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An Exploration into the Causes and Consequences of Women as a Minority in Technical Fields

Emily Fesnak
Syracuse University

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Emily Fesnak

Syracuse university

Abstract

This paper examines the causes behind why fewer women enter technology fields than men. By utilizing previous published research and studies from 1994-2016, the analyses made in this paper explore the evolution of women's interest and leadership in technology fields. The research dictates that there are not just sociological and structural causes for female adherence to entering technology fields, but the research also points to psychological causes, as well. In order to improve female representation and leadership in technology fields, it is crucial that these causes are acknowledged and addressed directly. Specifically, employers must recognize the differences between male and female employee goals and cultural and professional motivational factors. As well, while employers ought to be transparent in conversations surrounding the under-representation of women in this field, parents and teachers have a responsibility to facilitate strengthening of computer skills among young female students at home and in the classroom to improve female confidence with technology.

Executive Summary

The number of women in technology fields continues to be overshadowed by the number of men. Thirty years ago, that could have been chalked up to fewer women having the aptitude and knowledge to succeed in this field. In the 1970s, the ratio of males to females who scored above a 700 on the SAT math exam was 13:1; however, today, the ratio is 3:1. No longer is it the case that women are incapable of holding their own in STEM fields next to men, and yet, the number of women entering technology fields has not increased at the same dramatic rate as their test scores.

Drawing from twenty years of research, this paper explores the causes for a lack of female interest in technology-related fields. Specifically, when referring to "technology fields," the author is referring to computer science, computer engineering, and information technology fields. Based on STEM research, these fields struggle greatly to attract female interest. Among the causes found that discourage females from technology fields are the industry's failure to appeal to female career goals, lack of support and encouragement within the field, and cultural stigmas that perpetuate female computer anxiety. These three causes account for female disinterest in STEM subjects in school, which perpetuate to a disinterest in the field for a career, and even discourage women in the field from striving for leadership roles. In this way, the issue is rooted in a number of institutions and efforts to encourage more women to enter into the technology field must be made in the female mindset, the workplace, and within educational institutions.

The interactions that young women have with computers and in the classroom heavily impact their attitude toward computers when they enter the workforce. Multiple female computer

science majors reported that growing up, their male classmates and siblings were more encouraged to use computers than they were. As well, these same interviews expressed anxiety and self-doubt when comparing themselves to their male counter-parts. In this way, the technology industry is not the sole cause of female discouragement in this area. It begins much earlier and the responsibility to reverse this computer anxiety among females in technology lies on educational institutions and females themselves.

After exploring these causes through research and case studies, conclusions were drawn on to encourage more women to enter the technology and also succeed once they have entered this field. The solutions presented in this paper call for the industry to rebrand itself in order to appeal to both female and male interests and also calls for companies to institute female mentorship and leadership programs to support women entering the field. As well, schools must encourage young women to take an interest in computers and overcome their computer anxiety at an early age in order to nurture this interest in technology.

Most importantly, there must be open and honest discussion about the gender stigmas and discrimination that occur within the technology field. Without acknowledging that this is an issue, female employees will never overcome the gender obstacles to succeed in equal numbers as men in this field. Ignoring the problem and sweeping it under the rug just perpetuates this issue, that exists on multiple levels: professional and educational. By understanding the roles individuals play in encouraging and building up young and professional females, we can see great change in the numbers of women entering and succeeding in this field. The first step is to talk about it.

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A Lack of Interest

Science, technology, engineering, and mathematics (STEM) fields are incredibly competitive and critical in today's global economy. Specifically within these fields, science and engineering occupations "are predicted to grow faster than the average rate for all occupations, and some of the largest increases will be in engineering—and computer-related fields" (Margolis & Fisher, 2010, p. 2). Yet, women only occupy up to 25% of the workforce in these fields. This is not due to lack of knowledge or ability, but seems to boil down to a lack of interest among women. Discussed below are the ways in which women and men differ in their motivations, goals, and resources with information technology and computer science fields. While women have their own responsibility to overcome gender-based stereotypes on a personal level in order to be successful in technology fields, I believe the industry also has a duty to address and support the interests and goals of both men and women in technology fields.

The obstacle of obtaining and retaining female employees in technology fields, such as computer science and information technology, at competitive rates with their male counter-parts has been recorded since the technology boom in the late 1980s and early 1990s. According to Roli Varma, from the University of New Mexico, "women's share of baccalaureates in computer science began to drop off sharply from more than 15,000 in 1987 down to about 6,500 by the mid-1990s" (Varma, 2002, p. 274). The National Science Foundation reported the same low numbers a decade later in 2000. In fact, the percentage of women intending to major in computer science has decreased consistently since 1981. Women are notably excluded from this booming industry, and as per Varma's data, it is partly due to lack of interest.

