

From Where I Stand: An Analysis of Female Software Engineers Struggling for Acceptance in I.T. Careers

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Ten-Page Summary

Introduction

Since the late 1970's, women's participation in Information Technology (I.T.) careers has dropped from a high of 35% to a stubborn $20 \pm 5\%$ (NCWIT2016, 2016). This, despite rapid growth in software engineering and associated I.T. fields, and an overall deficiency of I.T. workers (TEKSystems, 2017; USBLS, 2015a, 2015b).

This research presents an analysis of ten interviews. All ten interviewees were women with I.T. careers of at least five years, though typically significantly longer. The analysis is presented through the lens of Max Weber's theory of Ständ, Class, and Party, (Weber, 2015), Pierre Bourdieu's theory of Symbolic / Social / Cultural capital (Bourdieu, 1984, 1985), Bourdieu's theory of Habitus (Bourdieu, Passeron, & Nice, 1990), Andrew Abbot's views on professional identity (Abbott, 1988), and Étienne Wenger's framework of Communities of Practice (Wenger, 1998). The goal is to understand better the norms which govern I.T. culture, show how these women have suffered under their imposition, yet thrived in their careers nonetheless.

The social significance of a workplace culture unwelcoming to women is fairly obvious. Systematic inequality such as sexism or racism is normalized violence and injustice (?). Less obvious, perhaps, are the practical implications. Current statistics indicate a very low U.S. unemployment rate overall, and a deficit of I.T. workers in particular (CompTIA, 2017; TEKSystems, 2017; Taulbee Survey, 2015). Outsourcing efforts which intend to save money may backfire (Johanek, 2015) forcing companies to recall – or “onshore” – their I.T. departments. Meanwhile, the employees who lost their jobs to offshoring often leave I.T. and are reluctant to return. Companies are in the difficult position of needing more I.T. workers, whom they have in turn made increasingly difficult to find.

These points may seem compelling, but equally important is the conceptualization, design, and implementation of computer technology itself. Jane Margolis, an educator at Carnegie Mellon University (CMU) makes this point well:

At stake in the experience of women as undergraduates is the makeup of the technology-creating population. ...It is predominantly men who are programming the computers, designing and fixing the systems, and intervening in the technology that will affect all aspects of our lives... The under-representation of women and minorities among the creators of information technology has serious

consequences, not only for those individuals whose potential goes unrealized, but also for a society increasingly shaped by that technology (?).

Margolis and colleagues restrict their comments to their female Computer Science (CS) students, as their education is essentially the beginning of their careers. More deeply, however, her point appeals to the pragmatic core of the American psyche: knowledge is rooted in personal experience, and so therefore is work. Technology implemented *by* men is designed *for* them. Others who have obvious investment in the design and use of technology are dismissed simply as “users”.

Literature

The setbacks women face in a software engineering career stand in direct conflict with the goals the industry itself. I.T. is a large, worldwide field, requiring a great diversity of skills and aptitudes. It also features an essentially negative unemployment rate; more jobs available than workers.

I.T. comprises a prominent segment of the world economy. According to Statistica, in 2017 the I.T. industry worldwide consisted of \$2.6 – \$3.5 Trillion in investment (Statistica, 2017a), and \$225 – \$462 Billion in revenue (Statistica, 2017b). In 2017, United States firms invested approximately \$1 Trillion (CompTIA, 2017). Ideally, a typical corporate I.T. department would consist of staff with a mixture experience levels. However, with an unemployment rate of 2%, hiring and retaining staff at all levels often prove problematic (TEKSystems, 2017). Graduates from postsecondary technology programs provide an average of 10,000 new employees annually (Taulbee Survey, 2015), though trends in I.T. industry growth (17% – 21% (USBLS, 2015a, 2015b)) suggest a net I.T. worker deficiency nonetheless.

