It's a man's world	Wide ranging field

Figure 5. Interview themes. The six main themes reduced from the raw capta/data.

What are the Perceived and/or Lived Experiences that Led them to Declare, Choose, and Enter the ITC Program of Study?

The participants in the study were dissatisfied with their current work and life situations.

They wanted better working conditions, more flexibility, open-ended opportunities, and better

pay. In addition, they wanted to positively impact the world and have creative problems to solve.

They wanted to be helpful, but not in the ways that they saw available, and they desired to be

part of a community of like-minded professionals. Information technology and computing was

not in the forefront of their minds as a career option. Influential people and information came

along to help show the way to a career path in the field. Three of the themes, *what a way to make*

a living, *you've got dreams*, and *show the way*, help further illuminate the nuances of the

perceived and/or lived experiences that led them to declare, choose, and enter the information

technology and computing program of study.

What a way to make a living. All the participants in the study were in the middle of a

career transition. The career transition was away from something that was not working well.

Four sub-themes emerged: untapped potential, low pay, high demands, and caregiving.

The careers that were not working well were causing a significant amount of duress. One participant was "getting extremely stressed out" in her work and had resigned from her position. She was stressed out by her ideas not being heard, her desire for change going unheeded, and her lack of ability to influence the direction of her organization. One participant described her work situation as short on opportunity in the field for which she had trained, leaving her in "a desperate situation where I had gone from having a pretty good salary to my resume wasn't getting me into any jobs other than entry-level, and I was struggling to support myself and trying to side hustle." Another participant, noting the low pay, high demands, and lack of flexibility, decided "I didn't want to live that way." One participant had spent time working in a factory and found the work back-breaking, repetitive, and overly rigid in terms of scheduling. The work was mind-numbing. One participant "just wanted to get my life settled again."

The career narratives available to the women in the study largely centered around helping professions. One participant, thinking back on her childhood career aspirations, said, "It always revolved around helping people." Psychology had been an option for two of the participants at different times in their lives. One of the participants had worked as a home health care aid. One participant first tried a profession in social work and decided to opt out of the program, "and I just didn't want to do it anymore or be a caregiver for barely any money when you're doing so much to keep people alive. It's just so much, there's no compensation for what I was doing. And there's no balance." The participant felt as though she spent enough time caregiving as a mom. "And then I'd have to come home and do all that stuff and it's just.... So, I definitely wanted to better that situation."

Nursing was at top of the mind as an available option that was good paying and steady. Although nursing had appeal for one reason or another, it felt like a limiting choice. One

participant described working in the medical field as "gross." Another participant had completed all her nursing courses and done well, but had never pursued a clinical placement. Another participant had signed up for a wait-listed program but never reached the top of the list. In the words of one of the participants, "Literally all the women I knew that were going to school were doing it. I was like, I don't feel right." The participant would "rather do something else where I'm not going to be doing the same thing over and over…. It's just that mentality of having to do all these cares and...I take care of enough people so maybe I would if I wasn't a mom, because I'd need to fill that void of being a caring person." In addition to being a caregiver, the participant would "rather go crazy on something with my brain." Another participant said, "I don't know. I just, it wasn't, it just didn't really spark my interest into the medical field."

Participants wanted to make an impact and positively change their communities. One participant "felt like I wanted to impact something greater than myself and my own work." Another wanted to make things better for her community. "It had so much potential and I really try to work every day thinking about what it is that my kids have as a future."

You've got dreams. The participants wanted a better way to make a living. When the answers that they had already explored for career and life fulfillment did not provide the outcomes or life they were looking for, they started looking around for other options. One participant had only thought of a few occupations until she completed her GED and returned to college. She said, "I guess I didn't realize that there were so many more things that I could do other than something I could already kind of do." Another participant had narrowly defined her career opportunities until she had more exposure in the career field. Five sub-themes emerged: financial security, opportunities, belonging, challenges, and flexibility.

Earning a higher salary was a recurring sub-theme. One participant, "started looking up high-paying jobs, stuff like that, and it all just kind of went from there." Another started by asking friends, and when a friend said she had started working directly out of school in information technology making $60,000, her interest was piqued. Money alone was not enough to draw women to the field, but was a pre-cursor for considering the field. Participants also wanted to enjoy their work; one participant describes wanting "to find a job that I enjoy and a job that I enjoy waking up in the morning to go to, and not, and instead of like hating my job, just feeling miserable, going to work." Financial security also provided latitude to build a "kind of lifestyle" that they want.

The participants had experienced career fields that were limited or circumscribed. They sought out opportunities that were going to grow and not shrink. Participants wanted positions that would evolve and would not be stagnant. They wanted to have the opportunity to work for a variety of company types, large and small, or independent. The participants oriented toward life-long learning. One participant had heard an inspirational online talk about the ways in which women sometimes underestimate their abilities and do not seek challenging roles, and she was inspired to get past this tendency "because you're always going to learn." She did not want to limit her potential by choosing only what she already knows. Another described a desire to have a degree on which to fall back in order to have the credibility to make the changes she wanted to see happen. "You get that degree, nobody can take it away from you. Once you get that degree and you have that working knowledge, it's never going to go away. You have that slip of paper behind you."

For the three younger participants, flexibility was a recurring sub-theme. One participant said she imagined flexibility being important to pretty much everyone. She "wanted a flexible

lifestyle" and thought that it is "something a lot of women, in particular, are looking for. Everyone is nowadays." The participant imagined that flexibility was even more important "for women who potentially want to have children and be able to have some flexibility when they're with their children. I think that was one of the motivators for me." In imagining a future desirable employer, one of the first questions one participant would ask is "Do they have a work–life balance? Things like that." Another participant said that an ideal situation "would just be having a balance between work and family. It's not necessarily, like I mean it's not if it's in an office or at home, it really doesn't matter to me at all. Just as long as there's a balance." In imagining this future state of balance, she said she can see it, and she would be "just smiling" and appreciating how that life "would be lovely."

One participant described the importance of belonging in a workplace that felt as though she were seen and supported. She "just want a place where I can just kind of be myself and not having to worry in a way and too much stress and just enjoy working with my coworkers and whatnot." She did not want too much stress and wanted to be part of a community. The thought of a boss breathing down her neck was a detractor. She also was concerned about being a slow learner and about others not being willing to take the time to see what she was capable of. She wanted to find a place she would enjoy.

The participants described the ways in which the trials, practice, and hardships of their previous lives had given them the strength to try to find better solutions to work and allowed them to start dreaming. A participant described how having children shifted her priorities and was an impetus for wanting more. "Since we've had kids, we have a lot of dreams that we want to do that don't necessarily involve working, breaking our backs to work." One participant described how her difficult life experience had prepared her to do the hard work to seek out other

options that were not readily available, with "everything always being so chaotic and trying to find a balance or just anything to hold on to. I think that's kind of what did it, it just made me really strong." Another participant had learned significant discipline and self-reliance in her previous career that made her highly independent and self-motivated. Another participant said that her significant experience as a leader in her youth had prepared her to take on something hard and outside of expectations.

Show the way. The theme of *show the way* encompasses the variety of ways in which the participants relied on external influences and influencers to see a path toward information technology and computing. The participants had not previously considered a career in the information technology and computing field. Three sub-themes emerged: computer novice, online resources, and others illuminate the path.

Three of the four participants had never even considered information technology or computing as viable options for their career. Except for the youngest participant, the participants did not really grow up using computers. This sub-theme of being a computer novice, without significant exposure to computers, was prevalent in three of the four participant stories.