The table to the right represents the findings of a University of California Los Angeles study that measured the percentage of women entering STEM fields over the course of four decades. The data in this table

	1971	1981	1991	2001	2011
Physics	0.2	0.1	0.2	0.2	0.2
Biological sciences	3.8	4.1	5.8	7.9	12.4
Computer science	0.8	5.0	1.5	1.5	0.5
Engineering	0.3	3.5	3.7	3.0	4.2
Math or stats	3.9	1.0	0.8	0.6	0.8
Chemistry	0.6	0.7	0.7	0.8	1.2

(Sax, Lehman, Barthelemy & Lim, 2016, p. 13)

further exemplifies the declination of female representation in computer science and related technology fields. From 1981 to 2011, this percentage of women intending to major in computer science dropped from an already low 5% to a miniscule 0.5%. On the other hand, women intending to major in engineering reached a 40-year high in 2011 with a mere 4.2% of women entering the field of study. This indicates that for nearly half a century, less than 4% of educated women were interested in working in engineering. In fact, every technology-related major recorded less than 1.2% of women were interested in entering these fields in 2011 (Sax, Lehman, Barthelemy & Lim, 2016, p. 13).

These numbers exemplify a long history of women's underrepresentation starting in school, even before they enter technology workplaces. Women are not as attracted to studying information technology and computer science as they are to other fields. In 2005, Tiffany Brinkley insisted that "despite the high demand for IT workers, women and minorities are entering this field in small numbers. Even though numbers have increased some over the last decade, they do not show a significant improvement" (Brinkley & Joshi, 2005, p. 24). This claim was supported by the findings of numerous other researchers' studies, such as Ajuka in 2003, Newton in 2001 and SESTAT and Ahuja in 2002 (Brinkley & Joshi, 2005, p. 24).

Perhaps, this disinterest in technology fields, which leads to female underrepresentation in the workplace, is an issue that stems from a young age. The issue may blossom at an early

stage before women or men even realize they are shaping their perceptions and attitudes toward

technology for years to come. M.K. Ahuja (2002) reported on the differing attitudes of boys and

girls towards computers in grade school. Her study found that boys are expected, and even

encouraged, to use computers at home and at school more so than girls (p. 24). As well, girls are

reportedly less likely than boys to be sent to computer classes and camps, according to a study by

Didio in 1996. Thus, from an early stage, boys are exposed to more technological encouragement

and interaction than girls. By having fewer opportunities to interact with computers, girls

develop a lack of interest and lessened desire to participate. This may result in long-term

implications. For instance, a lack of technological interaction at a young age may lead to

computer anxiety when older. Specifically, "women have been found to display lower aptitude

and higher levels of computer anxiety compared to men (Ahuja, 2002, p. 24).

As a female studying and intending to work in the technology field, I have experienced

computer anxiety throughout my college career. When I first started in my information

management technology major, I was intimidated by the overwhelming number of male students

in my classes compared to females. Subconsciously, I thought their overpowering presence in the

classroom indicated that the male students were more adept with computers and technology. I

spent extra hours studying, working, and volunteering for additional learning opportunities so

that I could overcome my computer anxiety. While this helped me to learn the material better,

not every female student is as motivated to overpower their subconscious computer anxiety as I

was. In fact, some may not even notice the symptoms of their own anxieties.

My freshman year, I started working in the School of Information Studies as a lab

manager in order to gain more technical knowledge outside the classroom. My office operated

under a more technical research and development student office in the school. When I was hired,

I was the only woman on a team of six students in my office. By the end of my sophomore year, I had two female co-workers, but I was the only one who applied for a promotion to work in the research and development office. In my four years at this school, I had seen three male students make the transition from the lab management role to research and development, but I am the only female to do so. The other two female students studied the same major as me and the other student employees in the research office, so their lack of knowledge or experience was not a factor. They chose not to even apply for the position without external dissuasion; it was their own decision not to pursue a path of greater learning, research, and payment. Perhaps, a sense of inadequacy or anxiety in one's major of study has the potential to deter one from acting ambitiously in that major.

The American Association of the University of Women (AAUW) conducted a study that supports this idea, finding that "girls assess their mathematical abilities lower than do boys with similar mathematical achievements" (Margolis & Fisher, 2010, p. xv). At the same time, "girls hold themselves to a higher standard than boys od in subjects like math, believing that they have to be exception to succeed in "male" fields" (Margolis & Fisher, 2010, p. xv). By holding themselves to a higher standard and simultaneously self-evaluating their abilities lower than their male counterparts, women seem to be setting themselves up for failure. They believe they are performing worse than they are and that STEM goals are beyond their reach.

