

Exploring Barriers in the Engineering Workplace: Hostile, Unsupportive, and Otherwise Chilly Conditions

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Abstract

Previous studies of the engineering workplace often emphasize understanding why and how women consider leaving a job and in some cases, exit engineering altogether. A 'chilly' climate has often been implicated as a primary or contributing reason for these exit decisions and has been classified in the literature under such descriptors as a hostile or macho work culture, mysterious pathways to career advancement, and extreme work pressures. This study expands on these previous studies by (a) emphasizing the engineering workplace experiences of millennials in order to understand whether these chilly climate conditions have evolved over time or are tending to persist into the next generation; and (b) studying men as well as women to gain deeper insight into which negative working conditions tend to occur across gender and which may be gender specific. We include results of interviews with 45 individuals who graduated with an engineering or computer science bachelor's degree between the years 1998 and 2015 from five different institutions including those that are research and teaching focused, big, mid-sized, and small, and geographically disparate (from the Midwest, Southeast, Northeast, and Northwest areas of the United States). All of those interviewed for this study can be considered millennials (graduating around the year 2000 or later) and 64% of those interviewed are women. Interviews were coded using existing classifications of chilly workplace conditions and expanded to include new codes as needed. Qualitative analysis of these results showed that of the five existing classifications of chilly climate, hostile culture was predominantly expressed by women. However, extreme work pressure, mysterious career pathways, and isolation were reported by both men and women; diving catch situations (where risk averse individuals are penalized in the promotion and advancement structure) emerged only once, and seven new classifications of negative workplace conditions emerged related to type of work (boring, inconsistent, underutilized); nature of the work environment (job insecurity, oppressive physical environment, poor management); and work/life conflicts.

Introduction

While many professional fields compete for talent, the battle for brain power is often particularly severe in high-tech, among science, engineering, and technology professionals.¹ This study focuses primarily on the engineering workplace which, for this study and paper, encompasses both traditional engineering fields as well as computer science. The engineering workforce in particular, while critical to global competitiveness, faces potentially significant shortages.² The consistently low unemployment rates associated with engineers as compared to other professions and overall national unemployment rates in the United States³ confirm that such a shortage does indeed exist. In response to unmet needs for talent in engineering, the National Academies⁴ have issued a broad and urgent call to increase recruitment and retention in engineering. Shortages of engineers and other workers trained in related science and technology fields is viewed as a threat to economic security and the capacity for innovation in the U.S. private sector.⁴

Compounding this shortage is the lack of women in engineering fields and the fact that women tend to leave engineering far more often than men.^{5,6,7} While almost 20% of graduates from undergraduate engineering programs are women, only 11% are in the engineering workforce.⁸ The lack of women in engineering is a significant barrier to diversity, but is also a significant opportunity to overcome shortages of engineers in the workforce. However, the odds appear to be stacked against the retention of women in the engineering workplace because they remain such a minority. In fact, some studies have suggested that the disproportionately high exit rates for women in engineering are almost entirely a result of the male domination of the field.⁹

This study focuses on both male and female engineers in the workplace during early career when exit rates are highest.⁶ Most women who leave engineering do so within the first ten years and typically not for reasons related to having and raising children.^{9,10,11} Moreover, 10% of men also leave engineering during early career.¹² These large numbers of engineers leaving the workplace merit close study, whether men or women. Thus, this study focuses on men and women, not only to further understand differences in workplace experiences across gender lines, but also to gain additional insight into how changes in engineering culture and work environment could positively impact both men and women in the interests of retaining engineers in a workforce that needs them to stay.

Background

A chilly or unsupportive climate emerges from a wide range of studies, from undergraduate engineering experiences to those in the workplace, as a factor in determining fulfillment, success, and often, persistence in engineering. In an extensive survey of over 5,000 women, Fouad et al.⁸ found that workplace climate was instrumental in determining job satisfaction among women engineers and 20% of women who left engineering did so because of workplace climate, boss, or culture.⁸ These results were duplicated in qualitative studies where women who left engineering discussed the work environment as a determining factor in those decisions.¹³ Outside the United States, an extensive study of Australian engineers showed that women were more dissatisfied than men with workplace culture and conditions.¹⁴

These and other studies beg the question: What is it about workplace conditions that creates such a formidable barrier to satisfaction, success, and persistence? A number of studies have provided insight into this question. In particular, Hewlett et al.¹¹ completed an extensive survey of over 2,400 men and women between ages 25 and 60 with training in engineering, science, and technology (SET) fields and identified five primary categories of workplace climate reported by women as antigens which ultimately contribute to exit from SET fields. *Hostile cultures*, related to lab coat, hard hat, or geek dominated cultures, can exclude or even harass women, leaving them marginalized in the workplace.¹¹ Women are often the only or one of a small number of women in a workplace or job site, leading to *Isolation* that, among other effects, leaves these women without a mentor or sponsor.¹¹ *Mysterious career paths* often leave women feeling stuck, stalled, or uncertain as to how to advance in their careers within an organization, and systems of risk and reward in these organizations often penalize those who are risk averse and unwilling to make a *Diving Catch* to save the day in a crisis. *Extreme Work Pressures*, related to long work hours, expectations of 24/7 availability, and strenuous deadlines are also instrumental in creating a chilly workplace climate. *Isolation*, *Extreme Work Pressures*, and *Hostile Culture* were also reported by a group of female civil engineers in Australia and persistence in engineering came as

a direct result of these women finding a way to ensure that they were part of a supportive and inclusive culture at work.¹⁵

In order to connect the dots among the retention statistics, the quantitative studies on the persistence of engineers in the workforce, and the qualitative studies that elaborate on why women lack fulfillment, satisfaction, or persistence in engineering, we find it important to understand more about male engineers. In particular, we seek to understand why men leave engineering, consider leaving, or struggle as a result of their work environment or workplace culture. Knowing more about the experiences of men will provide insight as to which engineering workplace issues tend to be gender-based and which tend to be more pervasive among engineering workers as a whole.