One of the participants, Julie, who is now in her 30s, recalls an instance from her early years at the university over a decade and a half earlier. She describes her experience with computers as growing up "just on the cusp of the generation where computers were so embedded into our daily lives." She did not have "that much experience with them other than for emailing and online chatting and stuff." She had high math scores and had received a letter from the university's computer science department inviting her to consider transitioning into the department. She ignored the letter, not being able to picture herself in the field. Looking back, she says, "I could have double-majored or something like that, and I wish I would have. But

yeah, I just didn't know that I would like it. I didn't know that I would have any interest." In retrospect, she wishes she had had more time to explore what the career field would be like. Without a lot of experience in the work world, she chose the same career field that both of her parents had pursued.

Clara, the participant in her 20s, grew up using computers at school, but was never overly interested in them. She was not interested in information technology because it was "necessarily a passion for computers or anything, but definitely just wanting to do something different that I can always learn with."

The oldest participant had not even used computers until she was in her adult life. Her husband worked in information technology, but she had no particular interest in technology for technology's sake. She instead was interested in technology as a tool to help people and to help advance her Native community.

The youngest participant, who actively chose computers as a passion, did so when she was in her early teens as a hobby. She had started gaming and found community. She felt supported and comfortable in her online community of like-minded gamers. It was a mostly male space, and her parents actively discouraged her involvement. Choosing computer science as her first career track was related to this passion she had for her hobby. She had a vision of becoming a game designer and one day playing her own game.

The three participants who were not initially into building computers or coding when they were younger enjoyed building and creating things in other venues. Two of the participants described fixing and building things as kids. One participant would fix her toys by combining them together to create new hybrids. Another had taken shop class and auto repair in high school.

The third participant described her love for working with people and said that she "also really like[s] to get in and build things."

Two important sub-themes co-mingled in the participants' experience that helped guide them towards information technology and computing careers: online resources and inspiration, and interpersonal nudges from close family or community members who helped the participants see that information technology could be a good career fit.

The participants had used online resources or communities to learn about and be inspired by the opportunities careers in information technology afforded. The online resources described such careers as good paying and flexible with many opportunities. One participant started with online career research. She really wanted a flexible career and started searching lists of work that can be done remotely. She found inspirational talks about women who were "making the life they wanted" as computer programmers and entrepreneurs. She wanted a flexible life full of opportunity. She took online tutorials in a number of different areas and tried learning to code. As soon as she tried it, she discovered that she really liked it. She was familiar with the problem-solving components, and the work felt natural. Her father was a hobby programmer and had built a "really cool" product that she hoped he would one day sell. Her father had been programming on the side since she was a teenager. In retrospect, she remembered him talking about how many opportunities there were in computers. He even had encouraged her to try it. At the time it had gone over her head, but now her memory was triggered. She approached her father, who was very supportive of her returning to school to learn programming.

One participant's husband had a brother who was a computer programmer. He saw similar skills and aptitudes in his wife. He repeatedly encouraged her to think about it as a stable, well-paying career path that would utilize her skills. She ignored him because she "really didn't

know anything about computers, like at all." Sometime later, she "heard a TED Talk, and I don't remember who the woman was, but she started Girls Who Code or something," and she listened to the presenter talk about how many women will not venture into fields in which they do not already have all the knowledge. It spurred her on to be brave and possibly try something different. If men faked it until they made it, why couldn't she? She wanted to show her young daughter that women did not need to limit themselves to what others imagined for them.

The third participant's husband kept "nagging her" to go back to school and study information technology. When he had been in school decades earlier, studying information technology, it was his wife who helped him with his writing and study skills. He knew she was capable of a great deal. He could see that she wanted to make a difference. He did not like seeing her miserable at work and without the credentials to have a say or the technical knowledge to truly implement change. It was with his urging that she decided to return to school.

The fourth participant was encouraged and supported by her online community to pursue a career in information technology. Her family had actively discouraged her interest in computer and in gaming. The lack of family support brought her down and made her doubt her own decision-making and abilities. Choosing to pursue information technology was the norm in her online community but an anomaly in her traditional Hmong community. When she struggled in her university course work, her family thought she was lazy. Her close gamer friends were at various stages in their academic career. One of her closest friends was finishing his bachelor's degree in computer science. When she ended up failing her introductory computer science course for the second time at the university, she was devastated. She sought out her uncle, who was a counselor at the community college, for personal and academic help. He told her that he believed

in her and that he knew she could be successful. He encouraged her to enroll in the Web and Software program and to learn programming in a different setting.

What are the Perceived and or Lived Experiences that Supported them within their ITC Program Setting?

The perceived and lived experiences of our participants that supported them during their program took many forms. Two main themes emerged that shed insight into the participants' experience of their success. The main themes are *you are not alone* and *it's a man's world.* The theme *you are not alone* encompasses the variety of people, institutional practices, and systems that supported the participants' success, and the theme *it's a man's world* relates to the previous life experiences and coping strategies the participants used to navigate the mostly male space of the information technology and computing program.

You are not alone. The theme *you are not alone* is composed of the ways in which the participants were supported in their journey. Within the program context, five sub-themes emerged to describe the ways in which the participants were supported. The five sub-themes are instructor support, collaborative classroom, institutional support, family and community support, and online support.

The instructors at the technical college were humble and supportive. The participants described their professors at the technical college as "amazing" and "my type of people." One participant noted that she "absolutely loved her professors" and another said that they helped her "learn to re-enjoy programming" and they helped bring back her "spark." One participant described the relationship with her instructor as "really personal" and said that they were "very humble and they really were dedicated to their students' success, and they just really knew their subject matter, which is really the most important." The instructors did not put on airs. They

were not pretentious or distant, but present and accessible. This was a markedly different from other educational experiences. "Sometimes in universities, you can deal with egos and things like that, and then I just didn't get that vibe at all from them." The participants did not feel judged, but felt as though they could "always reach out." If one instructor did not have the answer, they would "put a team on it" to help come up with a helpful solution. Another participant described how her instructors "built you up" and they authentically cared; they were "real with everybody, it didn't matter the age, it didn't matter, your background."

The instructors would verbalize their support; one instructor said "he loves helping students. So don't be afraid to come into office time and whatnot." Another instructor told the class, "We're here for your success, not for the program's success. This is for you to learn, for you to come and ask us questions when you don't know." Another instructor was quoted as saying, "Your success is our success."

The teaching methods were interactive and team based. The instructors had a "different way of teaching." In one participant's university experience the classroom experience was "just looking at the screen." Instead of listening to a lecture, at the technical college, "you actually get to code with the teacher, you do step by step with the teachers. So then when you're stuck or when you need help, then he's available, to be there for you." One participant said "each of the teachers made it apparent that we did not have to know every single thing IT-related in order to gain an understanding of the program that we were using."

The participants described a collaborative classroom space in which the instructors intentionally worked to build community. The instructors normalized working together and seeking help. The participants described small classes in which students got to know and worked with their classmates. On the first day, instructors asked participants to "stand up, talk about

ourselves, and then they learn our names." In the technical college classroom "we get to do group work and we get to kind of help each other because when we get stuck or whatnot then he, our instructors tell us to talk to our neighbors." Talking to their neighbors helped participant's learn complex concepts and get to better know classmates, or as one participant described, "that's how you meet friends and your classmates and whatnot." Group work was preferable to just "sitting there" and "doing your own thing," or to an instructor "just going through things on slides." One of the benefits of group work is that students realize that different students have different strengths and learning paces, so students "experience everyone is around that same area where not everybody knows everything" and that "everybody's learning at their own pace."