I.T. staff are typically graduates of postsecondary Computer Science (CS) or Management of Information Science (MIS) programs (Taulbee Survey, 2015), though neither is a strong requirement. The best predictors of long-term success in I.T. professions are software production and deployment, neither of these depends on a CS or MIS postsecondary education (?). Despite these low qualifications, however, I.T. workers are still difficult to find. I.T. departments have difficulty retaining female workers and workers of color. Since 1982, women have comprised 15% – 25% of all I.T. workers. The proportion for I.T. workers of color is far lower: 2% – 5% (NCWIT2016, 2016).

These statistics solidly establish an obvious contradiction: despite a desperate need for workers and multiple points of entry, the I.T. profession is nonetheless very exclusive. The unfair treatment women receive from their colleagues is a very important reason they are leaving the I.T. professions (?), despite an increasing need for I.T. workers (USBLS, 2015a, 2015b).

Previous research into this problem has centered on the features of workplace sexism (Delia, 2015; Merrills, 2016) and the ways female I.T. staff cope with them (Hua, 2010; Kolacz-Belanger, 2008). However, no vein of research has provided insight into the social mechanisms

which underlie and reproduce it. The following section explores several social theories, which provide a framework for understanding the sexism women experience in I.T. departments.

Findings

	Men	Women
Symbolic Capital	\$	\$
Cultural Capital	\$	\$\$\$
Social Capital	\$	\$\$

Table 1: The Cost of an I.T. Career

Bourdieu’s theory of symbolic, cultural, and social capital grounds the analysis directly in the women’s experience. In the I.T. workplace, all interactions are based on – and require – all three forms of capital. The difficulty women encounter is in the *cost* of their interactions. A conceptual diagram of the difference in capital costs between men and women is illustrated in Table 1. Given a constant cost for men, women require more cultural capital and *far* more social capital than men to accomplish the same goal.

In this study, Bourdieu’s theory of symbolic / cultural / social capital interacts closely with his theory of Habitus. Whereas Table 1 describes the *cost* women pay for interactions, the Habitus sets and controls their *price*. The sexism component of the I.T. habitus sets higher career costs for women than men. The reproductive quality of habitus enforces those costs throughout women’s careers, and even ensures younger female software engineers pay as the older ones did.

The application of I.T. habitus to women’s lives is summarized in Figure 1. Three major themes emerged from the research. The first is early influences and interest in the I.T. field, and writing source code in particular. When women decide to pursue an I.T. career, the path they take can be circuitous. The second major theme is loss, demonstrated in three major components.

The first is systematic, structural injustice in which sexism causes loss in women’s professional and to some extent, personal lives. Habitus is internalized, resulting in counterproductive habits and grief. Grief leads to the realization of loss, which in turn inspires efforts to recover. Recovery is first based in personal resilience and a sense of self-worth. Self-care includes reflection on their personal and professional lives: their first insights about their situation come from themselves. Finally, the interviews show when and how women reach out to each other to give and receive support.

Throughout the findings and analysis, we see the interaction between the increased social and cultural costs to women, and the I.T. habitus setting its price. We also see how women’s efforts to survive and support each other alleviates that price. Bourdieu’s developed the

Figure 1: The I.T. Habitus Applied

1. Beginnings: how women begin their I.T. career
 - (a) Early Influences: the influence of friends, family, teachers, peers, and mentors
 - (b) Career Appeal: why (generally) women pursue an I.T. career
 - (c) Career Trajectory: the (general) path women's I.T. careers trace
2. Loss: the losses women incur during their I.T. career
 - (a) Structural Injustice: systematic factors and workplace conditions which cause loss
 - (b) Counterproductive Habits: how the I.T. habitus works against women's careers and personal lives
 - (c) Grief: women's reactions to their insights about loss
3. Recovery: counteracting loss
 - (a) Personal Resilience: personal factors which support recovery
 - (b) Self-Care: ways women support their own recovery
 - (c) Structural Support: ways women support *each other's* recovery

theories of symbolic / cultural / social capital and habitus independently, but this research shows how they move together – like the two sides of a coin.