This study looks at a substantial number of interviews (45 total) of both men and women who hold a variety of different engineering or computer science undergraduate degrees and are in their early career as engineers in the workplace. The analysis of interview transcripts focuses on identifying negative, unsupportive, or chilly characteristics of present or past workplaces and on classifying those characteristics consistent with earlier studies. The goal of the research is to identify negative conditions in the engineering workplace that are likely to be more exclusive to women and other conditions that are experienced more equally by both men and women.

Methods

This research is part of a larger effort to understand the post-graduation experiences of individuals with undergraduate engineering degrees. Interviews were conducted in two phases, with two different sets of interview questions, both designed to elicit descriptions of engineering experiences in college and in the workforce from a diverse pool of graduates with undergraduate degrees in engineering or computer science. Coding and analyzing data from two different protocols was expected to reduce any bias introduced in either set of interview questions toward identifying or describing certain types of negative environments in the workforce over others. The first set of interviews (Phase 1) was conducted in 2010 and involved 9 men and 16 women with engineering degrees. The second set of interviews (Phase 2) was conducted in 2015 and involved 7 men and 13 women with engineering or computer science degrees. Despite the two different sets of interview questions, the interview protocols were otherwise the same and identical analyses were conducted for both sets of interview data for this study. In all, graduates from five institutions (listed below according to their Carnegie 2010 classification)¹⁶ covering a broad range of undergraduate experiences and geographic locations were interviewed across both phases of the study:

- **HBCU (Bac-Div):** A historically black, independent, and state-related institution of 2,605 undergraduates in the Southeast which offers four undergraduate engineering degrees.
- **Private1 (Masters L):** A small teaching institution in the Pacific Northwest of 3,238 undergraduates which offers six engineering and computer science majors.
- **Private2 (Bac-Div):** A small faith-based teaching institution in the Midwest of 3,993 undergraduates which offers five engineering and computer science majors.

- **Research (RU/VH):** A large research institution and flagship university in the Pacific Northwest which serves over 29,000 undergraduates, offers ten engineering and computer science undergraduate degrees, and confers over 12,000 degrees annually.
- **Women's (Masters L):** A small women's college of approximately 1,800 undergraduates in the Northeast with fifty majors, including computer science but no engineering majors.

A. Research Questions

Two research questions were addressed in this part of our study. These questions were designed to elicit differences in negative work environments and conditions experienced by men compared to women.

Research Question #1:

What kinds of negative conditions do women report in the engineering workplace?

Analysis of negative conditions reported by millennial women establishes a baseline for comparing the experiences and responses of these women to older engineering graduates (in other studies) and to men.

Research Question #2:

Do men report similar negative conditions in the engineering workplace?

This questions seeks to understand whether hostile or unsupportive conditions in the workplace are largely a result of being female or whether common themes underlie the experiences of both men and women in the engineering workplace.

B. Subjects and Procedures

Phase 1: Subjects were recruited from engineering alumni databases at three different institutions (Research, Private1, Private2) through completion of a screening survey designed to elicit basic demographic information and interest in participating in an interview. Study participants were then recruited from those who expressed a willingness to be interviewed in the three engineering majors that were most represented in the screening survey (civil, electrical, and mechanical engineering). A total of 78 interviews were conducted which oversampled for women but included those in early, mid, and late careers. This interview pool was further filtered to include only those individuals who graduated with a bachelor's degree during or after 1998 (millennials) resulting in 25 total interviews for analysis.

Phase 2: Faculty in engineering or computer science at five different institutions (HBCU, Private1, Private2, Research, Women's) were asked to identify alumni who were still working in engineering and had graduated with a bachelor's degree during or after 1998 (millennials). Of those alumni that were identified by faculty, all were recruited for Phase 2 and 20 individuals were subsequently interviewed for this phase of the study.

Demographics for both Phase 1 and Phase 2 interview pools are summarized in Table 1, including advanced degree data as could be gleaned from interviewee transcripts. In total, 16 men and 29 women were interviewed. These individuals graduated between 1998 and 2015 with an engineering degree (primarily civil, electrical, or mechanical engineering) from a range of institutions including both research and teaching as well as public and private institutions.

Table 1: Participant Demographics

Characteristic	Phase 1		Phase 2	
	Women (N)	Men (N)	Women (N)	Men (N)
Field				
Aerospace Engineering	0	1	0	1
Civil Engineering	4	0	0	0
Computer Science	0	0	4	0
Chemical Engineering	0	0	4	2
Electrical Engineering	5	8	4	2
General Engineering	0	0	0	1
Mechanical Engineering	7	0	1	1
TOTAL	16	9	13	7
Year of Graduation (First Degree)				
1998-2005	15	8	1	3
2006-2010	1	1	6	3
2011-2015	0	0	6	1
Advanced Degree				
Engineering	1	2	1	3
MBA	1	0	0	1
Other	1	0	0	1

C. Instruments and Data Analysis

Interviews followed a semi-structured protocol, including guiding questions and probes designed to explore motivations for choosing and persisting in engineering as well as barriers to desired career pathways including stress in the workplace. Interviews were conducted in person, by Skype, or by phone. In most cases, interviews were audio recorded and transcribed. When recording was not possible, extensive field notes were taken by the interviewer. To protect confidentiality, all names of interview participants were replaced with pseudonyms and company/institution names were removed from interview excerpts.

Phase 1 Interviews: These interviews included questions that emphasized reasons for choosing engineering as a major, perspectives on engineering as a career, and views on the ideal career. Interviews followed a semi-structured protocol, including guiding questions and probes designed to explore motivations for choosing and persisting in engineering as well as other career options.