The participants in the study had a significant amount of responsibility outside of the classroom. Participants described family and community support as key to their success. One participant appreciated how helpful her parents have been, and said that they "definitely have helped and influenced me along the way." She thought that "I'm sure it's harder for students that don't have that stability. And I'm not married, so for me right now they're a big support still. And they're helping me a little bit financially." She "wouldn't be able to do it if my parents weren't helping me at all, too." Another participant described how her husband and extended family shared childcare responsibilities and that "whenever anybody needs anything with kids or anything, somebody's always there. And my husband, he's really supportive." In the future, one participant could see that no matter what job she took, she would have support; she has "such a supportive family that no matter what, if it was for a job, if my heart was in it or whatever, and it was for the good of everyone, then we would work it out." One of the participants did not have support from her parents or siblings because she was going against cultured gendered norms and expectations. Even though she did not have her parent's emotional support, she had a great friend

online who "really cared" and whenever she needed help would help her with papers, scholarships or other problems, and he was "kind of mentor" for her.

The institutional student support structures helped the participants navigate additional support. One participant was able to enroll in and start classes the next day thanks to helpful staff. The college had resources to navigate financial aid. In another instance a participant described the Veteran's service office staff as "great," saying they made it really "easy figuring out how to activate your benefits and things like that."

In some instances, the support could have made been more robust to make difficult situations easier. Another participant described the difficulty of juggling her responsibilities and having to do all her homework late at night when her kids were asleep. She felt as though "they try to accommodate with having kids and stuff, but it's mainly with here, for example, they don't have childcare at all." Disability services helped one participant come up with a plan for maternity leave. The instructors were accommodating with assignment due dates, and the participant was able to complete the course on time with an "A." She said that she even had an accommodation for breastfeeding, which made the transition easier.

Tutors, labs, and other academic support helped the participants persist. One participant knew all her tutors "by name." As an older student, one participant "took advantage of everything that they were offering as far as help, because walking into something you don't know or never worked with is difficult." The technical nature of the program and the novice status of many of the participants made the learning curve steep. One participant first tried to learn coding on her "through various online programs" and "she didn't find that that was the best way to learn because you didn't have anyone to ask questions. And it's just here's a lot of information when you're first learning." Open labs were a great support, because "you can just

go in there and use whatever." One student was happy to work on her own in her strength areas, but when she came across a particular area or concept with which she was struggling she would use the support. The participant came "in to work on queries with the database instructor." She described the lab as "really awesome" because the lab assistant was "just walking around helping people."

The participants often found female role models as support figures online. There "are really good resources for young women to just even go look around the site and see all their testimonials of women that have really discovered a love for either writing code, or design or whatever and the kind of lifestyle that they can build with it." They encouraged other women to seek out inspiration online as well. One woman who was comfortable in the mostly male space, saying that it didn't "really bother" her, referred a classmate to visit a website where you could "hear things from a female perspective…because it's mostly all women."

It's a man's world. The theme *it's a man's world* was recurrent. All the participants in the study had significant experience navigating mostly male spaces in their lives prior to entering their programs of study. In their previous experiences, they had adopted adaptive techniques to deal with being a minority. Just because the participants had learned to cope did not mean that they thought a mostly male environment was ideal for any learner. The participants noted that women who hadn't had such life experience might struggle in the courses. Three sub-themes emerged: non-traditional female role models, experience navigating male spaces, and coping techniques.

Three of the four participants had mothers or other close female relatives who had experience working in non-traditional fields. In one instance, it was a mother who was a professional musician in a mostly male environment; in another, it was an aunt who was a leader

in business who showed the participant the ropes and would "drag" her along to events and conferences; and in another instance it was a family friend who was "a big deal" at a large local corporation.

The participants sought out additional role models to those available in their daily lives for guidance about how to survive and thrive in a mostly male work environment. These role models often were not women whom the participants knew, but were popular on lifestyle blogs, were on YouTube, or told their story on TED Talks. Another resources was a women who founded the site and had a compelling tech start-up story that she thought could help spur the other woman on. The inspirational stories showed women living their best lives and able to accomplish their goals and dreams.

One participant described how earlier in her career she "was always in the minority." She had an experience of "being one of the fewer females in my environment," and it had been that way "pretty much" her "entire professional career." Another participant "wasn't intimidated" even though most of her friends were baffled by her decision to choose a male-dominated program of study. One of the participants found true community in the mostly male space of online role playing and shooting games that was more of a community than her strict community-defined gender roles typically allowed. The men and women in her community held very different social responsibilities: women were supposed to stay in the domain of the household and cook and clean. Women were not supposed to have hobbies or play games or go out, that was nonsense reserved for the boys. She said, "There's just the difference, the social difference basically in our culture, all our tradition, but pretty much, yeah. So my parents are always get angry at me." In her online community the gendered rules did not apply, she could

"meet new people. I met amazing friends through my game, through arts, through online, basically. I, they're wonderful friends. They always been there for me."

The other participants had not had pleasant experiences in mostly male spaces, including experiences of harassment, inappropriate comments, and crude jokes. One participant said that "there's a lot of negative stuff still lingering around that. So just in terms of them saying inappropriate things." Another participant "worked in mostly male settings" and "had been harassed and stuff," but she did not let it get to her. A participant had managed many men in her previous work and found ways to adapt. The participants had learned to not let the gendered space impede them from attaining their goals. Getting through the experience was an obstacle to overcome. One participant said, "it doesn't bother me anymore" even though at first it had because she was "not totally uncomfortable, but a little bit like I didn't quite know how to act."

In order to thrive in the mostly male space the women had developed a range of coping skills. One participant learned "how to be friends with them but still separate so there wasn't any weird vibe like that. Just setting some sort of professional level of friendliness." She had learned to keep a distance, and when she did, she learned, that the "guys do not care at all. If you just are professional and you are respectful of yourself". Another technique was not engaging and not speaking out against inappropriate behavior but just "not engaging in it" and "they started to stop." Even though some men adjusted their behavior, the participant learned that "there was always like one or two that were kind of obnoxious." Another participant learned to cope by turning up her mothering skills; she was the "ultimate mom." It came to a point that she just decided in order to find a community in the class she would find the "boys, young men, whatever, that didn't want to interact or they didn't want to clam up, or what have you, sit down with them" and "egging them on a little bit, talking to them every day." She would make sure to

say hello and find "out a little bit, something about them." As a mom figure she "was trying to bring them out of their shells." Because she also was older than most of the men around her, the technique largely worked. They respected her, would reach out and invite her to things, and even gently tease her. She still was not completely integrated into their world, but like her experience with her own teenage kids, it was okay, "I'm older, a woman, and they had all the commonalities of, I play online, I can build my own PCs, I've built my own network. So they had all these different commonalities between themselves". She couldn't, "speak their language".

The participants knew that it was not this way for all women. Many would feel uncomfortable in the mostly male classroom. Participants noted that during other phases of their lives they may have felt uncomfortable in the classes as well. One participant said some of the women she knows had said they said they might feel "intimidated or uncomfortable entering into that." Another participant noted that some people might even change their mind if they had thought information technology was going to be a good career fit and then they walked into a mostly male classroom. "It might change their mind about wanting to do it if they knew like, 'Oh, you're going to be one of the only one, two or three women in the class'." One participant noted that it may even be more difficult to walk into a mostly male space if one is young or inexperienced, "It's more what I think that young people, especially, would be thinking about. Like you think about going to school. I think at that point you're much more intimidated by the idea of being in the minority." Another participant described the extra attention she received: "see how many different just men, in general, there are in the classroom. And it was obvious that my teachers weren't going to get me mixed up with any of the guys." One participant described how she had made friends with another woman studying information technology "but she didn't

end up getting a job in that field. I don't know if she didn't finish or what, but she always talked about how there were no other women."