Interviews

Three major themes emerge from the interview analysis: early influences, loss, and recovery. Early influences explain how the interviewees chose I.T. as a career and illustrates some of the basic, personal motivation which still informs their decision to pursue it. This section also examines the role of friends and family (especially the influence of fathers), education, and seminal mentoring. A common thread through these experiences is the nurturance and personal acceptance exhibited by their role models, which they experienced long before they chose an I.T. career. Their experience with role models also provided psychological sanctuary during difficult times.

The section on loss carefully examines how the women internalized the male-dominant I.T. culture to their own detriment, how external factors reinforced this internalization and habitual repetition, and the grief which resulted. Most of the loss experienced by female software engineers is systematic: caused by a structure of confluent factors rather than one factor in particular. Most loss is also experienced as an aggregate of interactions, rather than any one interaction in particular.

The I.T. workplace is male-dominant, as is its culture. This culture imposes male-oriented rules and norms on all I.T. workers, but clearly this culture has a disproportionate and adverse effect on women. The culture restricts women's bodies, personalities, or abilities. This includes both *realized* expression (actions, personal traits, or abilities they've actually done or expressed) and *potential* expression. The result of imposing these norms is the first and greatest loss women experience: loss of self. Loss of self entails a curtailing of person, personality, or ability according to imposed rules. Imagine the word “**don't**” sounding in your head; the source can be one or more people, an institution, or yourself. The result, though, is always the same: a diminution of some aspect of self.

Beginnings

One major factor in the interviewees choosing I.T. as a profession is the influence of friends and family. Parents have primary influence on the role of gender in choice of profession, as Thomasina describes:

I was raised by parents that did not see gender as something that held you off from doing anything you wanted to do. I was very much encouraged in sciences and math to do that from a very young age. ...and we talk about the bias as kids grow up, and being segmented into that, “Well, you're a girl, you should do this, you're a boy, you should do this.” It still is very prominent and I feel like maybe I skated through that because my family wasn't in a situation ... I didn't grow up in a situation where I felt that bias. I never felt like I couldn't do something

because I was a girl, but I think a lot of girls do feel that as they grow up, and they're kind of diverted.

Thomasina's experience suggests parents need to coach girls when taking interest in STEM and computer science fields. These fields are dominated by boys and men, so parents need to be sensitive to any additional needs girls have when asserting their interests. In the literature reviewed earlier, it is clear most girls enter STEM fields prepared. Or at the very least, any additional experience boys have over girls doesn't substantively matter when evaluating their work. Young women's perceptions may differ, however, and that difference may justify additional STEM training to bolster their self-confidence even when their skills in these subjects are already competitive:

I can remember my dad sitting down at the kitchen table with me in first grade, second grade because my teacher wouldn't give me extra math work and I wanted to do more math... Yeah, in fact rather than discouraging me from it, he encouraged me at it. He celebrated that I was doing well in those fields, and that I had an interest in that. So, I feel like I had an advantage from a relatively young age.

In their narrative, fathers emerge as especially important in supporting young women's STEM and computer science careers. The influence of fathers is manifested in numerous ways. For instance, Linda's father was influential on her in his facility and confidence with working with electronic equipment:

That's because my dad was doing this home study course for electronics repair, to be an electronic repair technician to get into a different career. I remember him making these devices and making a television set, and I thought that's pretty cool 'cause I was in there playing with the volt meter and some of that.

Loss

The most prominent theme which emerged from the interviews is *loss*. The loss these female software engineers experienced varied in degree and in kind, and was understood and expressed in numerous ways. The following subsections explore the various ways these women experience loss. Most make it difficult to distinguish personal loss from professional loss.

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Most of the loss experienced by female software engineers is systematic: caused by a structure of confluent factors rather than one factor in particular. Most loss is also experienced as an aggregate of interactions, rather than any one interaction in particular.