Long-Term Implications

The above AAUW study demonstrates how anxiety in one's abilities results in "fewer girls than boys entering STEM careers" (Margolis & Fisher, 2010, p. xv). Varma reported in her study that "since the early 1990s, the gap between female and male students' scores in mathematics and science have been narrowing" (Varma, 2002, p. 279). There, female students

are demonstrating increasingly greater interest and talent in this area, working to combat the computer anxiety reported in Ahuja's study. Nevertheless, studies conducted in 1994,1995, and 1997 all reveal that women feel less prepared than their male-counterparts in STEM areas (Lundeberg, Fox, & Puncochar, 1994; Sax, 1995; Seymour & Hewitt, 1997). As well, men and women have both reported that they believe men are better than women in the fields of mathematics and computing (Margolis & Fisher, 2002; Valian, 1998). Based on these findings, although women's personal aptitude and confidence have improved in relation to working with technology, when compared to their male counter-parts, women still report a sense of inadequacy.

Thus, women are minorities in the technology industry not because they are inherently unable to understand the material or perform required skills, but partly due to their own lack of confidence in the workplace. They can possess the same qualifications and aptitude as men in technology, but the stigma that technology is a man's field deters interest in pursuing this career. To clarify, women are less inclined to join a field where they feel less successful than those around them. This reasoning can be applied to any person, such as when a person quits an extracurricular sport because he or she is not as skilled as his or her peers. When applying this mentality to the workforce, such insecurity in one's abilities deters capable female and male candidates from entering and growing in a particular field, namely information technology and computer science. However, as women are already minorities in this field and mentality in the industry favor men, women are more likely to exit from this line of work than men.

The Influence of Negative Stereotypes

However, some women are deterred from joining the technology industry before they even enter the field due to stigmas surrounding this industry. In Varma's study, she interviewed

undergraduate male and female students of various nationalities about their perception of

computer science majors. She found that both male and female students of multiple nationalities

reported that they perceive computer science majors to display anti-social behavior. An Asian

male student stated that "they usually hang out in the department, doing homework, staying up

late, just to work on projects" (Varma, 2002, p. 279). A Hispanic male computer science major

said that "[computer science majors] talk about computers more than any other topic…usually,

you just talk about computers all the time" (Varma, 2002, p. 279).

While the female students reiterated the same sentiment as the male students, they used

harsher language when describing computer science majors. A Hispanic female student said that

computer science majors "definitely don't have a life. [They] don't have a social life at all…"

and a white female student also reported that she assumed computer science majors "do not have

social lives" (Varma, 2002, p. 279). Interviews with students of both genders echoed anti-social

behavior, however, the female students were the only ones to explicitly mention a "social life."

This is important to note because it indicates that sociality, or the lack there of, is a crucial aspect

considered when these female students consider majoring in this field.

If a woman does not see herself as fitting this anti-social stereotype, it can deter her from

pursuing a career in this field, despite her own interest in the topic area (Margolis & Fisher,

2002). Not fitting in with her fellow students establishes the student as an outsider, even if only

in the female student's mind, and influences a student's confidence in that field of study. For

instance, Varma interviewed female computer science majors and noted that they consistently

report doubts in their own skills compared to their male counter-parts. An Asian female student

claimed, "I enjoy [computer science] and I am still learning, but I don't have a vast majority of

knowledge that some of these kids have." A Hispanic female woman reported that "I don't let

myself get intimidated…But, sometimes…I feel like that, maybe, I could not do a certain segment because I was a woman." As well, a Native American female student stated that "In some of [my] classes, I feel really intimidated about answering questions, because most of the guys know more in that field…It is kind of hard for me to talk because I feel intimidated by the guys sometimes" (Varma, 2002, p. 280).

In my predominantly-male computer engineering classes, I have also found myself struggling to volunteer answers to professors' questions. I'm afraid to answer a question incorrectly and seem inferior to my male counter-parts. In many of the classes, I naturally gravitate toward the back of the room where I am less likely to be called on and must make a conscious effort to move to the front of the room. When professors call on students randomly to answer questions, I will answer correctly when called and I understand the information. I have earned A's in all of my computer engineering classes, yet I still second-guess myself when I am asked questions in class. However, my male counter-parts will volunteer answers more willingly than all of the girls in my computer engineering classes. As one of five girls in a room of approximately 30 students, the difference in attitude is easily noticeable in the eyes of the minority group. The intimidation associated with being a minority in the classroom seems to affect the confidence of students belonging to that minority.

The Effect of Low Self-Efficacy

Brinkley labels this phenomenon as self-efficacy. According to Brinkley's definition, "self-efficacy refers to an individual's perceptions about her or his computer-related or IT-related abilities" (Brinkley & Joshi, 2005, p. 27). Another study found lower self-efficacy among women than men who work in traditionally male-dominated occupations (Betz and Hackett, 1981). The results of this study support the first-hand anecdotal accounts of Varma's case study.

Anti-social stigmas coupled with a noticeable minority status in academic and work environments seem to have a direct impact on low female student and employee self-efficacy.