The participants universally thought that the classroom environment would be better if the classroom had more of a gender balance. The classroom dynamic is strikingly different than other experiences that the participants have had in higher education. One of the first thoughts a participant had upon entering her first class was, "I'm a woman. There are no other women in these classes." One participant noted, "I've never seen anything, like in school when you go to any other classes, there's usually a good mixture." One participant, acknowledging that it was fine the way it was but that it would be preferable to connect with other women, said, "I mean, it doesn't really matter that there aren't very many women, I guess, but it would be nice to be able to connect on that level. Not that there has to be that level." Another noted that she thought in mostly male environments harassment increases and that having a gender balance decreases that chance, regardless; she said, "I can handle that kind of situation. I definitely don't want to have to."

What Experiences do they Expect in their Future ITC Professions?

The participants in the study were looking forward to working in the information technology and computing field. Their positive expectations far outweighed the negative expectations of the work and life culture that they thought they would face. They knew the field would be largely male and that they would find challenges. The work itself appealed to the participants; they thought it would involve challenges and problem solving, continuous learning, and opportunity for growth. Two main themes emerged: *it's a man's world*, and *wide-ranging field*.

It's a man's world. The participants in the study expect that they will face challenges in their future professions working in male-dominated spaces. In imagining her future career, one participant had "definitely thought about it" being a mostly male space and "did do some reading about it" she had discovered that it was "a reason that a lot of women quit their jobs." She "also read something that said even in IT, that women are getting paid less than men for doing the same thing." Another participant imagined that a mostly male space will be completely manageable except for "being at a big table with a bunch of arrogant men, which is something I think about. That would be very uncomfortable." They also believe that they have the tools and capabilities to navigate the challenges.

One participant has already experienced some of the challenges she likely will face in the work world in the process of applying for internships. She was in an internship interview that was going well when she mentioned that she had two little kids and was in school fulltime. The interviewer asked her "How would you have any time for a job?" She replied, "I'll make time." She was not offered the position. The same participant had a separate interview during which the interviewer asked her to describe her daily life. When she described her day, he asked "how I had time for job. Because they asked me all the stuff I did and I was like, 'Well, this is what I do'." The participant had a supportive spouse and the ability to do the work, but the interviewer could not get past it. In recounting the story to her husband, he said, "you just should not tell them what your life is like". She did not want to hold herself up as "Wonder Woman" but wanted to be able to be authentic.

Wide-ranging field. A recurring theme in the interviews was the belief on behalf of the participants that information technology and computing was a wide-ranging field that encompassed high levels of professional, technical, and communication skills. The field was not

limited to geeky stereotypes but was about problem solving, helping people, and building things. They knew that a variety of work environments existed and were proactive about thinking about finding a work culture that aligned with their field. Five sub-themes emerged to describe their understanding of the field: *broad opportunities, helping make a better world, people skills and technical skills, continuous learning and problem solving,* and *pop-cultural influences.*

Participants described their future field of information technology and computing as "practical and secure" and full of "opportunities." One participant said she enjoyed learning to code, and she knew it "would open up just a lot of broad possibilities." The work was not just one thing, "it wouldn't necessarily just mean that I was spending all my time writing code for the rest of my career, but that it would open up management." The field could accommodate a range of personalities and styles for example, "some people might be better at teaching it or maybe writing web tutorials or something like that, and some people might be better at just digging into the data and things like that." A participant said, "I honestly think that as a field probably most people could find some area of it that they like because it's so integrated into business now." It isn't so much a matter if you are the type of person to go into information technology, "it's just a matter of finding out where your personality would fit into which area." One participant encouraged young people to explore all of the possibilities in information technology and "all the different areas of study that you can get into."

The participants in the study wanted to help make the world a better place. One participant chose IT is because she wanted to "impact something greater than myself and my own work." Another participant noted that "IT is influencing basically the entire world. It's a good feel to make some sort of positive impact in."

The participants wanted to impact the daily lives of users. One participant wanted to be a part of "making tools that are easy and clear for people don't understand I felt like would make a positive change in people's work lives." Computer's should serve people and their daily work. One participant described a "disconnect in the software industry" and that the user experience is not always the best". In one instance a participant described "literally grabbing some of our end-users by the hand" and asking them "how you're using it and how it's not working for you'."

The participants imagined that their future careers would rely on their ability both to work well with others and to solve technical problems. Teamwork is "a really good experience for the students" one participant said, because there is "a good chance that might be how you're working out in the field." Another participant thought that "in software, good communication skills, it's known that they're really needed in the field." The reliance on both people and technical skills was appealing to the participants. One participant likes to "oversee everything and touch base with the different teams and see what's going on, but I also really like to get in and build things." The participants like both, and one sees herself "in some sort of consultant role." The participants like to "mediate between people," "think of the big picture," and work on "the managerial side of things" to have a bigger impact. One participant likes leadership roles and "blending working on my own and then working with other people."

All the participants described the ever-changing nature of the industry. They knew that they would need to be able to pick up additional programming languages, research solutions on their own, and continually adapt. One of the participants already was thinking of the next credential she would attain in network security. The demands of continuous learning were appealing instead of daunting. The participants like roles that provide challenges to their critical thinking and problem solving, and they love to solve real problems. One participant "loves" that

"you can create so many different things right from nothing, really. Or you can build off of other things. And there's so much information out there, too, about different ways to learn. It's just like there's so many challenges, it's never ending." Participants believed that it was "fun" to solve problems; "you get stuff done" or "got this to work." One participant noted that she was nervous about the amount of mental stress involved and was concerned that she may not have the "strength" to persist in a particularly rigorous role. This concern did not make her want to leave the field, just adjust to a different occupation in information technology that may have less pressure.

Although the stereotypes of the type of people who worked in information technology were understated and broadly defined as meaning that most people could find a place working in the field, recent popular-culture depictions of women working in information technology emerged as a sub-theme. One participant mentioned the cartoon movie, *The Emoji Movie*. However, the same "type" of character occurred in other popular settings as well, including cartoons and television shows. One participant said, "there's so many where there will randomly just be a tech person that can do everything that they need to have done." This type of character comes in and "hacks" things, she might even hover above the keyboard and solve something quickly with her ability to problem solve. The characters were often not mainstream or were a little "weird" with "blue hair," "piercings," and leather." The participant knew that the depiction of the characters was not realistic, but they were appealing. They helped people and saved the day. In the simplistic depictions, there is a crisis and someone "needs to break into this." A character who overcomes challenges to have a broader impact was what mattered. For this participant, "whether you're fighting with the computer or whether you're fighting for something. Just having that fight in you is really…necessary."

Chapter V: Summary, Conclusion, and Recommendation

Participants in the study did not have significant exposure to information technology as a career option. They never considered it as a career field they would enter. Close family and friends encouraged the participants to look further into the field as a career option. Once they started looking, they found inspiration online. The participants were looking for flexible, fulfilling work that would provide significant opportunities. They didn't want to be limited. The participants had significant experience in male dominated space. In the classroom, they relied on previously developed coping techniques. They persevered inside and outside of the classroom with the support of friends and family. They worked hard and felt supported by their instructors. The teamwork and collaboration of the community and technical college classroom served them well. In the future, they imagined that they would have some frustrations in their future work, navigating male space but that it was a challenge to overcome. When describing or imagining people who worked in information technology, they imagined people much like themselves: creative problem solvers who liked working in teams and had both communication and technical skills.

Conclusions

Social roles frame occupational opportunities for both men and women and both are more likely to seek and attain goals that are afforded by their gender role (Diekman & Eagley, 2008). Some fields including math, engineering, and computer science and computing roles have strong associations with the male gender (Ceci, Williams, Barnett, & Cooper, 2009; Morgan, Isaac, & Sansone, 2001;Wang, Eccles, & Kenny, 2013) In previous years, the participants recognized nursing, a profession strongly gendered female, and other health related professions that helped others, as the dominant route for both themselves and for other women to enter a well-paying,

steady career. For numerous reasons, ranging from occupational fit to timing and caregiver fatigue, the participants actively sought out a different path.