Per Bourdieu's theory of Habitus, this system is the result of a male-dominated I.T. culture which has been inculcated in its members, male and female alike. This culture entails rules about how I.T. workers are allowed to act and interact. One goal of this analysis is to illustrate the rules and norms women must obey, and how they differ from the rules and norms for men.

Many of the rules or norms imposed on women are double-binds, or "damned if you do, damned if you don't". For instance, women who spend time at work instead of at home are considered bad wives and neglectful mothers. Conversely, women who don't spend enough time at work, in lieu of family time, are bad employees: distracted, disloyal, and unproductive.

Recovery

The women interviewed here showed that they could not and did not stay in a state of permanent loss. Their personal resilience bolstered by external supports, they improved their situation to a livable – if not always comfortable – new status quo. This section will explore the different ways these women recovered from loss and built their careers and the careers of other women like them.

Women's resilience to the effects of the I.T. habitus comports with Wenger's theories on communities of practice. In a knowledge-based profession such as I.T., learning is essential for the continuation of one's career. If Wenger's theory is correct, community must be formed *somehow*, in order to support the learning necessary to sustain a career. In the following sections, we will see how women create their own communities of support to sustain their I.T. careers.

Symbolic capital is the basis of competence and is the primary currency between I.T. workers. Especially in instances where they understand they are paying premium social and cultural capital, women are careful to notice any problems determining the social price of an interaction. For instance, one cannot be incompetent or non-competent and still perform well. Trina noticed this in one of her Computer Science courses:

Yeah, and I actually missed one of her classes, so I missed the class where we got the paper back, or our tests. Everybody in the class failed the test. I was the only one who got an A on that particular test and she was about to read me the riot act, and then she was, "Oh yeah, you're the one that passed." And I'm like, "I didn't just pass, I aced it."

Similarly, Connie noticed that while she received poor work reviews at WebCo, she received very good reviews at BookCo. This, despite her doing the best work she could for both companies, and both companies being reputable:

Yeah. I think I left on a very, for myself, on a very positive note, because after that, I went to BookCo, and it was really soul boosting for me. That I'm worth

something, I'm worth a lot, a lot more than ... I am smart, is what I found out... Then I was like, "Oh, that means I am smart", so that felt good. I think after that point, everything went a little up for me.

Connie frames the experience as pedagogical; a "learning experience" from which she derives further confidence:

I learned from everybody. Later, after working with a lot more, then I realized that it's not the year of experience, it's how much you know that translates to how smart you are, or how much I should learn from you, so that was good. I learned a lot from that team, a lot in technical world.

Arguably, the "teacher" of this pedagogical experience is Connie, not the experience itself. It would be easy enough – perhaps easier – to interpret her experience at WebCo as evidence she should *leave* her chosen career, not pursue it further. Ivy has similar thoughts, noting how she has progressed in technical skill and work responsibility, despite low management reviews:

This sounds cocky, but sometimes I feel like I know more sometimes than the people that I'm ... are my leads. They gave me this low review. Like, "You're not adaptable. You really need to work on that." I'm like, "I just solved the problem that you guys didn't know what to do with." I'm ... They didn't want to make me a lead, but I've got guys who can't make decisions. I'm the one doing the design work.

Implications

Finally, the essay examines the factors by which the interviewees recover from loss, including personal resilience, self-care practices, and the construction of women's support networks. The women interviewed here showed that they could not and did not stay in a state of permanent loss. Their personal resilience bolstered by external supports, they improved their situation to a livable – if not always comfortable – new status quo. Women's resilience to the effects of the I.T. habitus comports with Wenger's theories on communities of practice. In a knowledge-based profession such as I.T., learning is essential for the continuation of one's career. If Wenger's theory is correct, community must be formed *somehow*, in order to support the learning necessary to sustain a career.