In fact, a study by Hunt and Bohlin in 1993 found an inverse relationship between computer anxiety and computer self-efficacy. The study found that when one feels greater computer anxiety, their computer self-efficacy, or computer confidence, is lower. Therefore, the increase in computer anxiety among women compared to men results a greater diminished sense of self-efficacy among female co-workers. As Varma's research demonstrates, women in information technology or computer science fields feel more computer anxiety than men in these fields and thus, "low self-efficacy which may be especially common among women, is expected to lead to more negative attitudes toward IT as a career" (Brinkley & Joshi, 2005, p. 27). As well, this correlation may be one of the causes for the lack of female leadership in technology companies. Women will not be ambitious in their career goals if they carry a sense of anxiety and inadequacy for their work.

Based on Varma and Brinkley's findings, the insecurity of not fitting in with a stereotype crosses ethnic boundaries and affects female's perceptions of their abilities. According to Varma's study, white, Hispanic, Native American, and Asian American women were all interviewed. Women from each of these nationalities interviewed reported feeling the influences of gender-based low self-efficacy or computer anxiety.

Dispersion of Female Interviewees in Varma's Study (2002)

Reported gender-related low self-efficacy:

White Females:

Hispanic Females:

Native American Females:

Asian American Females:

Appealing to Different Goals and Motivations

If women consistently feel that they are not matching the progress of their male counterparts, they will believe they are not capable of success and, consequently, are more likely to develop disinterest in the field. One can argue that women can change their mentality and behavior to fit the anti-social stereotype associated with computer science majors. By fitting the stereotype, women may not feel so detached from their male colleagues and feel more comfortable working in a male-dominated setting. However, changing one's behavior is not the quick fix for this issue. There are underlying differences between female and male goals, motivations, and interests within this field. To encourage more women to enter and remain in technology fields, companies must understand and cater to the unique interests of females, as well as males. Therefore, instead of suggesting that women change their own outlook to match the stereotype aligned with this field, I believe the industry should cater to a wider audience of interests and welcome more diverse goals from its employees.

A study by L.J. Sax, J.A. Jacobs, and T.A. Riggers found that women tend to gravitate

toward service-oriented careers more than men do. For instance, collegiate women report

stronger social activist values than men do. However, these social activist values are negatively

associated with interest in a STEM major (Sax, Jacobs & Riggers, 2010). This indicates that

STEM fields are not generally associated with socially-beneficial work on a personal level,

therefore, employees don't commonly feel a connection with individuals in the community

through their work. Even within STEM fields,

"women attracted to a STEM discipline tend to

be drawn to fields such as the biological

sciences, where opportunities to help others are

more explicit" (Sax, Lehman, Barthelemy &

	1971	1981	1991	2001	2011
Physics	0.2	0.1	0.2	0.2	0.2
Biological sciences	3.8	4.1	5.8	7.9	12.4
Computer science	0.8	5.0	1.5	1.5	0.5
Engineering	0.3	3.5	3.7	3.0	4.2
Math or stats	3.9	1.0	0.8	0.6	0.8
Chemistry	0.6	0.7	0.7	0.8	1.2

Sax, Lehman, Barthelemy & Lim, 2016, p. 13

Lim, 2016, p. 10). By referring again to the chart

utilized on the first page of this report, it is evident that the data from the University of California

study supports this assertion. The percentage of women enrolled in computer science (0.5%) and

engineering fields (4.2%) trail by more than 8% behind the percentage of women enrolled in

biology sciences. Biology sciences dramatically leads the percentage table with 12.4% of women

reporting interest (Sax, Lehman, Barthelemy & Lim, 2016, p. 13).

The findings from these studies exemplify that women are attracted to opportunities for

service and people-oriented careers. Consequently, the anti-social stereotype surrounding

computer science directly contrasts this desire and may be a factor in deterring women from

entering this field. Even within the STEM industry, the technology and computer field must

compete with fields, such as biology, that more obviously fulfill women's service-oriented career

goal. When Varma's female interviewees explicitly labeled computer science majors as not

having a social life, that may have had a larger impact on the female students' interest in the major than the male students. With such a stigma stamped on the technology industry as a whole, it will be difficult to appeal to females without making an effort to shed that anti-social image. If not, female employees will find alternative career paths that will satisfy these social desires.