The participants did not arrive at information technology as a career path easily. They could not picture a future self in the career. One participant, upon receiving a letter from her computer science department at her university encouraging her to apply to the major had no context for the field and couldn't see it. In Future Self Theory, imagined future selves are constructed from a range of experiences, exposures, cultural boundaries and real and imagined models (Markus & Nurius, 1986). The images frame our career options. Our future self is an imagined mix of aspirations, goals, motives, fears, and threats. In the theory of possible selves is a social cognitive theory that examines the socio-cultural and historical context to understand the questions "do I see myself being a person who" or "do I want to be a person who" (Markus & Nurius, 1986). A person's self-concept is dynamic, changing over time and influencing their motivation and willingness to change their present self. In this research, the participant stories demonstrated remarkable shifts over time that allowed them to integrate a career in information technology in to their self-concept.

In recent years, winding career paths have been reflected in post-modern career theory. Career theory has become less about selecting an occupation and moved in to the paradigm of "life design" where one constructs career through small stories, reconstructs the stories in to a life portrait and co-constructs intentions that advance the career story into a new episode (Savikas, 2012). One such theory, the chaos theory of careers (CTC) describes modern career story themes that includes periods of disillusionment, chance, unplanned events and non-linearity (2014). The decision to study information technology was a significant departure from their early career plans or from the plans in which they were encouraged to pursue. It took a significant life

change or crisis for the participants to question the story of what success looked like for a woman. It was not easy, but during a time of crisis, it was an easier transition for the participants to make. The participants in our study were deeply dissatisfied with their options for a career. Three of the four participants experienced significant anxiety about providing for themselves and their current or future families. They felt like they were either stuck in low wage work or in danger of not doing what was necessary to attain a good career. Our participants reflect broader economic changes. As the divide between the haves and have nots has gotten greater and those traditionally marginalized have been disproportionately affected by the changes (Sweet & Meiksins, 2015). When the participants explored career options, financial security and opportunity were important factors in their career search.

People with a high level of agency, or a belief that they can accomplish what they set out to accomplish, are efficacious and quickly take advantage of opportunity structure or find institutional work arounds to get to a sought-after result (Bandura, 1997). The participants had been leaders in other realms of their life. One participant had managed over 200 people, both men and women at one point in her life, another participant had co-workers who relied on her to solve problems for them. A third participant had attained a high level of skill and expertise in a male dominated field that required dedication and practice. They had encouragement from their own experiences and from others that they were capable. The work options that were open to them were under-utilizing their skill sets and they knew they were capable of more.

Schwartz, Rubel-Lifschitz and Carver (2009) demonstrated that as societies became more equal the differences between genders regarding the value of benevolence, universalism, self-direction, hedonism and stimulation shrunk with men and women valuing the skills at similar rates. The participants in the study showed a high degree of wanting to be the agents in their own

lives. They wanted to make a life of their own, on their own accord. They wanted their own financial freedom and opportunity. The participants wanted to make a life for themselves, find pleasure and enjoyment in work and use their brains to solve problems.

The participants were encouraged to explore an information technology career path by close male relatives. Research shows that a father's encouragement to a daughter to pursue a computing career was impactful (Eccles, Jacobs, & Harold, 1990). In their study, Ogan, Robinson, Ahuja and Herring (2006), demonstrated that while both mothers and fathers impacted their daughter's decision to pursue careers in STEM, a father's encouragement was more impactful. One participant's father had been a hobby programmer and was very supportive of her career path. In this research, the importance of non-father role models emerged. One participant was "nagged" by her husband, who worked in information technology, to think about information technology as a career option and a third's husband brought up the idea many times. The fourth participant was encouraged by her close male friends online and by her uncle.

Both male and female role-models are equally effective in attracting female students in to STEM as long the role-models were seen to be like them (Drury, Siy, & Cheryan, 2011). The participants found inspirational role models who emphasized the ability for women or others who are under-represented to overcome challenges and author their own story. While many of the role models were females in information technology, others were successful women in business who had attained positions of power or influence. For one participant a female friend who graduated from the same information technology program and started earning a good salary right away was an inspiration. The participant also had a brother-in-law she respected who was a web developer that encouraged her to look in to pursuing the program. In another instance, a role model was an aunt who had been successful not in information technology but in business. While

many of the role models who encouraged out participants were in their extended familial or social networks, the participants also sought out inspirational role models online that have made a good life for themselves and overcome significant challenges to be successful in information technology. The participants were inspired by TED talks, podcasts, you tube videos and web sites devoted to successful women in information technology.

All the participants wanted to solve problems and help make the world a better place. In this way, the participants were able to craft an internal narrative that aligned with gendered work values. Diekman, Brown, Johnston and Clark (2011) found that while both men and women value communal goals, women had significantly higher levels of association with communal goals than men. The difference in the importance of communal goals was an important variable in women not choosing careers in computer science or other stem fields. Computer science was not associated with communal goals. In a later series of studies, Brown, Thoman, Smith, and Diekman (2015) found that regardless of gender, major or college, when students were given messaging regarding the communal goal affordance and societal impact of STEM both male and female students were more interested in pursuing a career in the field. The participants in this study saw information technology and computing as an opportunity to positively contribute to their community and to society by creating great, useful products. The products they wanted to create would make work life easier for others or helping users solve the daily problems that they may encounter with their computers. The goal was not to conquer but to help create better tools. The participants want computers to serve people, not vice versa. Computers are increasingly a part of everyone's life, the participants cared to make that experience better. In one instance, a participant also didn't want to see her community left behind as technology rapidly changed and

she saw her people not keeping pace. She saw studying information technology and computing as a way to serve her community and help propel it forward for her kid's generation.

Gendered constructs are variable by class and race and socio-economically status (Brewer, 1999, Kite, Deaux, & Haines, 2008, Lyons, Ng, & Schweitzer, 2014). Kite, Deaux, and Haines (2008) critique much of the research on the stability of gender stereotypes, noting that most studies rely almost exclusively on white, middle class, college age or educated women and fails to take in to consideration the variety of ways women are gendered especially within other socio-economic and cultural milieus. One of our participants had an unreliable mother who was an addict. Her conception of being a good mother was caring for her children but also being a financial support. Two of our participants who came from families with lower socio-economic status emphasized the importance of work and meeting the financial needs of your family as priorities. What mattered more than the career choice was how hard they were willing to work. Putting in time and holding down a steady job was esteemed in their family environment. The goal for one of our participants was that work and earnings needed to be shared responsibilities between her and her husband because it was too economically fragile for their family to rely on the precarious reality of low skilled work. She and her husband had adapted their gendered work values, prioritizing her studying information technology. The participant's brother, also stuck in a low wage cycle, didn't have the opportunity to go back to school or pursue his dreams because he was committed to a gendered idea that prioritized his wife's ability to stay home with the kids. One participant who found a strong identity in being a mother found identity in mothering her classmates and serving her tribal community in a way that they needed help. Service to her tribal community as an information technology professional was just another extension of serving her family.

In the literature, we saw that shifting community boundaries and migration open new avenues for women to define their lives in novel ways. In our ever-changing world, we are constantly exposed to new ideas and ways of being and "doing gender" (McDowell, 2018; McNay, 2013). For one participant who came from an extremely traditional gender background, where she felt like she couldn't possibly be successful in the narrow definition of roles, she found an alternative community online that helped her see other ways of being. She found freedom in her online community that allowed her to be herself. She took solace in her online community. Her family didn't understand her choices or her values and the push and pull of values and gendered identity caused significant emotional strain. Doing gender in a way that is not aligned with community norms is often punished. Exploring new ways of being and doing gender often precede broad social acceptance and can be risky (McNay, 2013). Acting against type can bring punishment or in other words, being a good fit to gender stereotypes leads to social reward (Diekman & Eagly, 2008). Her sisters and parents would mock her choices and even call her "lazy" or "stupid". Even though the participant had the opportunity to explore different ways to be gendered, she was still beholden to her family responsibilities of caregiving for her younger siblings and significantly contributing to household work.

