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**A MIXED METHODS ANALYSIS OF THE INTERSECTIONS OF GENDER, RACE, AND MIGRATION IN
THE HIGH-TECH WORKFORCE**

A Dissertation Presented

by

SHARLA N. ALEGRIA

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2016

Sociology

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Approved as to style and content by:

Enobong Hannah Branch, Co-Chair

Donald Tomaskovic-Devey, Co-Chair

Tom Juravich, Member

Joya Misra, Member

Laurel Smith-Doerr, Member

Banumathi Subramaniam, Member

Michelle J. Budig, Department Head
Department of Sociology

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ABSTRACT

A MIXED METHODS ANALYSIS OF THE INTERSECTIONS OF GENDER, RACE, AND MIGRATION IN
THE HIGH-TECH WORKFORCE

MAY 2016

SHARLA N. ALEGRIA, B.A., VASSAR COLLEGE

M.A., UNIVERSITY OF SOUTH FLORIDA

Ph.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Enobong Hannah Branch and

Professor Donald Tomaskovic-Devey

Despite public policy initiatives and private sector investment to recruit more women, women's participation in high-tech work has decreased since 1990. I use interviews with tech workers and nationally representative quantitative workforce data from the American Community Survey to examine the consequences of race, gender, and immigration for tech workers' experiences and wages. While previous research shows a decrease in the proportion of women in tech work, these conclusions are somewhat misleading as they do not consider the intersections of race and migration with gender. I find only modest change in the absolute numbers of women. Rather, as the field grew, male migrant workers have primarily filled the new positions. Using only a gendered lens obscures the complicated racial and global dynamics of the tech workforce. I empirically examine three aspects of tech worker's experience. First, I look at differences in wages by gender, race, and immigration status using decomposition techniques. I find that, despite the investment in recruiting women, there is a considerable wage gap that reflects the intersecting race, gender, and immigration inequalities. Second, I explore the kinds of work that tech workers do, and find that by mid-career many white women had moved into management position that emphasize interpersonal skills over technical skills. I call

these positions “translational” as they are expected to translate technical information to management and business directives to technical teams. Finally, I examine how tech workers imagine the ideal engineer works. I find that many workers envision someone who is always at their computer working very long hours and constantly engaged in technical pursuits, but the workers I interviewed valued work/life balance. Managers had more control over their schedules but they also worked nights and weekends. Software developers and others in strictly technical positions worked closer to an 8-hour day. Meanwhile, technical work such as software development is increasingly done by migrant contract workers who work with legal restrictions that push them to work like the ideal engineer described in the interviews.

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CHAPTER 1

INTRODUCTION: WHY STUDY TECH WORK?

Despite public policy initiatives and private sector investment to recruit more women, women's participation in high-tech work has decreased since 1990. I use interviews with tech workers, observations from tech conferences and "hack-a-thons," and nationally representative, quantitative workforce data from the American Community Survey to examine the consequences of race, gender, and immigration for tech workers' experiences and wages. While previous research shows a decrease in the proportion of women in tech work, these conclusions are somewhat misleading because they do not consider the intersections of race and migration with gender. Women's declining representation presents a puzzle that must be understood in the context of the field, where work is highly mobile, teams may be made up of members from around the world, certain specialized skills are in high demand, and notions of flexibility and innovation loom large for both workers and companies.

I seek to understand how gender, race and migration status operate in a field with high levels of gender and racial segregation as well as efforts to broaden participation. As Glenn (2002) demonstrates, our understandings of social categories such as race and citizenship take new forms that better reflect the reality of social life when understood through a gendered analysis. My analysis holds gender, race, and migration together as analytic categories to better understand the mechanisms shaping the demographic distribution of the tech workforce.