Phase 2 Interviews: These interviews included questions that also emphasized reasons for choosing engineering as a major and views on the ideal career. Unlike Phase 1 interviews, however, these Phase 2 interviews targeted the relational fabric of the work environments that career engineers (and related technical professionals) experience, workplace stress, and the connection between these two elements of the work environment.

The interview questions for both Phase 1 and Phase 2 that are directly relevant to the research questions in this study (and their analysis) are summarized in Table 2.

Table 2: Interview Questions (used to evaluate Research Questions)

Phase 1	<ul style="list-style-type: none"> • Would you tell me about why you decided to pursue engineering? • Tell me about your engineering workplace experiences. • Tell me about critical moments for you related to engineering. What experiences have tended to draw you towards, or push you away from, engineering?
Phase 2	<ul style="list-style-type: none"> • What led you to your original degree <state degree>? • Does anything tempt you to leave your position as <restate position and company/organization>? • Could you describe in as much detail as possible your present work environment? • What is the worst work environment you've ever had? What made it "the worst"? • What do you see as barrier(s) to advancement in your present workplace? • What do you see as barrier(s) to fulfillment and satisfaction in your present workplace? • Do you feel that your workplace or work environment is stressful?

Once transcribed, the interviews and field notes were analyzed using a grounded theory approach to identify emerging themes of what types of hostile or unsupportive conditions young engineers experienced in their workplaces.¹⁷ After the initial coding, workplace experiences were re-classified according to workplace categories identified in the extensive 2008 Athena Study¹¹ of engineers in the workplace. Those negative conditions that did not fall into one of the five Athena categories, were initially classified as 'Other'. A subsequent second pass at this data classified these 'Other' work and workplace conditions into categories bounded by similar underlying themes.

Results

Responses of interviewees were first classified according to five existing categories of negative working conditions established by Hewlett et al. in their 2008 Project Athena Report¹¹ which involved surveys with individuals working at 43 global companies in science, engineering, and technology. The frequencies by which individuals expressed impressions of a negative or unsupportive workplace within these five categories are summarized in Table 3 and Table 4 for women and men respectively.

Table 3: Negative Working Conditions reported by Women Engineers

Field	Interviewee (BS/BA Yr)	Workplace Conditions					
		Hostile Culture	Isolated Workplace	Mysterious Pathway	Diving Catch	Extreme Pressure	Other
Civil Engineering	Kristen (2004)	X					
	Judy (2004)	X	X			X	
	Annie (2006)	X					X
	Leah (2003)	X					
Chemical Engineering	Karen (2001)	X	X			X	X
	Natalie (2013)	X	X				X
	May (2008)	X	X				
	Kara (2010)	X		X	X	X	X
Computer Science	Maureen (2011)	X	X				X
	Clara (2011)	X	X			X	
	Grace (2011)	X		X		X	X
	Tara (2010)			X		X	
Electrical Engineering	Summer (2004)					X	X
	Lucy (2002)	X	X				
	Sarah (2003)	X	X				X
	Trudy (2002)		X	X			
	Jackie (1998)		X				X
	Molly (2015)					X	
	June (2008)	X				X	X
	Marcie (2013)	X	X				
Mechanical Engineering	Britney (2008)	X				X	
	Emma (2002)	X	X				X
	Gina (2005)		X				X
	Beth (2005)					X	
	Marilyn (2003)	X				X	X
	Mary (1999)	X					X
	Sally (1999)						X
	Rachel (1998)						X
TOTAL	29	20	13	5	1	12	16

The five primary categories of negative workplace were modified slightly to include responses of both men and women and are described briefly below:

- *Hostile Culture*: emphasizes perceptions of being marginalized in the workplace by specific types of culture (lab coat, hard hat, geek, etc.) that include a certain type of individual while excluding others. A hostile culture, while often predatory (and associated with such behaviors as sexual harassment) is not always associated with gender discrimination.
- *Isolated Workplace*: can include women who are alone or part of very few women on a team or a site to the extent that the woman feels isolated with limited opportunities for collaboration, participating in community, or building friendships in the workplace. As with hostile culture, feelings of isolation can impact both men and women for different reasons and in different ways. The important aspect of an *Isolated Workplace* for coding purposes is that the individual feels isolated and is able to identify potential sources of those feelings.

- *Mysterious Pathways*: covers feelings of being stalled, stuck, or unable to move forward in a career. Originally classified as a result of not knowing the pathways to promotion or advancement, this category was expanded slightly to also reflect those career pathways that are stagnant or stalled for both men and women.
- *Diving Catch*: refers to a tendency of some workplaces to put those who are risk averse at a disadvantage. In a diving catch work environment, the individual who feels less comfortable with risk feels more at a disadvantage with regard to advancement or performance because he or she is penalized by not feeling comfortable to jump in and save the day in high risk situations or high profile crises. Often, risk aversion is amplified or grounded in the lack of a support network in the workplace, individuals who will back an employee up in case of failure in high risk situations.
- *Extreme Pressure*: refers to factors in the workplace such as long hours, demanding deadlines, expectations of 24/7 availability, or other factors that are perceived to be highly stressful and likely to disrupt satisfaction and fulfillment in both work and personal lives.

Table 4: Negative Working Conditions reported by Men Engineers

Field	Interviewee (BS/BA Date)	Workplace Conditions					
		Hostile Culture	Isolated Workplace	Mysterious Pathway	Diving Catch	Extreme Pressure	Other
Aerospace Engineering	Caleb (2004)		X				X
	Fred (2005)	X				X	
Chemical Engineering	Ben (2002)	X					X
	Henry (2007)						X
Electrical Engineering	Brent (2000)	X					X
	Phil (2003)	X					X
	Chien (2002)	X					
	Dirk (2005)					X	X
	Jacob (2004)					X	X
	Joseph (1999)						X
	John (2010)					X	X
	Joshua (2005)					X	
	James (2014)			X		X	X
	Gregory (2004)	X	X	X			X
Mechanical Engineering	Leo (2006)	X				X	X
General Engineering	Stephen (2008)					X	
TOTAL	16	7	2	2	0	8	12

Examples of how these established categories of negative working conditions were expressed by both women and men in the workplace are provided next.