Participants weren't naïve to the fact that the work and school culture in information technology and computing is largely male dominated. Navigating a mostly male work and school culture was on the minds of our participants. The participants had expressed that they had experience in similar spaces and had learned a variety of coping techniques. Participants thought that younger or less experienced students might struggle navigating in a space that was so lopsided to one gender. As groups become more balanced with men and women all people feel more like they belong (Goodale, Alt, Lick & Johnson, 2018). The participants all stated that

more diversity would benefit the industry. They also thought that they would prefer more of a gender balance. They found the gender imbalance annoying at times. Instead of being overly discouraged, the participants dealt with it pragmatically as a hurdle to overcome. It wasn't a lack of bad experiences that propelled women, in fact a number had experienced overt or subtle sexism and even harassment based on gender but an egalitarian outlook that they should have a place at the table as full participants. The participants actively encouraged their female friends and relatives to think about information technology and computing as a possible.

Participants saw themselves in their instructors who modeled good communication and collaboration. The community and technical college instructors were open, there to help and even humble. They invested in the success of their students. A few of the participants who had significant experience at universities compared their experience with the supportive practitioners at the technical college with aloof and pretentious faculty at the university who often made them feel stupid.

Despite the anticipated gender imbalance, our participants anticipated a positive work culture for themselves in information technology. The reality of the participants future work may be more difficult than they anticipate. Numerous studies have found male dominated work cultures have more stereotypical views against women, higher rates of implicit bias and more incidence of micro-aggressions (Ashcraft, McLain & Eger, 2016; Ellemers, 2018; Maddock & Parkin, 1993; Reuben, Sapienza & Zingales, 2014). Implicit bias may have already impacted one participants career. As a woman and a caregiver had been a significant barrier in her attaining an internship in the field. It was not her ability to meet the requirements of the job technically or in terms of time. In two separate instances, the perception of different male interviewers about her ability to commit or juggle the various life activities.

The participants in this study had strong self-beliefs in their ability to be good students. In the research female students under-estimate their science and math ability and the likelihood that they would be good at a field like engineering or computer science (Ehrlinger, Dunning & Devine, 2003), even though female students are no less good at math than their male counter-parts (Ceci, Williams, Barnett, & Cooper, 2009). They had positive educational experiences and liked learning. In the applied computer fields, rigorous math preparation through calculus was not an issue. The participants in this study did not bring up math in particular but creative problem solving. Three of the four participants highlighted their love of problem solving and their desire for it to be part of their work.

In the research, the sub-theme of being a computer novice was re-occurrent. The participants in this study emphasized that they knew nothing about computers and that the men in their program seemed to know a significant amount more than they did. In the literature, while female students were as confident as their male counterparts in their beliefs in their abilities, male students over-estimated and female students under-estimated their abilities when it came to more complex computer related tasks (Creamer, Burger, & Meszaros, 2004). One participant doubted that she was capable of the rigors of a computer programming even though she earned high grades in her complex computer systems courses. A participant who was enrolled online and earned grades to place her on the President's list was shocked when she entered the classroom and the men in the class seemed to have a different, specialized computer related vocabulary and felt intimidated by their knowledge of computers. Upon entering her first day of class, one participant said that the biggest difference between her and her male classmates was their knowledge of and familiarity with computers.

In previous research, both male and female college students hold similar stereotypes about the types of people who work in information technology. The stereotypes tended to be more masculine and included descriptions such as: technology oriented, singularly focused on computers, lacking in interpersonal skills, masculine features- pale, glasses, unattractive, "genius" and male (Cheryan, Master, & Meltzoff, 2015). In a summary of their and other research related to stereotypes, Cheryan, Master and Meltzoff (2015) concluded that not due to their intractable lack of interest in these fields but instead, that women's interest is constrained by societal factors regarding negative stereotypes about of the kind of people, the work involved, and the values of the information technology field. The stereotypes that our participants had varied drastically from those present in the literature. The negative stereotypes of a genius loner who was unable to communicate or interact socially were not present with the study's participants. Instead, the participants talked about the importance of having good communication skills and strong technical skills, of collaborative work and building off other's solutions. They described the wide range of roles in information and technology and thought that most people could find some role in the field that they enjoyed.

Research has shown that media sources impact the perpetuation of stereotypes (Cheryan, Plaut, Handron, & Hudson, 2013). Females portrayed in the media conformed to many negative stereotypes surrounding careers in computing including being "geeky", obsessed with technology, not very good at relationships. There is some indication that the cultural stereotypes around information technology and computing are changing. The two younger participants described female characters in gaming and other pop culture such as movies and cartoons as divergent from the geeky male stereotypes in the literature. The female characters were cool and powerful and even a little counter- cultural. They had blue hair and wore leather. They were able

to jump in and save the day with their technological prowess. The participants didn't even mention the nerdy stereotypes as an influence or even a thought. The emergence of video influencers and inspirational speakers online along with the enormous amount of content online may have accounted for our participants seeking out and finding non-stereotypical role models online.

The participants are well equipped and excited to work on diverse teams to solve problems. Much like the literature suggests, women who work in information technology often have better communication and team-work skills than their male counter parts. They earned good grades in their programs, took the work seriously and spent a significant amount of time outside of class time researching and learning. They enjoyed teamwork and contributing beyond their own work. They liked to build off the work of others and positively contribute to the overall good. The participants showed significant interest in consulting or managing.

Participants were attracted to information technology and computing because of the promise of opportunity. The participants believe that having a strong technical skill set gives them a leg up in the labor market. They are not satisfied with only making good money. They want a better life with more flexibility and balance, interesting problems to solve and a positive team environment. They are not afraid to look around and even move to find a company that aligns with their goals and values.

Recommendations

Much of the existing research examining women in information technology and computing programs of study has been in the university setting with participants from largely upper-middle-class backgrounds. In this exploratory study, participants from a variety of backgrounds were interviewed. During the process, much of the existing research was verified,

although some interesting differences emerged for further examination. The recommendations include suggestions for further research, recommendations for two-year colleges for marketing programs, and recommendations for industry to attract more women to their organizations.

Further research. One goal of this exploratory research was to examine the stories of women who had chosen to study information technology and computing at a two-year college in order to look for items for further research.

While there has been significant research on the role that teachers and counselors play in student's career decisions, for adult learners, intimate partners and others likely play an outsized role in helping women to see non-traditional career paths as an option. An additional, related question could be, are gender roles changing in lower-middle class families developing strategies to cope with declining male wages by encouraging women to enter high paying, high opportunity job fields? Are the margins responding differently or the same than middle and upper middle-class families? Are women from lower-socio-economic classes likely to have more or fewer barriers to entry as related to family support and gendered expectations?

The research findings suggest that new stereotypes regarding women in information technology are emerging from pop-cultural settings that could be both powerful and encouraging. Are the stereotypes changing for all women? Existing research looks at the stereotypes of upper-middle class women. Could women from different backgrounds, with less exposure to professional work environments hold different stereotypes?

All the participants under-scored the importance of relating to their instructors. Their instructors were there to help them and encouraged them to work together to solve problems. The participants compared this to the lecture-based university experiences. The collaborative, team-based classroom experience was a highlight of many of the participant's educational experience.

Does a team- based pedagogy impact student's perception of the world of work in information technology? An under-researched area is the difference between the practitioner/ instructor model in career and technical education compared to the expert model in university and transfer oriented community college. Could having more practitioner educators in information technology help women persist in their programs? A related question, are PhD trained computer scientists reinforcing negative stereotypes about information technology only being for geniuses?