Attracting workers to Science, Technology, Engineering, and Math (STEM) generally, and tech in particular, is a matter of national economic security as described by the National Academy of Sciences (National Research Council 2010) and the key to "winning the future," according to the Obama Administration (White House 2012). Yet, rapid growth in the field has not been facilitated by the underrepresented American workers targeted by numerous

broadening participation initiatives, but by highly skilled foreign born professionals, who simultaneously enmeshed in the race, gender, and class politics of their home countries, the corporate interests that determine labor practices in the tech field, and US immigration law. At the same time, women's representation has actually decreased from a high of 37% of Bachelors' degrees in computer science in 1990 to a low of only 20% in 2006, even as women's representation increased in other STEM fields (Hayes 2010). Women's declining representation in tech presents a puzzle that must be understood in conjunction with the rise in migrant labor, particularly because the decline in representation is the result of growth in the field and not the result of a decrease in the number of women entering the tech industry (National Science Foundation 2011).

My theoretical framework focuses on the intersections of race, gender, and immigration to understand how the tech field is gendered and racialized, thus offering a new understanding of the problems related to broadening participation. The women in science literature tend to regard gender as the primary mechanism affecting which people enter and succeed in science, to the exclusion of race or ethnicity or citizenship status. Meanwhile, the literature on immigration in science tends to focus on the importance of highly skilled immigrant labor for American competitiveness or on the experience and incorporation of immigrant workers in US science firms without attending to the gender of these workers. Neither body of literature addresses the strikingly low numbers of US-born men and women of color in these fields.

In this dissertation, I combine quantitative analyses on the demographics and comparative rewards (wages) of workers in the tech field and interviews with tech workers about their experiences at work. I followed the occupation codes established in the US census to determine occupational categories; thus, tech workers include electrical engineers, computer systems analysts, computer scientists, computer software developers, system administrators,

and tech managers. Conceptually, I understand tech workers to be workers whose primary activity is producing computing-related knowledge, products, and services.

Plan of the Dissertation

I empirically examine three aspects of tech workers' experience. First, I look at differences in wages by gender, race, and immigration status using decomposition techniques. I find that, despite the investment in recruiting women, there is a considerable wage gap that reflects the intersecting inequalities of race, gender, and immigration. These wage gaps persist even after controlling for demographic, human capital, and job-related variables. Second, I explore the kinds of work that tech workers do. Drawing from 45 interviews with tech workers, I find that even women with advanced technical training tend to do work that emphasizes stereotypically feminine skills, such as communication. Many of the mid-career women I interviewed hold positions that I call "translational," as they are expected to translate technical information to management and business directives to technical teams. Finally, I examine who "engineers" are and how they work to understand how computer-related engineering is gendered and racialized.

Throughout the interviews, workers referred to people who do primarily technical work, such as software developers and system administrators, as "engineers," while the people who coordinate tech teams and bridge different parts of the organization are "managers." I adopt this language of engineers and managers throughout the dissertation. The managers I interviewed are also tech workers inasmuch as their job is to produce software, hardware, systems, or networks and they could not do their jobs without technical skills and knowledge. Most managers started as engineers and worked their way into managerial positions higher up the corporate hierarchy. Women are especially well-represented among managers, as chapter two demonstrates.

I build on the work of Glenn (2002), Salzinger (2003), and Wooten and Branch (2012) to expand and apply the concept of “appropriate labor” to tech work. I use “appropriate labor” to describe the socially negotiated and normatively enforced ideals about the race, gender, and citizenship status of workers who best fit to particular jobs. For Wooten and Branch (2012), appropriate labor is not merely a match between workers and work, it offers a justification for why these workers are appropriate for this labor. They show that the white press and employers in the post-civil war era thought black women were naturally caring and tolerant of hard work and, therefore, that they were appropriate domestic workers. Glenn (2002) demonstrates that as racial/ethnic groups became incorporated into the US, the work each group did and the normative expectations for what it meant to be Mexican, or black, or Japanese, for example, shaped one another.

Drawing further from Glenn (2002), I push the concept to think of appropriate labor as a productive process. Shifts in the race and gender of the workers in a job may be related to a shift in how we understand the skills and characteristics required for the work. Changes to a job may either open doors for a different group of workers or shift the normative race and gender expectations for the workers currently in the job. Appropriate labor calls for a match between our understandings of race/ethnicity, gender, and work and allows for those understandings to shift in order to preserve the match.