Hostile Culture

For women in particular, a hostile culture was often perceived to be in line with an 'old school' work culture, dominated by men, traditional management styles, and male personalities.

Marilyn, Anna, and May spoke to this culture directly in describing their present workplaces:

“And it still is very much a man's world that there tend to be at least clusters of the older guys that are the good ol' boys club” mentality that think that you're not competent because you're a woman and it feels like you have to fight a lot harder to prove that you know what you're talking about or prove that you're competent.” (Marilyn, Private2)

"The good ole boy system is intact. You feel like an outsider... It's 8 a.m. and your boss is asking you why you are late. It's a constant ... they didn't trust me to do the job. A lot of hovering over me. I am going to stay here and watch you do this task (managers/supervisors). You need to trust your employees ... that's just the way they managed (it wasn't related to gender or age... it is what it is)." (Anna, HBCU)

"My company culture would tempt me to leave. Our company is a natural resources based company. Very old school. Traditional hours. Very male dominated management. Very few young school, forward thinking people. An inflexible culture." (May, Private2)

However, some women expressed feeling uncomfortable around the 'good ol' boys', because these older men were now highly sensitized to the consequences of old school or male dominated mentalities on women. Judy spoke to this problem, as part of her negative workplace experience:

"The younger engineers were used to working with women. [But] some of the older guys, I couldn't stand being in the same room with because they had no idea how to treat me. They just treated me really... I don't think badly was the right word but they didn't know what to say to me. And I don't know if that was because I was young or because I was a woman I'm not sure why only three guys I could be alone with because they were just concerned not really for my safety but if those guys would say something stupid and I would get them fired." (Judy, Private2)

While some women spoke of hostile, macho work cultures which were pervasive in the group or company they worked for, other women spoke to the behavior of a single male who disproportionately and negatively influenced their view of the workplace. For instance, Britney said:

“There was one day I had gone to a meeting and, one of the gentlemen had treated me not so well and refer[ed] to me as kind of [M]iss something something, talking to me in a demeaning way,” (Britney, Private1)

Women were not alone in expressing a hostile culture at work. However, men tended to experience a different kind of hostile environment. For example, Leo, while not perceiving his experience to be an issue of gender, felt that only a narrow set of behaviors were acceptable in the workplace, similar to what women expressed in the context of a 'good ol' boys' culture. Leo stated:

"I would have to say, the biggest barrier to advancement I think is other people's perceptions, or narrow minded views of an employee's potential." (Leo, HBCU)

Contrary to the oft-used stereotype that men thrive on competition, Ben spoke to the hostile culture that emerged when competition overwhelms healthy collaboration:

"Everyone is in each other's space. This guy held on to his data so tight that as a teamwork element, it didn't work at all. I would be doing something at cross purposes to what he was doing but I had no idea. He had one of the final cards in regulatory body of work. Worst experience was characterized by poor transparency and a personality clash (him, the data hoarder and me, the jump in and help personality)." (Ben, Private2)

In our interview pool, women who expressed hostile work cultures often, but not always, referred to their gender as an element in these negative cultures. Men, however, did not cite gender at all but had other forms of hostile work culture that impacted their ability to perform and ability to be fulfilled in their present employment.

In summary, 60% of our interview pool expressed some form of Hostile Culture in previous or present employment experiences. These perceptions ranged from the influence of a single individual (manager, outspoken coworker) to a more pervasive organizational culture, but in all cases, these influences were important enough for an interviewee to bring up and describe in detail as a contributor to stress, decreased fulfillment or other negative impression of the work environment.

Isolated Workplace

Many individuals expressed a sense of isolation. This negative feeling was driven by a variety of different factors. Some individuals were simply the only individual working in a particular function and felt the lack of like others to collaborate with. Maureen expressed this feeling from the first day she walked into her job:

"I was the only in-house developer. I didn't know what I was doing and I had no one to help me. The first day, I walked in and they told me they promised five iPad apps in three months..." (Maureen, Women's)

In Maureen's case, feelings of isolation produced doubt regarding her ability to meet her employer's expectations. Her isolation amplifies her job stress. In other cases, peers with similar job descriptions were present in the work environment but the age gap between the early career individual and peers created an additional barrier to be overcome. Natalie captures this in her description of the workplace:

"[A]t my old job there was no one else my age around. There was a huge age gap and I had to work that difference." (Natalie, Private2)

Physical distance also drove feelings of isolation:

"Yeah, so... there was nobody sitting right around me so that made a difference too. So if I wanted to talk to somebody I really had to go pursue them. It's not just your cube-mate or whatever." (Trudy, Private2)

As did the inability to connect at a more personal level with colleagues:

“It’s hard to make personal connections when you're supposed to act in the best interest of the company at all times, when this other person is involved,” (Gregory, Research)

While these types of isolation were not gender specific, many women did speak of isolation in light of being outnumbered by men in the workplace. Emma and Jackie describe instances where being isolated directly by men influences their ability to work:

“But it was a terrible place to try to connect with people and it was not friendly to females at all... There was one female engineer on a staff of about 200 engineers,” (Emma, Private2)

“There’[re] three women and I’m the only Caucasian woman... And I think part of the pressure is because of that. Women operate differently. We see things differently... engineering is a very male environment; very competitive, it’s hard...” (Jackie, Private1)

In some cases, women even see gender-driven isolation as a barrier to their ability to advance. Maureen explains this phenomenon in relation to her work culture:

“I am the only woman; not one female on the executive staff. I work with wonderful [gentlemen], but there is a lot of Midwest culture... a much more traditional outlook on women... I can’t help but think that affects things/advancement. They are strong faith, Midwest guys, with traditional stay at home wives... I can imagine that if you are around that all the time and there is one stray woman ... they can’t help but put those expectations on me...” (Maureen, Women’s)

33% of our interview pool experienced some form of *Isolated Workplace* in previous or present employment experiences. These experiences were driven by physical separation from peers within the workplace, large age or gender gaps, and a lack of social cohesion among coworkers. In many cases, individuals felt that isolation drove some feelings or questions about inferiority to peers.