Based on these results, it can be deduced that women in STEM careers are not fully driven by personal gain of knowledge and skill, but also by a wider external call to serve society through their talents. In other words, women are motivated by how their work will impact the greater community, rather than by their personal passions. In Brinkley's study in which she surveyed high school students on their self-efficacy, work values, and perceptions of a career in information technology. She then compared these results with the students' intent on choosing information technology as a career. Her results suggested that a "technical [work value] was not significant for girls, but was for boys; and social interaction [as a work value] was significant for girls, but was not significant or boys" (Brinkley & Joshi, 2005, p. 32). In other words, boys focus primarily on gaining more technical skills, while girls focus on utilizing their skills to have a social impact. Without understanding these differing motivations, the technology industry cannot succeed in appealing to the interests of both genders. Specifically, if leaders in technology companies do not take the time to understand the goals of women entering this field, they cannot appropriately attract women to work in technology with enthusiasm, purpose, or vigor.

Brinkley's results convey a difference in focus and goal for males and females considering technical careers. While women enter STEM fields hoping to utilize their skills in a way that influences others, men enter the field hoping to improve their skills for personal and professional gain. Varma had similar findings when she interviewed male and female information technology students at the University of Mexico. Varma found that once male

students were exposed to computers as kids, "they were hooked right away and decided to continue with computer activities for the rest of their lives. They perceived the computer as a buddy that would not talk back to them" (Varma, 2002, p. 278). Yet, female students did not express the same friendly emotions felt toward technology from young ages, but instead reported that they grew up using computers primarily as resources in school (Varma, 2002, p. 278). Consequently, females consider the larger, social perspective of information technology that supports communal growth, while males think if information technology as their personal passion and interest through which they can grow personally.

These differing perspectives ought to be considered when recruiting more women to careers in technology. The same motivators that attract men to the field will not attract women. Thus, when appealing to women, companies in the technology industry ought to emphasize their social responsibility initiatives and the impact their work has on the greater community. Understanding the difference between the goals and interests of men and women in this field will help the industry to cater to the needs of both. One universal message will not envelope all the interests of men and women considering working in technical fields.

The Importance of Narrowing the Gender Gap in Leadership

This applies, as well, after women enter the technology field and begin to progress in their careers. Even after women overcome the internal obstacles to enter this field, few of them continue on to hold powerful and influential positions in companies. According to Crunchbase as of December 2016, a world-wide business information platform that follows industry trends, investments, and news, both General Electric and Google's boards of directors only consist of four women of seventeen total directors. As well, Crunchbase reports that Intel's board only consists of two women out of twelve directors, while IBM's website reports only four out of its

sixteen directors on its board to be female. It is difficult to visualize a path to leadership if there

is no precedent already set to follow. A majority of the top companies in this industry do not

represent women equally on their boards, which normalizes this gender imbalance in leadership

roles. By normalizing this idea that women do not have as great an opportunity as men for

leadership roles, fewer women then see themselves achieving these roles of power. It is a vicious

cycle that will continue until industry leaders, male and female, make an active change.

Female Leadership on Technology Corporation Boards of Directors

General Electric

Google

Intel

IBM

Equal representation in leadership roles is crucial not only to acquire gender equality in the workplace, but also to reflect the needs of female workers within the company. When leadership positions are dominated by any one gender, race, or age, it is impossible for the leaders to foresee or understand the struggles or concerns of those not represented in the room. For instance, when I interned at IBM over the summer, I met another intern who served as the president of the business fraternity at the University of Georgia. She told me that while she attended a national business conference one year, she heard a speech from a male executive on appropriate female workplace attire. She couldn't help but scoff when she heard the executive discuss the grave importance of wearing panty-hoes when in the office. The man had never worn panty-hoes in his life, but was telling an audience, half comprised of females, that they would not be taken seriously if they did not wear pantyhose undergarments in the office.

She wondered why her undergarments were so important in a place of business. A man would never be told he had to wear boxers or briefs under his suit. As someone who had attended numerous national conferences as a female leader representing one of the highest-ranked collegiate business organizations in the nation, she felt he had no ground to tell her what she should or should not wear beneath her business attire. Furthermore, she insisted the message would have been better received had it come from a female executive. A female executive would have the first-hand experience and respect to understand and intelligently advise the students on appropriate female workplace attire. The man did not have the experience to speak for women. This is just one small example of how more female leaders would prevent such oversights and assumptions which can be deemed offensive.

Sheryl Sandberg, the current COO of Facebook and former COO of Google, wrote about the effects of female underrepresentation in leadership roles in her book *Lean In*. In the book,

Sandberg recounts that when she was pregnant with her first child, she struggled to walk the length of the Google parking lot to get to her office. Eventually, she went to the CEO and founders of Google and told them that the company needed to have designated parking for pregnant women. Her bosses immediately agreed with her; the lack of parking spots was an oversight because these men had never even considered the issue before; Sandberg was the first female employee to bring the issue up. Had she not been one of such few female leaders in the company, perhaps this change would have been made sooner. Sandberg and my colleagues' anecdotes demonstrate the influence more female leadership can have in the development of companies and their environments. More diversity in representation brings faster progress and ensures the interests of all employees are considered.