Importantly, appropriate labor does not describe the everyday working habits and natural inclinations of living, breathing people; it is a trope of the ideal worker for a particular job, as chapter three demonstrates. Salzinger (2003) argues that the trope of the docile, cheap, nimble-fingered, ‘*maquila*-grade female’ shaped *maquila* work even though it did not describe *maquila* workers. Local organizational forms shaped gender relations, which in some factories bore little resemblance to the *maquila*-grade female trope. The trope was a powerful image

against which *maquila* workers could be measured. Salzinger (2003) provides the framework to understand appropriate labor as a trope for who the ideal worker for a particular job is and what skills and characteristics they possess. The trope is a productive one, shaping our understandings of race/ethnicity and gender through work and our understandings of work through race/ethnicity and gender. Each of the three substantive chapters of this dissertation articulates and expands a different aspect of appropriate labor.

Changing the Conversation: What Does it Take to Broaden Participation?

The goal of this dissertation research is to better understand how inequality persists when companies, individuals, and governments ostensibly embrace diversity and equity. The tech industry provides an ideal case study. As of 2010, the National Science Foundation, a critical funding source for a wide variety of scientific research, operated 19 different programs specifically focused on broadening participation in science and an additional 19 programs that emphasized broadening participation among several goals. U.S. lawmakers, science policy advisors, and analysts are seeking even more ways to attract immigrant workers with world-class STEM skills. At the industry level, leading companies are making a “business case” for recruiting women as part of an effort to design products that will appeal to a broad range of consumers and meet growing demands for workers (Microsoft 2012).

Tech industry leaders, such as Google, Facebook, Apple, and Twitter, have tried to demonstrate their sincerity by admitting past failures to recruit women and releasing data on the gender composition of their overall and tech-specific workforces (see Forrest 2014). As part of an effort to recruit and retain women, tech companies are also expanding parental leave opportunities for both men and women; Microsoft and Netflix offer unlimited leave during the first year after a birth or adoption and Adobe offers up to 16 weeks of paid leave (Kell 2010).

At least some of the push to broaden participation in STEM, and especially tech work, is because the tech industry and government advocates believe there is shortage of skilled workers. In 2005, Congress charged the National Academies with identifying challenges and making specific recommendations “to ensure that the United States maintains its leadership in science and engineering to compete successfully, prosper, and be secure in the 21st century” (National Research Council 2007: X). Among the committee’s recommendations was “Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world” (National Research Council 2007: 9).

Echoing the recommendations of the committee, Microsoft CEO Bill Gates, testified before Congress in 2008 to plead the tech industry’s case for increasing the number of US tech workers. He also told Congress that there were 100,000 new tech jobs in the US annually, but in 2006, there were only 15,000 college graduates with tech degrees (Competitiveness and Innovation 2008). Like the National Academies’ report, Gates argued that the position of the US as global leader in innovation was at risk because the tech industry faced a labor shortfall that could be ameliorated if the US encouraged immigration (Competitiveness and Innovation 2008). The efforts to broaden domestic participation and increase immigration for skilled tech workers are two sides of the same coin. Both sets of initiatives aim to increase the number of skilled tech workers. Tech industry leaders, like Bill Gates, seem focused on recruiting more women in the long term and meeting the current demand with immigrant labor. The efforts to recruit more women show little evidence of paying off; women’s participation has decreased since the 1990s (Hayes 2010).

A Gendered Pipeline Problem?

There is a massive body of research on participation in STEM work that demonstrates emphatically that women are underrepresented in many STEM fields. This literature identifies gender socialization, desires for work and family balance, and lack of mentors, as barriers for women. Gender socialization, especially socialization that occurs in schools, is often cited as a cause for the prevalence of women in certain occupations (Blickenstaff 2005; Simpkins, Davis-Kean, & Eccles 2006). Teachers, observers, and girls themselves tend to believe that they are less capable than their male classmates even when objective measures would suggest otherwise (Correll 2001; Hyde et al. 2008).