Leadership implications for the problem of sexism in I.T. are numerous. First is the problem of initiative. Leaders who would change the I.T. culture must confront the "you go first" problem: both I.T. workers and management know their workplace would benefit from better cohesion, but both believe the other "should go first" to solve the problem. Leaders will need to bring both together simultaneously, to commit to rejecting and replacing the current sexist I.T. culture. This commitment will require continuous negotiation, new ideas, and reliable feedback mechanisms (?). Reducing sexism in the I.T. workplace will likely require new forms of dialogue between male and female I.T. workers and management. I.T. workers

within common social strata will need to engage with each other more to resolve and prevent sexist discrimination, rather than simply obeying orders from management or Human Resources.

Further research would also examine the young male “geek” video gaming culture as exemplified in the Gamergate case (Quinn, 2017). Most striking about this case is the severity of the attacks against Ms. Zoë Quinn, a game designer, given the nature of her “transgression” against the norms governing gaming and game review. The attacks seem, in a word, overblown; exaggerated displays of aggression, open hostility, and threats against her person. None of these seem warranted, except perhaps to their larger male audience. This research is important because despite the apparent innocence of adolescent male vitriol, the boys who would so freely express such violent sentiments are exactly the sort who grow up to be software engineers as men.

Future Work

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Once brought to their attention, Human Resources departments are often assigned to sort out all manner of “social problems”. Explicitly, their role is to manage access to benefits such as health and retirement, and are sometimes called on to mediate problematic situations between employees. Less explicitly, they work closely with the company’s lawyer(s) to help it avoid legal liability. Accusations of gender-based discrimination can render corporations susceptible to costly, extensive court proceedings and public relations problems if the allegations reach public attention. Whenever such accusations are brought, director-level and upper management would be notified immediately, and H.R. representatives step in to mediate the situation. Their approach is very top-down, management-oriented, and legalistic. Additional reporting and surveillance (?) measures would be implemented, with the goal of discovering and punishing transgressors.

The top-down, legalistic approach has several advantages. Once management is “on board”, they can explicitly set the tone for the entire company: if top management says openly that gender-based discrimination is wrong and counterproductive, then any ambiguity about it is resolved. Management is also able to provide clear direction for awareness initiatives, sup-

port groups, or in the best circumstances, policies or programs which encourage and train women for leadership roles. Programs and policies such as these are also popular in progressive urban areas, and may provide a public relations boost for the company. This same approach is also limited in several ways. The first is the basis of judgment: definitions of “discrimination”, “misconduct”, and more generally, how to know their effects. As previously discussed, the I.T. habitus generally prevents workers from sharing dissenting views with management, so the power of management allows them the prerogative of any definitions or judgments they choose. What management cannot control is their employees actual thoughts and feelings, expressed or not. Management’s assertion of force can be met with assent and compliance, or backlash and quiet subversion.

Alternatively, one could use a bottom-up, grassroots approach instead. On a small scale, efforts against sexism would consist of small-group interaction and organization. Goals for these groups would be equally small-scale, though important: discuss and monitor the progress men make in breaking sexist habits, hear women’s career stories, and take steps to further women’s careers. Cooperation and creativity should be the central values of these groups, as much as mutual benefit. Men may need to cede power at times, though the practical realities must be understood carefully.

Conclusion

The major findings of this research reveal substantial differences between the way men and women in I.T. are viewed and judged. Most of these are unexpected; buried deep in social context and nuance. The complexity of the situation bolsters its credibility. Many problems presented here will not be easily or quickly solved; it’s difficult to know which problem is most important and even more difficult to know where to begin in solving them. These objections, however, do nothing to diminish the importance of addressing as directly as possible the problem of sexism in I.T. and elsewhere.

The greatest advantage of the work presented here is the women’s voices themselves. Admittedly I have summarized much of what I heard in interviews, but except in instances where I demonstrate connections between their testimony and its larger context, I have served mainly as reporter. Certainly, it is my goal to preserve as much of their voice as possible. The leadership implications identified in the previous section may provide some guidance; a larger and more nuanced conversation about sexism in the workplace is certainly merited. That, coupled with some concrete, tangible changes in the habits – the *habitus* – which so effortlessly supports sexism.

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