College marketing. Community and technical colleges will be the training ground for many of the jobs of the future in information technology (Chapple, 2005; Dowd, 2012). To attract more women as well as a diverse group of men, the researcher recommends that colleges create materials and campaigns that emphasize creative problem solving and creating a better world for users as key themes. Participants in the study mentioned the importance of problem solving and making a difference. In addition, they should consider using inspirational YouTube videos of both men and women who have found a way to build a great life in the field. The depth and variety of the field should be emphasized. Participants in the study found inspiration online. The participants were encouraged by role models of women in information technology who shared their stories in an online platform. The participants were largely computer novices. They were interested in using computers as a tool to help solve problems. Computers as a core image should be de-emphasized and used as tools to have an impact, as opposed to an image in itself.

Industry. Creating a more diverse workforce is a selling point to incentivize future diverse workers. A key damper on the positive effects of diverse teams is when a corporate culture is closed or has a low level of diversity these organizations have higher turn-over rates and lower levels of job satisfaction from members of the under-represented community (Milliken & Martins, 1996). In such situations, conflict and a desire to maintain the status quo can impede

the benefits of diversity. When the diversity numbers hit a critical mass, the problems of high turn-over rates and lower levels of job satisfaction go away. The participants in this study are willing to put up with a male dominated culture, but it is not their preference and if opportunity arose, would willingly seek out other opportunities. Creating a culture of belonging for all people is a great strategy for recruiting a diverse workforce. In this research, evidence of implicit or explicit bias during the recruitment and hiring process was present.

Attracting more women from diverse backgrounds is an important strategy for companies looking to continue to grow and innovate. The participants enjoyed working on teams and solving collaborative challenges. The participants embrace the importance of both interpersonal and technical skill development. In order to encourage more women to enter the field, attract a more diverse applicant pool and retain women employees, the researcher has a few recommendations. Companies should tell the story of the range of opportunities in information technology. The participants in this research study value a positive company culture that values employees, provides work life balance and flexibility and solves big and important challenges that impact user's everyday lives.

Summary Conclusion

The participants in this study shared their career stories. They had developed a vision of their future selves where they were successful professionals in information technology and computing. The path to seeing themselves in the career field was winding and included significant influence from friends and family and their own online research. They anticipated a financially secure, flexible career with many opportunities. They looked forward to continuous learning and challenge. The participants were resilient and able to overcome significant

challenges in their lives. They appreciated the amount of support they received from their

instructors, college staff, friends and family.

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Appendix A: Interview Guide

Interview Guide:

The purpose of the study is to better understand what perceived and or lived experiences supported women entering and persisting in **information technology and computing training** programs of study.

Describe your current program.

Draw an idea or something the interviewee stated.

Can you tell me a bit more about_____ ?

How would you describe _____?

Now let's go back in time, tell me about a moment in time when you began to see yourself within this career....

Draw an idea or something the interviewee stated.

Can you tell me a bit more about_____?

Can you explain what you meant when you said _____?

Move along this line until you are back to the current day, and then have her envision what she sees next.

Close with the her talking to a younger version of self.

What would you say to that person?

Can you tell me a bit more about_____ ?

Can you explain what you meant when you said _____?

Appendix B: Sample Data Reduction Table

CAPTA	CAPTA Text	Codes	Categories	Themes
	When I was an auto tech, we had a "pit," which was a room underneath the garage. Cars could pull into the garage and we could change their oil from underneath the vehicle without needed to jack the vehicles up. The pit was where the grunts (that was me) were stationed. Grunts could do work but were not yet trusted to work eye to eye with customers. :) We had to earn our keep in order to work in the sunlight upstairs which also allowed for more social interaction with people throughout the day.

Speed was always the name of the game. Usually we were tasked with routine 10-minute-or-less oil changes. Sometimes grunts could actually be changing oil on multiple cars, which took some planning and coordination. Occasionally we were able to have | The pit was where the grunts (that was me) were stationed.

Grunts could do work but were not yet trusted to work eye to eye with customers. :)

We had to earn our keep in order to work in the sunlight upstairs.

Sometimes grunts could actually be changing oil on multiple cars, which took some planning and coordination. Sometimes we were tasked with automatic transmission fluid flushes and filter changes, radiator flushes, and fuel filter changes, but this was usually not the case with only one person in the pit.

I was the grunt in the pit running two bays when I heard a code call for a fuel filter. | Grunts were stationed.

Grunts could work but weren't trusted.

Grunts had to "earn keep"

Grunts could change oil. Sometimes.

Grunts could sometimes to do more complicated work.

I was the grunt. | Novice

Novice

Novice, Learner

Novice, Learner

Novice, Learner |

	more "fun" and were tasked with automatic transmission fluid flushes and filter changes, radiator flushes, and fuel filter changes, but this was usually not the case with only one person in the pit. Safety glasses were not required on the job. While I was finishing up my math degree and transitioning into a tech-ed degree, so safety had not yet been engraved in me. I was raised on a farm. We NEVER wore safety glasses on the farm. I also worked construction…you guessed it…no safety glasses required there either. Sometimes sun glasses were worn out of necessity during a roofing or siding project in which the sun seemed to raise the temperature 30–50 degrees hotter than the air temperature, but no actual regard for one's eyes. One impressively busy day at the shop, I was the grunt in the pit running two bays when I heard a code call for a fuel filter (why the	So throughout this day I was going to prove myself. Safety glasses were not required on the job while I was finishing up my math degree and transitioning into a tech-ed degree, so safety had not yet been engraved in me. We NEVER wore safety glasses on the farm. I also worked construction…you guessed it…no safety glasses required there either. The shop didn't have a working eye-wash station, so I had to wait out the pain. I learned many important lessons that day…the first is to wear safety glasses (although goggles might have been better that day).	Prove myself. **Safety hadn't** been engraved. **I didn't know.** Never wore safety goggles on the farm. Safety precautions **weren't taken.** I had to wait it out in pain. Lesson learned: wear safety goggles.	Novice, Learner Novice Novice Novice Novice, Lens Expert Learner

	business spoke in numerical codes I still have yet to understand…I think it was to make the customers feel as if they didn't totally understand what the services were that we were providing…how hard it is to say "fuel filter" instead of "We need a 17 {oil change} and a 37 {fuel filter} on this one!") So throughout this day I was going to prove myself. I didn't need any help and was going to keep up with the 10 minute oil change promise while trying to do additional tasks. I had two cars, one in each bay, and had both plugs pulled and both filters off. With the fuel filter change on the right bay I figured I'd have just enough time to let the oil drain and be able to have the fuel filter done as well. As I rushed, I loosened the tank side of the filter first. Then I started on the line side of the filter. As soon as the filter was loose gasoline sprayed me in both eyes due to the pressure still in the line.			