Mysterious Pathways

Individuals who described experiences in this category felt, at some point or another, that they were stuck, stalled, or unable to advance or uncertain as to how to move forward in their career. Both men and women describe experiences involving repetitive and otherwise unrewarding work. Kara and Grace explain how feeling stuck or stalled impact their experience in the workplace:

“...but sometimes things can get repetitive and it just feels like you're just stagnant. And if I feel like I'm stagnant at a place and I'm not moving much or as much as I want to then, that could lead me to leaving the company.” (Kara, Private2)

“[T]hey didn't really have a great training on their programs, you really had to learn everything on the fly which was fine but, then I went to a different department and took on a different role and I just kept getting passed over for

promotions into other positions that I was really qualified for by people who weren't." (Grace, Women's)

Along with feeling stuck and unable to advance, individuals like Gregory explain that *Mysterious Pathways* can stem from a lack of recognition and advancement in a large workplace:

"Barriers to advancement in the workplace would probably be an extremely competitive environment for I guess very little gain. To give you an example, if you perform excellent outstanding in your group which is very very hard. If you work really hard and you do better than expected and the next day something really clicks and it all works out, then at the end of the year you might get a 2% increase. So there's no real advancement because it's such a big company, to offer this to everyone who does well would be just really unrealistic for the company." (Gregory, Research)

While Gregory is stymied by stiff competition in his group, Anna lacks the work opportunities to advance:

"The barrier is not having the opportunities (tasks) to put you in your position forward. I would have to move into a different area to move into management," (Anna, HBCU)

Both Gregory and Anna are stuck, unable to advance because barriers outside their control appear to stand in their way. Other individuals feel stuck and otherwise unable to advance because of how they are positioned within the workforce. James explains his situation in competing with veterans for a better position moving forward in his workplace:

"That's an easy one, I am a contractor and I am not a veteran so federal preferences are always towards veterans, or people who have already worked as federal employees. So it can be very difficult if you are not a veteran to get a job as a federal employee." (James, Research)

Fortunately, feelings of being stalled, stagnant, or unsure in advancing in the workplace were fairly infrequent in our interview pool. Only 16% of participants expressed these *Mysterious Pathways* impressions in one form or another.

Diving Catch

Individuals in a diving catch work environment find themselves less able to advance and seek reward if they are reluctant to take risks in situations that require a "diving catch". These individuals are at a disadvantage because they are often overridden by those who are more willing to jump in and fix a problem at a potentially critical moment. Kara described her direct experience in the workplace dealing with risks and rewards:

"And a lot of times this happened at [company name] too, so they don't work closely with you [and] they don't know that you can advance to the next level. They would just wait and wait and wait until you do something extra ordinary." (Kara, Private2)

Oftentimes *Diving Catch* situations are seen in what are also described as “macho” cultures.¹¹ Recognition and reward result from successful risk taking, and thus, individuals who mitigate high risk situations may be at an advantage in terms of advancement and acknowledgment.

Despite previous studies that show *Diving Catch* to be a frequent barrier to women in the workplace, only 1 of the participants (a woman) in this study expressed these types of negative influences in the workplace. *Diving Catch* is often accompanied by a lack of support and social camaraderie. Thus, some *Diving Catch* situations may be masked by reports of *Isolated Workplace* or *Hostile Culture*. Thus, it is likely that *Diving Catch* situations are under-reported in this interview pool.

Extreme Pressure

Extreme Pressure among interview participants is characterized by long work hours, intense deadlines, demanding workplace expectations, and unpleasant, direct relations with customers. These factors detrimentally impact satisfaction and fulfillment. Joshua and Tara all describe the *Extreme Pressure* stemming from long demanding hours on the job:

“Pilot training is... really, really intense, a lot of like work, really long days, a lot of studying, basically like- almost have to devote your life to it and put everything else on the backburner to stay afloat in the program and pass. You know? It’s a little bit different world, you know, it’s not just like a normal nine to five job that’s for sure... I feel like it consumes me and my time and like everything...” (Joshua, Research)

“For myself what causes the greatest stress would be, basically when I have to get a task done in a short period of time, I think that causes the most stress for me just knowing that I have limited time to get something done. That makes me really stressed.” (Tara, Women’s)

While long and demanding hours are most often described as the source of *Extreme Pressure*, the type and number of deadlines involved in a job also makes a (detrimental) difference. Molly speaks to this point:

“Everyone has a lot of deadlines, but we have a lot of deadlines. I think it’s probably an industry thing ...lots of deadlines.” (Molly, Research)

Many of these deadlines are imposed by clients and external forces that exert pressure on an individual to get a task done in a given amount of time. Direct relations with clients can put more stress on top of these long hours and hard deadlines. Leo speaks directly to this problem:

“Externally because when you're dealing directly with the customer, at times that can bring on a level of stress when having to deal with tough conversations.” (Leo, HBCU)

Job stress, in the extreme, is not simply a negative work environment issue, but can take over personal lives as well. Jacob and Fred speak to this point and feel that their jobs have taken over their lives:

“I'd felt like my life was gone and I'm not getting that back...Yeah... Just how much time that took away from my personal life and from my life outside of work. It was real frustrating.” (Jacob, Research)

“...exhausting to taking care of the A through Z's on the job and then you have another alphabet of things to do outside of the job to make sure you are taking the right steps, making the right relationships... continuing to press on these relationships until something goes in your favor.” (Fred, HBCU)

The culmination of all of this pressure can have very real health impacts on individuals. Long and unpredictable work hours, deadlines, demands, and other workplace pressures can create a great deal of stress and negatively influence an individual's physical as well as mental health. Karen and Grace speak clearly to these health impacts:

“[M]y previous job was stressed so I would say yes there was a health risk with long-term sustained stress. That being, too much anxiety not enough sleep and too much work outside of normal work hours.” (Karen, Private2)

“A lot of my coworkers seem to have problems with anxiety or depression in this industry that seems to be very common so you need to make sure that whatever you're doing it seems to make you happy and to make sure that you don't stay in it if it's not making you happy.” (Grace, Women's)

A large number of individuals interviewed spoke to *Extreme Pressure* on the job. 44% expressed this negative work environment issue in either their past or present employment experiences and indicated that *Extreme Pressure* is a significant concern for their ability to balance work and personal life, perform, meet deadlines, and stay healthy.