In schools, women suffer from a lack of female mentors in STEM disciplines (Sonnert, Fox, and Adkins 2007). Even when they do enter and succeed in engineering majors, Cech et al. (2011) find that they are not confident in their ability to be professional engineers. Similarly, international research shows that women have lower self-evaluations of their abilities with computers than their male peers (Vekiri 2013; Meelissen and Drent 2008; Robnett 2013). For example, in a survey of 5th grade students in Greece, Vekiri (2013) found that boys used computers more and were more confident in their computer competence.

If women do pursue a STEM field and believe they are capable, researchers argue that they still have to reconcile desires for family life and workplace success. Blackwell and Glover (2008) find that women in the UK with degrees in science, engineering, or technology are less likely to work in those fields than men with similar degrees and more likely than women with degrees in health-related fields to leave the workforce if they become mothers. Ceci, Williams, and Barnett (2009) and Frome, Eccles, and Barber (2006) argue that the desire to balance work and family life presents an additional barrier for women. Eccles (2005) argues that, for many women, the value of learning computing does not outweigh the value of a more feminine-typed

course of study that they believe will better allow them to pursue and care for children. Eccles and colleagues further argue that science careers are time consuming and male dominated (Eccles 1994; Frome, Eccles, & Barber 2006). This literature suggests women are less likely to be able to balance work and family and more likely to experience discrimination, hence in their view it should not be surprising that women are underrepresented.

This literature contributes a sophisticated, gendered analysis, but tends to regard all women as the same, as if race, class, citizenship, ethnicity or sexual orientation does not matter, and all women have the same response to the pressure to conform to heteronormative femininity. In contrast to earlier findings Cech, et al. (2011) find that concerns about balancing work and family do not have a significant effect on college women's decision to pursue engineering. The difference between Cech and colleagues' findings and earlier findings may be due to cohort effects or selectivity bias that drew women who were less family oriented to the schools where their research was conducted. No matter the source of the difference, this contrast shows that desires for work and family balance do not present the same barriers for all women.

Even when researchers are attentive to race in shaping the experience of men and women in science, gender often becomes the dominant theme. For example, Varma and Hahn (2008) surveyed 150 computer science or engineering majors at minority-serving institutions (historically black colleges and universities, tribal colleges, and Hispanic serving colleges) to learn where along the pipeline these students are more likely to leave. While the researchers carefully selected a racially diverse sample and present descriptive statistics for the racial breakdown of their sample, all of the statistical comparisons are between men and women only.

There are a handful of studies that do examine gender, race, migration, and/or class intersectionally. O'Keefe (2013) studies the importance of "exceptional" popular science fiction

characters, particularly Star Trek's Lieutenant Uhura (a black, female, Communications Officer), for underrepresented minorities in STEM fields. She finds that these characters, despite their small numbers, were inspirational to her interviewees. Ong (2005) conducted longitudinal interviews with 36 undergraduate physics students and found that the women of color, in particular, engaged in "body projects" to help them manage the mismatch between their appearance and the stereotypical image of a physicist. These studies deal with multiple identities and help us understand how people who do not match the stereotypical scientist find inspiration and alternative paths.

Framing the demographics of scientific fields as a gendered "pipeline problem," or even part of the culture or organizational practice of the field, misses the important global and racial factors that have the potential to transform how gender operates in the context of each field. Immigrant STEM workers live with different kinds of relationships to their employers than do American workers. An employer must sponsor the H-1B Visa and, while it can be transferred between employers, a period of unemployment can jeopardize visa status. This is a particular problem for workers contracted for specific projects who are compelled to find new assignments or jeopardize their immigration status (Banerjee 2006). Banerjee (2006) interviewed Indian men in the U.S. computing workforce and found that, despite high pay, they navigate a complex set of immigration laws that puts their legal status in the U.S. entirely in the hands of their employers. Many of her interviewees experienced periods in between contracts when their visas were technically not valid and they could have been subject to deportation—a threat that American workers do not face.