The Effects of Ineffective and Male-Biased Evaluations

Barbara Berg, PhD., a historian and the author of *Sexism in America*, attempts to explain why there are so few women in leadership roles. She claims that patriarchy is America's "default setting," which creates a culture in which men hold the positions of privilege and power and "women are very often treated as second-class citizens." Therefore, Berg speculates that "it's always been problematic in American society when women have gained power" (Newsom & Acquaro, 2011). When power is defined and controlled by men, women seem to resort to settling for lesser positions, pay, and treatment. When they are not given the same opportunities in a patriarchal society to advance, women are left out of leadership roles to further create more equality. Gavin Newsom, the current Lieutenant Governor of California and former Mayor of San Francisco emphasized that it is dehumanizing to question the authority and legitimacy of women in leadership roles purely because they are women occupying roles normally occupied by

men. He states, "when you are not treated the same, you're dehumanized. When you're not given the same opportunity, you're dehumanized" (Newsom & Acquaro, 2011).

Perhaps, women's lack of representation in leadership roles is influenced by more than a "second-class" stigma, such as discrepancies between males and females' strengths in the office. Because the technology industry does seem to follow a patriarchal hierarchy, as more men dominate leadership roles than women, then evaluations and timelines for promotions are drawn out by male standards. There is little to no female leadership in these companies to point out that female employees have different needs and strengths than men and these differences ought to be considered when assigning promotions.

Mentorship

One particular area in which men and women are treated differently is through mentorship. Robert Thomas, the current general manager of IBM's Analytics, wrote in his professional blog on February 5, 2016 that "finding and cultivating the right mentors will change your life and career." He continues on to advise that "everyone should cultivate mentors and mentees throughout their career; gather what they can, and focus on the next step" (Thomas, 2016). W. Whitely, T.W. Dougherty and G.F. Dreher (1991) define mentoring as "an intense developmental relationship of relatively long duration in which protégé receives a range of career and psychological help exclusively from one senior manager (Levinson et al, 1978; Claswon, 1980; Kram, 1985)" (p. 133). Whitely's definition and Thomas' attestation exemplify the importance of mentee/mentor relationships as one progresses through their career. They are crucial components of an employee's success and consideration for advancement. However, it seems that women are at a disadvantage compared to men when it comes to finding mentors in the workplace.

Sheryl Sandberg also wrote about the differences between women and men's experiences with mentors. Based on the findings of *The Mentor's Perspective: A Qualitative Inquiry and Future Research Agenda,* Sandberg wrote that "mentoring and sponsoring relationships often form between individuals who have common interests or when the junior members remind the more senior members of themselves" (Sandberg, 2013, p. 71). It is more common for junior members to remind senior members of the same gender of themselves. As more senior members are male, as evidenced by the Crunchbase data, it is logical to deduce that it is easier for junior male members to acquire mentors. This notion is supported by a study conducted by G.H. Dreher and A. Ash in 1990 that found "one explanation for a lack of mentors for women can be found in the theory of interpersonal attraction. The theory of interpersonal attraction posits that individuals are most comfortable interacting with those who are similar to them" (Ahuja, 2002, p. 28). This means that senior men, who largely outnumber senior women in the technical companies across the industry, tend to gravitate toward younger men as mentees.

Sandberg insists that since there is a reduced number of women in leadership roles, there are not enough senior women to mentor junior women. Therefore, senior men must take on more junior women mentees in order for more women to obtain leadership roles. This is a crucial point to discuss because "while relationships are important for men in later career stages, relationships are important for women throughout their careers" (Ahuja, 2002, p. 28). In other words, mentorship for female employees is crucial early in their careers in order to keep these women in the field, while male employees rely on these relationships for advancement later. In fact, in a study conducted by Van Velsor and Hughes in 1990, which interviewed 189 male and 78 female executives, women reported a greater reliance on work relationships as sources of development

and learning in the workplace. In this way, the early support of mentors is crucial not only to keep women in this field, but to also encourage more female leaders.

Performance Evaluations

Women utilize mentors and networking differently than their male counter-parts. Women rely on these work relationships to thrive, however men do not rely so heavily on these relationships in order to progress in their careers. In 1995, Igbaria and Baroudi's research found that women experience more restricted career advancement than men, while men experience more favorable career opportunities than women do. As women and men have different needs to progress in their careers, it seems many business structures favor men. Consequently, men and women are judged on different playing fields. Igbaria and Baroudi concluded their study saying that "career advancement opportunities for men and women can be evened out if similar criteria were used for both groups" (Ahuja, 2002, p. 27).

