A Modern Investigation of the Low Rates of Women in Computing

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The gender gap in science and engineering fields has been steadily shrinking over the past century. According to a report by Geigner and Crow, the number of women graduating with degrees in medicinal, biological sciences, and physical sciences has increased over the past 40 years from 15% to 53% (Geigner and Crow 92). However, computer science is one of the only STEM fields that has seen a persistent decline in female participation. In fact, women made up 37% of undergraduate degrees in computer science in the mid 1980s but now make up 17% (Geigner and Crow 92). Theories explaining the lack of women in computer science assume that women are disinterested and that education is driving them out of the field. However, this paper supports the theory that technology culture and sexism are the ultimate causes of women leaving computer science. If this culture does not change, the implicit biases, women's self-perceptions about their place in the technology industry and the media will continue to drive women out of the field.

Culture has played a large role both in men's views of women and in women's perceptions of their own gender identity in the computer science field; this contributes to the lack of female presence in the workplace. Since most women who enter college with little to no prior experience in programming, many feel intimidated and lose confidence in their own technical abilities. A study at one of the most prestigious universities in the country, Carnegie Mellon University, followed women studying computer science throughout their undergraduate careers. As initially enthusiastic women encountered difficulties in their course work, the comparisons between their lack of experience and their male peers led some to switch out of the field (Margolis 105). One woman stated,

"…It's very intimidating…often think I'm in the lower half of the class, working hard but below many people who still don't have to work at all, and it's frustrating. I'm intelligent… I very much enjoy coding… but I think I pick up ideas slower than other people, and I get mad at myself" (Margolis 106). Women start to drop out of the computer science curriculum, not directly due to men, but because of their own perception of their capabilities, which technology culture has influenced (Margolis 106). Men tended to exaggerate their achievements and even when men and women had the same grade in a class, women were more depressed about their academic performance (Margolis 107). Women had a tendency to blame their intelligence when receiving an unsatisfactory mark, while men blamed the curriculum. This type of self-evaluation can be dangerous and is a contributor to why some women stop pursuing computer science in college.

Education plays a role when it comes to the discussion of the lack of women in computer science because it is one of the first places where they are exposed to the culture of technology. Some say that the lack of women in computing is due to their low interest, so are less likely to graduate with a degree in computer science. Patricia Ordonez was a math whiz in school. In high school, her teachers noticed her talent in solving problems and pushed her to pursue computer science in college (Henn 1). When Ordonez arrived at Johns Hopkins in the mid-1980s, she found that all of her male classmates were ahead of the material (Henn 1). When Ordonez asked her professor a question during class, he responded, "You should know this already" (Henn 1). The aforementioned study at Carnegie Mellon shows that it is not education that has caused women to leave or the belief they were inherently bad at it. Even though women were interested in computer science, the sexist culture, even in education, is rigged against their success.

Although some have been advocates of helping other women in computer science, others in the field do not acknowledge that gender is a problem. Open source software operates differently from most products in the technology industry. Rather than confining the contributors to employees at a company, any individual around the world can work on an open source project. At first glance, this model is ideal and seems to promote inclusion. On the contrary, this platform has the highest rates of harassment amongst non-cis white men (Nafus 673). Open source has the record lowest number of women in any computing field at 1.5% (Nafus 673). Men in open source are the least likely to acknowledge that gender is a problem, but, surprisingly, women do too. Intel Labs conducted a study among the employees at an open source firm where the more technical developers, all male, sat on one side of the room while the 15 staff members who worked on documentation and testing worked on the other side (Nafus 674). The 15 employees, including women, believed that it was their individual choice to work in support rather in development. The women insisted it was their choice and claimed the office geography was a mere coincidence rather than a statistic indicating sexism (Nafus 674). This belief in personal choice plays a role in women's perceived control. One woman referred to those who believed gender was an issue as "whiners not doers" where all the hype is talk rather than action (Nafus 674). Labelling those who seek solidarity with others and billing organizational resources as "whiners" is dangerous and prevents any solid action against harassment. Women go as far as hiding their gender or using gender-neutral names in online forums to avoid online harassment.

Jessie Frazelle was a former maintainer at Docker, an open source project, and is currently a software engineer at Google. Frazelle has faced increasing amounts of harassment as her success in open source has grown.

She has received death and rape threats, photos of herself covered in blood, and videos of men masturbating to her conference talks. Because Frazelle has faced plenty of harassment for being a woman in technology, she refuses to identify as a "woman in tech." This is not an uncommon response for many women who want to succeed in the field. In June 2016, Rebekah Bastian, the Vice President of Zillow, wrote an op-ed piece for *The Huffington Post*. Bastian's piece, "Why I Am Not a 'Woman In Tech," discusses why she despises the association of women in technology as different than any person in technology. Although her logic is completely understandable, the epigraph of her op-ed represents the problem with the logic, "The fact that I have a vagina doesn't seem overly relevant." When women associate themselves with inclusion efforts, they are embarrassed because it makes them seem less technical and guilty of using gender as a way of abusing minority status (Nafus 674). Some women whom I have personally talked to believed that once they opened the discussion of "women in tech", the computer science community would pigeonhole them as social justice advocates rather than computer scientists, which is also sexist. Although Bastian believes that her vagina does not seem relevant, she works in an industry that statistically says her vagina is relevant. The technology culture has forced many women to either leave the field with pride in their identity or to swallow harassment, downplay their gender to succeed and conform to the stereotypical programmer persona. Some women end up rationalizing harassment as playful banter (Nafus 673). There should be no shame of identifying as a "woman in tech"; rather, the shame stems from a culture that claims women do not belong in technology.