A Demographic Profile of the Tech Workforce

A careful examination of the demographic profile of the tech workforce demonstrates that immigration has been the mechanism by which the field has expanded so far¹. Women's participation has decreased and Americans of color have never composed more than a tiny fraction of workers. First, I show change in the demographics of the field by gender over the 50-year period, to examine only men and women to show the picture upon which most previous research relies. Next, I disaggregate the demographics of the field as fully as sample size allows by race and region of origin, to show the differences among women and men. This approach allows me to demonstrate how much we are missing by focusing on gender alone. The strategy of simple, descriptive disaggregation highlights racial and national differences that have consequences for paths into or away from STEM careers. The strength of this approach lies in its simplicity. No complex or sophisticated statistical modeling is needed to see that gender, race, and migration need to be considered simultaneously to make sense of the tech workforce.

¹ I use data from the census and the American Community Survey to examine the demographic profile of tech workers as the field grew since 1960. The data for this study are drawn from the Integrated Public Use Microdata Series (IPUMS) 1% samples for 1960 and 1970, 5% samples from 1980, 1990, and 2000 as well as the American Community Survey from 2009, which replaced the 1% long-form census (Ruggles et al. 2010). Ten-year intervals are less than ideal, since change in computing happened rapidly in the 1990s. Hence it is likely that much of the dot-com boom and bust are masked by the length of the interval during this period. Combining these samples provides a representative, random sample of workers in the US that spans the 50-year period of dramatic growth in the tech workforce.

IPUMS data provide the most comprehensive set of quantitative information on long-term changes in the US population, including immigration, earnings, and occupation. In addition, IPUMS integrates the data samples across years to allow for uniformity in variable names and meaning, including harmonized occupational titles, permitting an analysis of occupations over time. Since IPUMS is based on the decennial census, it does not trace changes in individuals across years, instead I examine trends cross-sectionally. I limit the sample to individuals employed at least part time with at least a bachelor's degree. These workers are more likely to intend to have careers in the sciences rather than casual employment and have pursued education related to their chosen occupational field. In other words, they have traversed some version of the metaphorical "pipeline."

The disaggregated analysis examines white men and women, underrepresented minority men and women, US-born Asian men and women, non-US-born Asian men and women, non-US-born Western men and women, and other non-US born men and women. White men and women include only white men and women born in the US or abroad to American parents. Underrepresented minority men and women were born in the US or abroad to American parents and identify their race as black, Hispanic, Native American, or any other race that is not white or Asian. Since Asians are not underrepresented in STEM fields, they are separated from other minority groups for this analysis.

US-born Asian men and women were born in the US or abroad to American parents and identify their race as Asian. Non-US-born Asian men and women are those born on the Asian continent, Indian subcontinent, Japan, and the Philippines. Since entrance into the US was severely restricted for Asians prior to 1965, the majority of Asians in the US, particularly those of working age, were born outside the US (Xie & Goyette 2003). Most Asians in this analysis are non-US-born (87%). Asian immigrants are the majority of non-US-born workers in both life science and computing, with 54% and 65% respectively. China, India, and the Philippines each send about one-quarter of all workers from Asia with the remaining quarter coming from other countries.

Non-US-born Western men and women include those born in Europe, Canada, Australia, and New Zealand. Canada, Germany, and Russia are the largest sending countries, each sending 10-15% of non-US-born Western workers. Other non-US-born men and women include those born in Africa, South and Central America, the Middle East, the West Indies, and the Caribbean. Slightly more than 20% of other non-US-born workers come from South America, slightly less than 20% come from Africa, Mexico, and the West Indies (each send roughly 15%), and an additional 12% come from Cuba.