Working in a small research and development office in the School of Information Studies with six male students, I have experienced a variety of gender-based discrimination. I experienced three years of discrimination in the form of undesired touching, sexual advances, and unwarranted assaults on my work ethic. It took me three years to finally report the discrimination I faced that ultimately made me feel incredibly uncomfortable in such a small office. Since my manager and all of my co-workers were men, I hadn't felt comfortable talking to them about gender bias and discrimination in the office. I felt outnumbered and was worried I would be labeled irrational and troublesome in the workplace. During that time, I would have benefitted from a female mentor, who could reassure me and guide me through an uncomfortable workplace issue. I wouldn't have felt so alone and unsure of myself. It had taken two female engineering friends to explain that my experiences were discriminatory, as I hadn't even been

sure until I told them my story. If I had a female mentor or fellow employee in the office, it would not have taken three years to finally report the discrimination to which I had been subjected.

Based on the above findings and my experience, gender stigmas, lack of professional development opportunities and unequal evaluation methods contribute to women's lack of representation in leadership positions. Their lack of representation is not a result of female employees exemplifying fewer leadership qualities. Neither women nor men are being judged solely on the quality of their work because if that were the case, there would not be such a grand gap between gender representation in leadership roles. Both are judged based on unspoken social expectations, which seem to favor men. For instance, In Sheryl Sandberg's *Lean In*, she cites a 2012 study by Corinne A. Moss-Racusin in which scientists were given identical resumes for a lab manager position, one under a male pseudonym and another under a female. Scientists of both sexes gave the male student higher marks as an applicant and considered the female less competent, offering her a lower starting salary and less mentoring (Sandberg, 2013, p. 151-152). Women and men alike must recognize the implications of letting gender-based stereotypes influence merit-based decisions. Without acknowledging that women suffer discrimination at the hands of both male and female leadership, men will continue to have an inherit advantage over women in the workplace.

Although there is nearly a 20-year difference between the timing of Igbaria and Baroudi's study and Moss-Racusin's, the findings are the same and there has been little recognition or action to change this epidemic. Gender still plays a crucial role in the way women and men are evaluated professionally. Purely based on gender, women will miss out on career-progressing opportunities which hold them back as leaders in the field. Not only that, but Moss-Racusin's

study demonstrates that women do not receive the mentoring opportunities that studies have found so vital in women's careers. These gender stigmas are depriving women of both opportunities and resources to not just be successful, but to even remain in the workplace.

Breaking the Glass Ceiling

In this way, men more easily progress in their careers to leadership roles than women and, in Sandberg's words, "the proverbial old-boy network continues to flourish" (Sandberg, 2013, p. 71). According to a study conducted by Kirchmeyer in 1997, similarities to others such as gender, culture, age and education at the same managerial level heavily influence one's career progression and perceived success over time. Kirchmeyer's study suggests that one's culture, history and physical appearance is used as a source of connection between co-workers throughout a person's career. Lack of this connection can deter one's ability to progress in a company or field. Therefore, the lack of women in higher positions "have a negative influence on the advancement of women at lower and middle levels" (Ahuja, 2002, p. 28). In this way, the progression for women in technical careers is a catch-22. Without women in high leadership positions, lower and middle level women struggle to advance. However, if lower and middle level women can't advance, then women cannot infiltrate the "old-boy network."

As long as this outdated system of small networks of powerful men remain in place, women will continue to be the minority in the workplace. Being the minority such in a competitive environment leads individuals in that minority to turn against each other. Sandberg refers to this as the "there can only be one" attitude (Sandberg, 2013, p. 163). The results of a study by Katherine Stroebe in 2009 supported this notion, as she suggested that when a woman achieves success, particularly in a gender-biased context, her vigilance towards gender discrimination declines. When it appears that only a select few women can be selected to

continue to advance their careers, female co-workers are considered competition and enemies instead of allies. This only perpetuates negative stigmas surrounding women in the workplace and keep women from more leadership roles.

It may be that when women are in the minority, they are less supportive of other women, which counter-productively hold women back even more. For example, while discussing this notion with my aunt, who works in a large finance firm in Pennsylvania, she noted that "if I could choose between working in an office full of men and an office full of women, I would choose the men every time" (Linda Fesnak, personal communication, August 20, 2016). Shocked, I inquired why she felt that way. My aunt responded that women are "catty" and "mean" to each other. Although my aunt does not work in the information technology industry, her assessment is not industry-specific. As minorities in this field, women are prone to view each other as competition, fighting for the few available leadership positions set aside for female employees. Consequently, with so few female mentors available in this industry and so much competition, women commonly feel unsupported and inadequate in the workplace. They are competing against the men and the women and have minimal support to help them succeed in their chosen careers.

The Need For Active Change

The only way to improve the representation of women in the workplace, as well as in leadership positions, is to acknowledge that women in technology fields have different expectations and needs than men. Only then can women-supportive environments be constructed so that women can be noticed and advance in their fields. First, leaders must make an effort to have this discussion about inequalities in this field. In December 2013, Sandberg spoke at the TEDWomen 2013 conference and described the hesitance she felt from other women in

leadership roles about speaking out on this issue. She was told that if she spoke at TEDWomen, it would "end her business career." She was advised that she could not be a serious business executive and also speak about being a woman. Her gender and gender's influence on her experience working in business were treated like a secret. However, as long as leaders in the business world continue to act as though gender does not have influence in the workplace, there will never be progress in this area.