Men as well as women had experiences in all but one of the five primary negative workplace categories. In combination, results from Tables 3 and 4 are used as the basis for discussing our two research questions, but first we explore, qualitatively, how 'Other' unsupportive workplace conditions were also expressed in our interview pool.

Other Influences

While many individuals interviewed, both men and women, spoke to the five categories of chilly work climate defined in the Athena report¹¹, individuals also spoke to other issues that influenced their overall perception of the workplace. These issues were further classified into three categories and seven additional classifications within those three categories during the second pass at coding the interview data:

Type of Work

- *Boring*: refers to interviewees who were simply disinterested in their work.
- *Inconsistent*: describes a roller coaster feeling at work, where workload or other stresses tended to fluctuate between low activity periods and extreme stress, high activity periods.
- *Underutilized*: speaks to feelings of engineering skills being underutilized in the nature of work assigned to an individual.

Nature of Work Environment

- *Job Insecurity*: covers issues of uncertainty regarding continuing employment in negatively influencing an individual's overall work experience.
- *Oppressive Physical Environment*: refers to characteristics of the physical work environment that create a negative work perspective for the individual.
- *Poor Management*: refers to negative, chilly, or absent direction by management that reaches a level where it negatively colors the individual's entire view of the workplace.

Work/Life Conflict

This category emphasizes situations where conditions of the workplace (hours, location, etc.) interfere with personal priorities.

Brief examples of participant responses in each of these three categories are provided below.

Type of Work

Some individuals were bored by too much repetition over too time in the same position:

(Boring) “And it was so boring to me. Every time I was in there, I was like, ‘Oh, I do not want to be an engineer. I do not want to sit at a computer all day.’” (Marilyn, Private2)

(Boring) “[S]ometimes things can get pretty repetitive. I don't think you can get to a point of you have learned the maximum amount that you can learn on the job. I think there's always something that you can learn as it goes even though you've been there 5 years or however long you've been there, but sometimes things can get repetitive and it just feels like you're just stagnant,” (Kara, Private2)

Other interviewees expressed disinterest in their work because they felt that their engineering skills were underutilized:

(Underutilized) “I mean, I’m a trained engineer, why are you having me do administrative stuff? Why am I in these meetings when you could have somebody else who’s not paid or not highly specialized?” (Jackie, Private1)

or they were not doing what they were hired to do:

(Underutilized) “I took the job and I've been there a few months and I still wasn't writing any code I was clicking this button and looking at graphs and I kept asking when does the coding start? Finally became very clear to me that the role I had been hired for was not the role that I had interviewed for.” (Grace, Women’s)

Still other interviewees were feeling burned out by a roller coaster of stress or start-and-stop projects:

(Inconsistent) “My experiences in engineering have been very--feast and famine. There have been times when the work is extremely boring, waiting for more work to come in or just funding issues and so there's times like that

where I kind of wish things were more meaningful or I could just find another job, whether or not in engineering. So um...and then there's other times it's so crazy that gosh I just need some time off.” (Jacob, Research)

(Inconsistent) “...like any job, it’s frustrating. Someone tells you to start a project and then they tell you to stop the project because they’re afraid there’s no customers and then like two months later they’re like, “we got a customer, are you done yet?” And you’re like, “you told me to stop.” So that kind of stuff.” (Dirk, Private1)

Thus, no single theme emerged by which the nature of engineering work presented a barrier to early career graduates. Rather, the nature of engineering work could be oppressive in different ways to different individuals.

Nature of Work Environment

For some, the work environment was not only or not necessarily chilly or hostile, but still limited an individual's ability to thrive. Some interviewees were very concerned about their future employment within the company to the point of feeling scared on a regular basis:

(Job Insecurity) “...in my past position the culture was very demanding, high accountability, very stressful, and I kind of had a fear of losing my job fairly regularly in the position that I was in,” (Karen, Private2)

(Job Insecurity) “... it’s really scary when you work someplace and they aren’t doing anything. Like when you come into work and you’re like, am I going to get paid on Friday? Are they going to make payroll?” (Sally, Research)

Certain positions create inherent barriers to job security. James speaks to this issue as a contractor in the engineering field:

(Job Insecurity) “Being a contractor can be stressful, because we are not sure from time to time if we're going to be employed. Our contract can be terminated, it's a work at will State. So for absolutely no reason at all, either party can terminate the work relationship,” (James, Research)

Surprisingly, a few interview participants, both men, spoke to the physical environment of their workplace as a source of distress. For example:

(Oppressive Physical Environment) “My old job was just a floor of cubicles which sounds depressing, and actually [when] I first got there it was kind of drab and gray and I was like this sucks. I kind of call it cubicle farms...” (Jacob, Research)

(Oppressive Physical Environment) “I think there is some sort of emotional stress from just the way the lack of colors on the wall. It’s all grey everywhere.” (Gregory, Research)

Lack of leadership or poor management was often a cause of distress for both men and women interviewees:

(Poor Management) “So there was no one to oversee me, there was no one to give me work, there was no one to design a cohesive project for me. So I spent the summer kind of running around from person to person saying, “Do you have any engineering change orders I can process? Do you have anything I can do? Please, something?”” (Emma, Private2)

(Poor Management) “I had other instances where I've had a boss that was really difficult to work with, he really didn't know what he was doing he wasn't a tech person he was trying to manage a lot of tech people. He was so afraid that we were going to expose him or undermine him that he became a micromanager even though I wasn't really sure what he was doing so it made our jobs really difficult to do. Ultimately that's why I ended up leaving that job” (Grace, Women's)

All of these additional work environment issues came up occasionally for both men and women and did not seem to be specific to one gender or the other.