The culture in the technology industry has shaped the perception and exclusion of women. The technology boom from 1995-2001 resulted in computer science becoming one of the most popular and in-demand degrees to receive. As companies continue to see their stock increase with the growth of the Internet, the demand for experienced programmers exceeds the present supply. As more technology companies continue to emerge, the *brogrammer effect* contributes to the shrinking proportion of women in programming (Kumar 28).

The brogrammer phenomenon is "the arrogance of the modern day programmer who embodies technical prowess combined with macho-ness stereotyped in frat boy behavior…"(Kumar 28). This attitude represents the subtle yet deeper problems in male-oriented corporate culture at companies that college graduates aspire to work for. Women in the technology industry have faced gendered insults and sexist jokes from male colleagues and many feel like they must ignore or "laugh it off" to gain acceptance as one of the "guys" (Kumar 28). Companies subtly contribute to this sexism when there are no lactation rooms for women who may be nursing and instead must use the restroom (Kumar 29). These same companies also install game rooms and Ping-Pong tables for their employees' enjoyment. Even educational, technical conferences like DEFCON, the largest annual conference on Internet security, symbolize brogrammers' sexism. During a hacker jeopardy game at the conference in 2016, one of the categories was "Pornographic" and paid women to strip throughout the event. As it grows and further excludes women, this deeply embedded culture in companies is hard to change.

Even companies that acknowledge the gender gap and create efforts to find female computer scientists address the issue by claiming to be gender-blind. Gender-

blindness is a practice that, supposedly, does not distinguish individuals by gender. Much of society has adopted gender-blindness in response to the rise of second wave feminism, LGBTQIA+ community and abstract liberalism (Sanchez-Flores 53). Abstract liberalism is the ideology that there are equal opportunities and equal rights (Sanchez-Flores 54). If individuals work hard enough, they will achieve their end goals without considering any systemic biases society has against them. As the definition of gender moves away from a binary concepts to a fluid concept, many want to scrap gender identity completely. If there is no gender, there is no sexism. As some claim that gender is a social construct built by our culture, the only way to resolve the societal problems stemming from gender is to deconstruct it. In fact, some companies no longer require applicants to list their gender on job applications. This ideology is similar to color-blindness, which posits that the best way to end racial discrimination is to disregard an individual's race, ethnicity and culture.

Despite its good intentions, the ideology is inherently flawed. White individuals who are unlikely to experience disadvantages due to race can ignore racism. Colorblindness denies negative experiences due to color and rejects racial identity. With the growth of the Black Lives Matter movement in the United States, individuals used the hashtag #blacklivesmatter to express solidarity with the unarmed, innocent black men who were being murdered and incarcerated by police. The colorblind response to this was #alllivesmatter. Even though all lives matter, it ignores that black lives matter less than white lives in the criminal justice system. Gender-blindness operates in a similar way.

When several technology companies, like Mozilla, Dolby and BBC, started adopting gender-blind applications, they hired significantly more women (Carson 1). Speak With a Geek (SWAG), a business service company that aids companies with their

most advanced technical problems, conducted a study that presented 5,000 applicants' resumes to employers (Carson 1). The employers granted job offers to only 5% of the women. After removing specific identification characteristics from the resumes, 54% of women received job offers from the same employers (Carson 1).

Although this may seem like the ultimate way to solve the gender gap, this methodology is still sexist. Rather than addressing the inherent sexism an interviewer or recruiter may have towards a job candidate, it shields a candidate from it. This methodology implies that there is something wrong with the individual rather than the system that excludes them. Also, applying gender–blindness to the hiring process will not fix the inherent sexism within the company. Once a woman accepts a job, she will still face sexism in her work life making it more difficult for her to succeed. In reality, gender-blind does see gender, but only the male identity. In the aforementioned study that Intel Labs conducted, many men claimed to be gender-blind stating that providing women with safe spaces and special groups in computer science was sexist. Even though the United States government has passed laws to inhibit racial and gender discrimination, society has not progressed. Our culture's adoption of gender-blindness is a way of avoiding extremely uncomfortable but necessary conversations about privilege in modern day society. Gender-blindness is not a solution but rather a gender-creative and sensitive society that celebrates our gender identities rather than shames them. If our culture created the concept of gender, we must deal with the impact of the construct rather than live in cultural denial.