Even in my own experiences as a student and employee in the School of Information Studies at Syracuse University, I have noticed a hesitance to address workplace inequalities associated with gender. It is uncomfortable to address concerns about gender stereotypes when I am in the minority. The awkwardness was sometimes palpable when such issues were addressed, so much so that I would tend to downplay these issues. It seemed easier to act as if there were no issues at all than to acknowledge and address them directly. Leaders in the business and technology industries have a duty to make this a comfortable and normal conversation. By doing so, discussions to solve gender inequality in the technology field will flow more freely and practical solutions can be created.

The industry must, essentially, re-brand itself to appeal to females and females must be better prepared from a young age to consider information technology and computer science careers as viable options. AAUW poses a series of strategies to encourage young females to pursue technology majors and careers. For example, they suggest that educators encourage high school females to take more STEM classes in order to prepare them for possible careers in STEM fields. Once females enroll in these classes, AAUW insists that it is pivotal to "make performance standards and expectations clear" ((Margolis & Fisher, 2010, p. 92). This reduces the likeliness that females will misjudge their abilities compared to men and can appropriately

gauge their progress. To further encourage young females to stay in STEM, the organization

stresses that in order to combat the stereotype that men are better than women in STEM areas, it

is crucial to highlight female successes in the industry. By exposing more female role models

and more openly discussing the advancement of women in the field, it becomes normalized for

females to be prominent and successful in STEM ((Margolis & Fisher, 2010, p. 90).

It is important to not only prepare girls with career and academic skills to be successful.

Nurturing their talents is only half of the battle. The other half requires preparing women for the

stereotypes of the industry ahead. Addressing the threat of believing and behaving by way of a

false stereotype will result in "better performance for girls and young women, specifically on

high-stakes tests" ((Margolis & Fisher, 2010, p. 91). One way of promoting a positive learning

environment that overcomes the threat of such gender-based stereotypes is "by emphasizing that

intellectual skills can be improved with effort and perseverance and that anyone who works hard

can succeed" ((Margolis & Fisher, 2010, p. 91). To summarize, the AAUW research suggests

that maintaining open communication and acknowledgment of this issue results in positive

performance by young females. It is imperative for schools and workplaces alike to not sweep

the potentially-uncomfortable gender discussion under the rug, but highlight it and address is

directly.

This strategy has already been implemented by some major companies in the industry.

Both Intel and IBM have instituted internal "Women in IT" employee programs to support the

female employees. Creating and promoting programs like this are essential to get this

conversation started and acknowledge the issue at hand. Once the line of communication is

created, specific programs for mentorship can be established to provide female employees with

the resources they need. By recognizing that women need mentors in different ways than men

and orchestrating programs designed to cater to these needs, women and men have equal opportunity to utilize mentors that will help guide them in their careers.

As well, establishing merit-based promotional and reward systems within companies is a first step to eliminating gender as a factor when reviewing performance. Intel specifically focuses on a "meritocracy" system. Its employees are evaluated solely on their performance for the company and within a team. While a meritocracy system is ideal for eliminating unnecessary and unrelated factors from influencing promotion decisions, it is still crucial that leaders acknowledge that gender bias may subconsciously influence decisions. By recognizing this threat, it is less likely to have an impact on the ultimate decision.

Instituting female programs, mentorship programs, and merit-based reward systems are powerful in improving female employee opportunities in the workplace. However, in order to initially attract these females to technology fields, companies must focus on changing the way they market themselves to new employees. Technology employees are weighed down by an anti-social stereotype that is unattractive and unappealing to female students and potential female hires. By highlighting social responsibility programs, positive contributions to society, and client and customer-focused practices, companies are more likely to attract female employees. The industry as a whole must work to change the image of technology professionals as anti-social, robots to positive change-makers for society.

In this way, the industry must re-brand itself to appeal to females and males, as it cannot brand itself for only one and expect the other to follow. From a young age, females are sent the message that computers are for boys and men. This re-branding needs to infiltrate media, youth programs, and company advertising that reaches female audiences of all ages. If a female-friendly brand reaches girls at a young age, then those girls may turn that interest into a passion.

This point of change is the most important because without a rebranding of the technology industry and the technology employee image, the workplace initiatives will fall on mute ears. It is most important to demonstrate to female students of all ages that the technology field is not just for men, but for them, too. Once the seed is sewn, these students will enter the workforce prepared to be supported by mentors and be judged solely on their work ethic and skills in order to succeed.

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