Work/Life Conflict

Individuals expressed several different conflicts between work requirements and personal priorities, not all of which spoke to concerns about having children or starting a family. For example, some were frustrated by commuting constraints:

(Work/Life Conflict) “I have let my workplace impact my personal life... it has made me move to the East Side, even though we loved living in [city].” (John, Research)

(Work/Life Conflict) “I'm fifty miles north of San Francisco, so Silicon Valley is... like a three hour commute one way so I would have to pick up and move and go live in Silicon Valley and I don't really want to live there.” (Jackie, Private1)

Out of the interview pool, only two individuals (one male and one female) talked about work/family conflict and even then, as an issue into the future:

(Work/Life Conflict) “[W]ant to try to do a family because once you get up to that level, I mean, there's all the tenure issues and all this other craziness that means you basically can't start to have kids until you're 36 to 40 and I think a lot of people look at that, especially when they're 23 or something, go uh... Hell no.” (Phil, Research)

(Work/Life Conflict) “I think that just trying to balance family and the career is kind of a negative influence. I mean, I don't have kids right now but I look at the women around me who do have kids and try to do the same job.” (Marilyn, Private2)

Thus, contrary to preconceived notions that work/life conflict occurs mostly between work and raising children, individuals in this interview pool spoke to a much broader range of work/life conflict.

Discussion

Research Question #1:

What kinds of negative conditions do women report in the engineering workplace?

Women interviewed in this study reported all five of the major categories of negative, unsupportive, or chilly work climates: *Hostile Culture*, *Isolated Workplace*, *Mysterious Pathways*, *Diving Catch* and *Extreme Pressure*.

Hostile Culture was discussed by 69% of the female interview participants and most often in the context of the “good ol’ boys club”, traditional ‘old school’ work culture, as well as instances of direct predatory, discriminatory, or otherwise negative comments and behavior from predominantly male coworkers. These numbers are consistent with previous studies¹¹ that show 33% of women feel marginalized by a 'hard hat' culture, 37% by a 'geek' culture, and 63% experience sexual harassment in the workplace. Although this study is not quantitative, the fact that a majority of women continue to experience a hostile culture in the engineering workplace indicates that culture has not changed dramatically over the last ten years and that there is still much work to be done to ensure that women are included, respected, and safe in the workplace.

Isolated Workplace was reported by 45% of the women, much of which originated from male-dominated work environments. This result is also consistent with quantitative results in previous studies¹¹ that indicate 44% of women experience significant isolation in engineering companies. Isolation can also be an additional detriment in a *Hostile Culture* in that some work environments cultivate an unwelcoming and otherwise non-inclusive social and work space for women. Alternatively, *Isolation* can be more of a stand-alone impression, where the simple lack of co-workers to talk with, either due to the arrangement of physical space or due to gender or age gaps, cause someone to feel alone and unfulfilled.

Mysterious Pathways were reported by 17% of the women interviewed in which they felt stuck, uncertain, or unable to effectively advance. Work that becomes repetitive or meaningless can create mysterious pathways in which women are unable to move forward and develop new and pertinent skills. Certain positions and locations influence an individual’s ability to move forward and apply skills. For the most part, women from this pool of interviews, did not seem to experience *Mysterious Pathways* as a result of male presence or dominance. A previous study¹¹ showed that 40% felt a sense of being stuck. The much smaller percentage of women who reported being stuck in this study indicates either a difference in the feelings felt by the women in our interview pool, or a difference in question framing in the interviews themselves.

Only one woman reported an instance of *Diving Catch*. According to the Athena Report, in some cases, women are less willing to take risks because their “buddy system” is not strong enough to support them.¹¹ 35% of these women had difficulty with the notion of risk taking. Although our data did not show a clear link between not taking risks and advancement, there are other factors that contribute to lack of forward motion. What we did find was an instance where Kara was unable to advance and be seen as a result of not doing something ‘extra ordinary’. As previously mentioned, there are difficulties in determining whether or not this situation is more common among women as it may be masked by instances of *Isolation* or *Hostile Culture*. *Diving Catch*

situations may also cause individuals to feel stuck in their positions with no means to advancement.

Next to *Hostile Culture*, *Extreme Pressure* was the second most prominent negative condition with 41% of the female interview participants describing stress due to deadlines, and time constraints, and stress related health concerns. The *Extreme Pressure* felt in the workplace impacts an individual's ability to perform at work effectively, balance work with personal life, and stay healthy. In previous studies¹¹ *Extreme Pressure* was reported by 54% of the female participants. This is consistent with the time constraints, long hours, and deadlines described above.

Just like our primary categories of negative work environment, the 'other influences' categories, represent issues that can impact a woman's ability to persist. Nearly 55% of women reported instances of 'other influences'. Issues such as *Poor Management*, *Boring work*, and *Underutilized skills* create environments not conducive to fulfilling one's potential in the workplace. Women who are not provided with the proper tools and who are subject to stagnant, empty periods of time tend to question their role in the workplace which can, in the long run, compromise life satisfaction and stability.

Research Question #2:

Do men report similar negative conditions in the engineering workplace?

In terms of our five initial classifications of negative work environment, men described experiences in four of these five categories. The one exception that men did not mention was the risk-averse penalty embodied by the *Diving Catch* category.