	It was 15 minutes of pure pain. I couldn't open my eyes and offended everyone within a 100 yard distance with the profanities that quickly leaped out of my mouth.　　I remember feeling scared and wasn't sure the ramifications of gasoline in eyes. The shop didn't have a working eye-wash station so I had to wait out the pain. I learned many important lessons that day…the first is to wear safety glasses (although goggles might have been better that day).			
CAPTA #2	A simple phrase uttered by a previous boss has left a lasting impression upon me. That phrase "perceptions become reality." My previous boss was also my previous instructor and we had somewhat of a big/little brother relationship. He took me under his wing and tried to give me insights into the structure of the university where I had taken my first teaching post.	A simple phrase uttered by a previous boss has left a lasting impression upon me. That phrase **is** "perceptions become reality." My previous boss was also my previous instructor and we had somewhat of a big/little brother relationship. He took me under his wing and tried to give me insights into the structure of the university where I had taken my	"perceptions become **reality**"　　He took me under his wing and tried to give me insight.	Lens　　Novice, Learner, Expert　　Lens

	The position was in Chicago and the people were much different than what I was used to, having been raised in a rural town in central WI. As a kid I was taught to work hard, get your hands dirty, and you will be rewarded, i.e., a blue-collar upbringing. To an extent I still believe this too be true but the phrase "perceptions become reality" made me realize that sometimes hard work is not enough. People's perceptions of a you whether right or wrong are very powerful. He began pointing people out to me at the university in high posts and I began to think about my own perceptions of them. I began to realize that I perceived them as intelligent, powerful and highly successful simply because of their job title; yet my boss pointed out other aspects of these people that was perhaps less than flattering, and I began to wonder how some got their positions to begin with. Again that phrase resounds within my head.	first teaching post. The position was in Chicago and the people were much different than what I was used to, having been raised in a rural town in central WI. It has led me to realize that hard work is not always enough, perceptions are really powerful and those with powerful perceptions are often rewarded whether truly warranted or not. This has led to some internal struggles, however. I wonder if others have perhaps sold themselves out or somewhat altered themselves via perceptions.	The position and people were different in the city than in a rural setting. It made me realize that sometimes hard work is not enough. Perceptions are powerful. Perceptions lead to reward or punishment. Perceptions having power has led to internal struggle. Is this right?	Lens Lens Lens Lens Novice

	It has led me to realize that hard work is not always enough, perceptions are really powerful and those with powerful perceptions are often rewarded whether truly warranted or not. This has led to some internal struggles, however. I wonder if others have perhaps sold themselves out or somewhat altered themselves via perceptions. It is something I have continued fascination with and a big reason I would like to do something perceptions based for my dissertation.			

Appendix C: Interview Data Reduction Excerpt

Data/ Raw Capta		Codes	Categories	Themes
Interviewer:	Tell me a bit more about the other older students in your class.			
Sheila:	My first year, actually the man was the same age as my husband. He was quite a bit older than I am and he came back to school to help his work out. And there were times when, I mean, he completely had no idea, how to click through something, and it was just like, "Okay, slow down because you're trying to go too fast". So yeah, we connected, of course, because of us both wanting to sit in the front and absorb everything.	My first year, actually the man was the same age as my husband. He was quite a bit older than I am and he came back to school to help his work out. And there were times when, I mean, he completely had no idea, how to click through something, and it was just like, "Okay, slow down because you're trying to go too fast". So yeah, we connected, of course, because of us both wanting to sit in the front and absorb everything.	There was another student older than me. He came to school to help out his work. He also had no idea. He thought the instructors went too fast. We connected because we both sat in the front row so we could absorb everything.	You are not alone Better place Computer novice Computer novice You are not alone, computer novice

	to actually go out and actually do some work, to look for what it was that we needed to fix. That was all right too.	some work, to look for what it was that we needed to fix. That was all right too.		
Interviewer:	That's great. So as a final question, is there anything that you would recommend, maybe either to your younger self about encouraging you to go into IT			
Sheila:	Well, and we have.			
Interviewer:	Yeah, or other people within the nation or work?			
Sheila:	We have. Actually, there was a program through education that's brought a few of us together and said, "We're going to have this group coming		A group of students visited the gaming office and was looking for advise. I told them that you are going	Better world

	through, what could you say to them?". Basically I told them, "You're going to go to school, you're going to be sitting there," and I said to them, "And it doesn't matter what field it is you're going into, you're not going to know everything about that field".	Actually, there was a program through education that's brought a few of us together and said, "We're going to have this group coming through, what could you say to them?". Basically I told them, "You're going to go to school, you're going to be sitting there," and I said to them, "And it doesn't matter what field it is you're going into, you're not going to know everything about that field".	to be sitting their and you wont know everything, but that is okay.	Computer novice
Sheila:	But if you come back and you go, "Man, I can stand here as," and still consider myself an IT professional, and I can still stand here and say, "I knew nothing walking into my first day, but I'm walking away armed with stuff that I never thought that I would in." Don't be afraid to take chances on	But if you come back and you go, "Man, I can stand here as," and still consider myself an IT professional, and I can still stand here and say, "I knew	I am in front of you now as a professional and my first day of class I knew nothing. Now I am armed with tools. Don't be afraid to take chances. It will make you uncomfortable	Computer novice Wide ranging field

	something that might make you feel uncomfortable in areas that are unfamiliar to you, because if you hae the drive to go after it, you'll get there. Because it's you wanting it, not somebody else wanting it for you.	when you are faced with the unfamiliar.	You've got dreams
		If you have the drive you will get there.	Computer novice
		It needs to be you wanting it- not somebody else.	You've got dreams
Sheila:	And we also covered, as far as going into IT, all the possibilities, all the different areas of study that you can get into. We stressed the point that network security is probably the biggest issues for any-		You've got dreams
	"nothing walking into my first day, but I'm walking away armed with stuff that I never thought that I would in."		
	Don't be afraid to take chances on something that might make you feel uncomfortable in areas that are unfamiliar to you, because if you hae the drive to go after it, you'll get there.		
	Because it's you wanting it, not somebody else wanting it for you.		
		IT is a broad field, with a range of opportunities.	
Interviewer:	Everyone.		Wide ranging field
Sheila:	For any company, any walk of life. It's the number one priority. And if you don't mind reading,	The field matters, security is a huge issue	
	And we also covered, as far as going into IT, all the possibilities, all the different areas		Better place

	of study that you can get into.		
and you don't mind sitting and digging through things, consider going into the IT field. I know that my nursing background, as far as getting down to, when you're trying to diagnose something, somebody, whatever, I know that taking those steps or learning how to organize them is what helped me.	We stressed the point that network security is probably the biggest issues for any-	For any company or any walk of life- network security matters. If you don't mind reading and digging you should go in to IT.	Wide ranging field, better place
	For any company, any walk of life. It's the number one priority.	It is like nursing, you diagnose things, it is taking steps and organizing/	Continuous learning and problem solving
Interviewer: Yeah, it's problem solving.	And if you don't mind reading, and you don't mind sitting and digging through things, consider going into the IT field.		Problem solving
Sheila: Yes. And then, but moving into giving the advice, as far as my own daughter, because we did try to talk her into it-	I know that my nursing background, as far as getting down to, when you're trying to diagnose something, somebody, whatever, I know that taking those		
Interviewer: Okay, good. Yeah, how did you do that?	steps or learning how to organize		

Sheila:	She's a little bit more artistic. And we said, take advantage of those IT classes, the C++, and all of these other-	them is what helped me.	We tried to talk my daughter in to IT		Show the way
Sheila:	I said, "Take advantage of those. Make sure that, if your teacher can show you something just a little bit more than what he showed everybody else, take advantage of it". I'm not saying, be the butt-kisser, just take advantage of what it is that they're willing to teach you. I said, "Because it's going to help you out in the end". I said, "we're not going backwards. We're moving forwards".	but moving into giving the advice, as far as my own daughter, because we did try to talk her into it- She's a little bit more artistic. And we said, take advantage of those IT classes, the C++, and all of these other-	She is a bit more artistic but we encouraged our daughter to get as many technical skills as possible. We encouraged our daughter to get the most technical skills from her teachers as she can. We encourage our daughter to take advantage of what they are teaching.		Show the way, wide ranging field

		It will help you in the end.	Wide ranging field
	I said, "Take advantage of those. Make sure that, if your teacher can show you something just a little bit more than what he showed everybody else, take advantage of it". I'm not saying, be the butt-kisser, just take advantage of what it is that they're willing to teach you. I said, "Because it's going to help you out in the end". I said, "we're not going backwards. We're moving forwards".	As a people, we aren't going backwards but forwards.	Better world