As gender-blindness is a more widely accepted ideology in the technology culture, it dissuades blatant sexism and rather feeds implicit and unconscious bias, a

much trickier disease to treat. The most famous example took place in 2015 where Ellen Pao filed a lawsuit against a Silicon Valley venture capitalist firm, Kleiner Perkins Caufield & Byers. Pao had accused the firm of discriminating against her during her employment. Her suit claimed that Kleiner did not promote her because of her gender, and her complaints backfired when her boss fired her in 2012 (Streifield 1). The jurors relied on the facts at hand and ultimately determined that it was Pao's performance that held her back rather than addressing the role that implicit bias could have had in this decision (Streitfield 2). One juror believed that it was discrimination, identifying that the man Kleiner promoted instead had all the same character flaws as Pao. Although the lawsuit against this firm was highly visible, Kleiner Perkins Caufield & Byers is not the only company under scrutiny for implicit bias in promotion policies. Tina Huang, a former Twitter engineer, claimed the process for promotion is unclear and is inherently favored towards men (Streitfield 3). As companies claim to be diverse and welcoming environments, implicit bias is still prevalent.

Despite many women reaching mid-level management, very few make it to the "O" level – CEO (chief executive officer), CFO (chief technology officer), etc. As women start climbing up the corporate ladder, it becomes increasingly harder for them to break the next glass ceiling. Examining the few women executives reveals a common pattern (Cheung et al. 183). Over half have no children, and as they reach higher promotions, they are less likely to have them (Cheung et al. 184). If women projected a feminine style and persona, they were less likely to receive a promotion. If women embraced their femininity or sexuality, some employers deemed them unfit for jobs. If women did not play into a masculine role, men tended to view them as potential mates

rather than as colleagues. Nazre, a fellow partner at Kleiner Perkins Caufield & Byers pursued Ellen Pao for five years, before her termination (Streitfield 2). After Pao ended their brief affair, Nazre was hostile, aggressive and made her life harder in her workplace (Streitfield 3). As the cultre of technology pushes out more and more women as they climb up the corporate ladder, it can be difficult for women to reach the "O" level positions.

The technology culture roots the industry in patriarchal values where power is zero-sum. When women gain power at a company, it diminishes the power of men. Since most individuals strive for growth at a company, women tend to leave the field for careers where they have more potential to grow.

Making matters even worse, media genuinely transcends reality and reinforces the paradigms that exist in modern time. The media has reinforced the technology culture and the brogrammer effect for more than 30 years. Before the 1980s, the media did not personify programming. Women made up almost 40% of programming jobs in 1985, a year that also marked the steady and rapid decline of women in computing. One of the root contributors of the decline of women in technology was the Personal Computer (PC). PCs rose to popularity where the media marketed them as affordable and accessible computers intended to nontechnical users (Henn 1). As personal computers started to fill homes, the gender gap in computing grew commensurately. Advertisements marketed home computers towards boys as toys to play games on. In the 1980s, the advertisements for the Commodore 64 personal computer displayed exclusively men (Henn 1). If there were any women in these advertisements, they were not using the computer rather the advertisements overtly sexualized them. Women were either dressed in lingerie trying to distract men from their new computer or in the kitchen cleaning dishes.

The mass media marketing of PC's subsequently impacted academia as seen by Patricia Ordonez's college experience in 1985. Since boys were more likely to have had a computer growing up, they entered college with experience in programming where women had little to none. Although the technology industry makes a conscious effort to diversify its advertisements, stereotypes remain prevalent in today's media. Public, female role models provide evidence that other women can succeed in computing but the media has reinforced many stereotypes of programmers, including that they are asocial, nerdy, and male (Cheryan 61). In today's television shows, like CBS's *The Big Bang Theory*, the main female character is a stereotyped blonde, young woman whose character substance stems from her love life with a male physicist (Cheryan 61). An HBO series, *Silicon Valley*, highlights the stereotypes of that area's startup culture as it follows a group of young men trying to build a successful technology company. None of the programmers in the show are women and the only recurring female character plays an assistant and a love interest to a software engineer. Even though these shows are not as controversial as the personal computer advertisements in the 1980s, they are still dangerous because they help shape implicit bias starting at a young age. Children report that television, magazines and movies are their primary source of information about what real-life scientists are like (Cheryan 61). Media can influence how children see these characteristics of scientists to be typical and even a requirement of individuals in the field. As long as stereotypes are unchallenged in modern media and society, let alone in industry, change for the better will not occur.

As the political climate in the end of 2016 indicates, even though the United States has passed laws to end discrimination and promote racial and gender equality,

society has not progressed. Those who cling to the technology culture and stereotypes fail to grasp that diversity and inclusion are not just beneficial to our society, but also to companies. Companies with higher levels of diversity have higher profits and tend to be more successful than companies that are less inclusive. Society's culture, let alone the technology industry's culture, is still a culture of inequality, and it is everyone's loss.

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