As compared to the 69% of women who reported a *Hostile Culture* in the workplace, 44% of men in this study also reported instances of *Hostile Culture*. As expected, the type of *Hostile Culture* was not, for the most part, due to gender disparities but rather due to hostile perceptions and competition among coworkers. This contradicts the oft-quoted stereotype that men thrive on competition and indicates that corporate investments in developing a collaborative culture that thrives on true teamwork among coworkers can benefit both men and women.

Isolated Workplace was reported by 2 (13%) of the men interviewed. While the isolation felt was not due to the presence of the opposite gender, other reasons for isolation such as an inability to connect with colleagues was consistent with the types of isolation that women felt. A majority of women in this study who spoke of isolation did so in the context of gender disparity in engineering whereas men spoke more of social cohesion and non-gender associated obstacles that resulted in feelings of isolation. Both men and women thought of isolating circumstances as barriers to fulfillment, but women more than men. Women reported *Isolated Workplace* significantly more often than men in this given pool of participants which could be attributed to the small female:male gender ratio in most engineering and computer science environments.

Mysterious Pathways were also reported by 2(13%) of the men in this interview pool who spoke of barriers to advancement. Gregory, in particular, spoke to the presence of competition and a lack of recognition within his cohort as a means by which he was subjected to barriers outside of his control causing him to feel stuck. Specific positions within the workplace can also create

barriers to advancement and contribute to a sense to being stalled or stagnant. Whether or not women, 17% of which felt *Mysterious Pathways*, feel less likely to advance than men, is unclear.

Diving Catch was not outwardly reported by the men interviewed for this study. *Diving Catch* situations may be disguised by instances of *Isolated Workplace* and *Hostile Culture* but may also be less common experiences in males. Males tend to be more likely to react with a ‘diving catch’ in a critical situation that requires a risk to be taken. In general, *Diving Catch* situations are hard to isolate and analyze given the multifaceted nature of the issues described. Only one female, making up 2.2% of the total interview pool, described an instance of *Diving Catch* culture. Given these results, it is inconclusive whether or not taking risks is a prominent factor in advancement in this field.

Of the men in this study, 50% reported *Extreme Pressure* in either past or present workplaces. Long hours, intense demands and expectations, and unpleasant interaction with clients drive the *Extreme Pressure* in workplaces for men and women. This category, out of the five main categories of negative work conditions, was brought up by the largest percentage of men. Men felt *Hostile Culture* and *Extreme Pressures* in ways that relate directly to the work that they are carrying out rather than as a function of gender disparity. A lower percentage of women in this interview pool felt *Extreme Pressure* in the workplace, 41% of women compared to the 50% of men. Women may feel pressure and stress in other areas of their work culture that outweigh the pressure and stress felt by deadlines and long hours. It is also possible that the way in which males and females process work and filter incoming information could impact the way that they perceive work pressure and stimulation.

Out of the 16 men interviewed, 12 (75%) of them alluded to ‘other influences’. Given that men did not express many instances of *Isolation*, *Mysterious Pathways*, or *Diving Catch* situations, the fact that most of them have spoken of ‘other influences’ suggests that men do not experience negative work environments in the same ways in which women do, or by the same criteria. *Inconsistent work* and *Job Insecurity* cause men to feel an increased sense of instability in conjunction with *Extreme Pressure* in the workplace. Reasons for this stress stem primarily from times of “feast and famine”. *Underutilized skills* and *Poor Management* impact the credibility and interest individuals have with their current positions. Men also spoke of *Oppressive Physical Environments* in the context of isolation and emotional stress that contribute to their ability to be productive and maintain social cohesion. Interestingly, men had some of the same *Work/Life Conflict* issues as women speaking to the difficulty of sustaining a family and having children when working in an intense work position.

Limitations

We recognize that in drawing data from a limited number of men and women, the generalizability of our findings may be limited. However, as is the case with many qualitative studies, the goal is not to answer the question "How many?" but "How?". By limiting our interviewees to early career and to those who remain in the engineering workplace, we have both confined our understanding to what is negative in that workplace and also reduced the possibility of introducing confounding factors and negative influences from other types of workplaces. Doing so may impair the generalizability of future quantitative studies and also limit the effectiveness of any interventions designed to overcome barriers to fulfillment and success.

However, despite the relatively small size of the data set, we feel that our findings are valuable, as they provide insight not only into what kinds of experiences early career graduates in engineering have already experienced in the engineering workplace but also how these experiences both overlap and differ between men and women.

Concluding Remarks

This study reports on the experiences of 45 men and women in early career in engineering at a variety of different workplaces to better understand what negative workplace stressors are and how they influence an individual working in such negative conditions. Studying both men and women can provide insight into which types of barriers in the workplace should be addressed comprehensively and which should be addressed toward one gender or the other. *Extreme Pressure* and *Hostile Culture*, although defined slightly different between men and women, were the most talked about specific sources of negative work conditions.

Women in engineering and computer science workplaces feel negative work conditions related to *Hostile Culture*, *Isolated Workplace*, *Mysterious Pathways*, *Diving Catch*, and *Extreme Pressure*. These results are consistent with previous studies although our study found significantly fewer reports of *Diving Catch* among these early career women. *Hostile Culture*, *Isolated Workplace*, and *Extreme Pressure* situations, on the other hand, seem to be alive and well, changing little from previous studies. Men reported four of the primary categories of negative work environments including *Hostile Culture*, *Isolated Workplace*, *Mysterious Pathways*, and *Extreme Pressure*. Their descriptions of *Hostile Culture*, however, were not a function of gender as they often were for women.

In summary, this study has found a variety of different and negative working conditions among male and female engineers in the engineering workplace. Although qualitative, our study does suggest that some negative work influences may be declining and other influences may be emerging. Future work will include a more quantitative study to understand whether the numbers in our pool of 45 interviews have generalizability to a broader population.

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