Even though US understandings of race do not apply in all sending countries, in US terms, most of those in the Asian group would be thought of as Asian, most of those in the non-US West group would be thought of as white, and most of those in the Other non-US-born group would be thought of as black or Hispanic. Since US understandings of race cannot be directly applied to non-US born workers and nation of origin, is not a reliable proxy for race. We do not extend US-based understandings of race to the non-US-born workforce. For example, 89% of US workers born in Egypt identify their race as white, as do 88% of South Africans. To regard these groups as black because they are African would miscategorize many workers who would indeed be considered white in the US, yet to regard them all as white would miss the differences in how race is understood in these countries relative to the US.

I used the IPUMS 1990 occupation codes to determine occupational categories. IPUMS 1990 occupations codes are harmonized over time so that occupations are coded as they would have been coded in 1990, regardless of the occupational categories that existed at the time of the census. This means that occupations are coded as consistently as possible over the 50-year period. The computing occupation titles are: electrical engineer, computer systems analyst, computer scientist, computer software developer, and electrical engineering technician (census codes 55, 64, 65, 213, and 229). The later years do include more detailed occupation categories, which I use in the wage analysis in chapter two.

While this dataset does have limitations, it is the best data available for comparing non-US-born and US-born workers. The approach I take allows me to better capture and understand changes in the scientific workforce that stem from the dramatic shift in the makeup of the labor force post-1960. Disaggregating white women, underrepresented minority women, US-born Asian women and non-US-born women enables me to examine differences in the participation of these groups that may suggest complex gender dynamics not identified by the literature on

women in science. Similarly, disaggregating whites, underrepresented minorities, US-born Asians and non-US-born workers enables us to distinguish increasing racial diversity driven by immigration as opposed to increased participation of historically underrepresented groups.

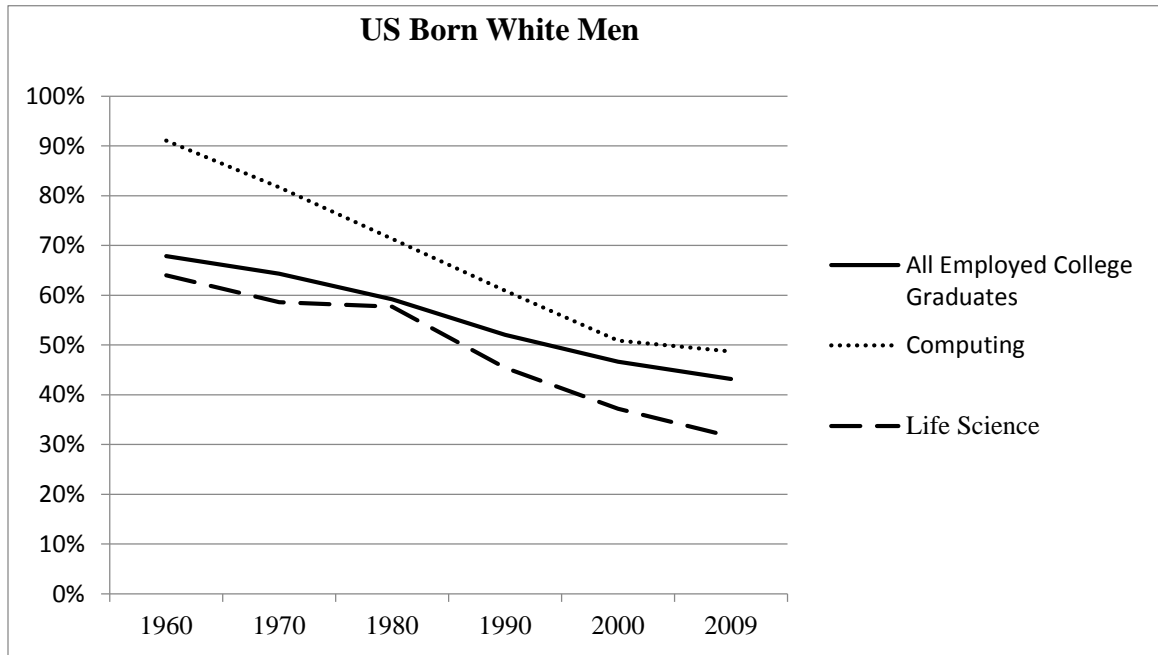
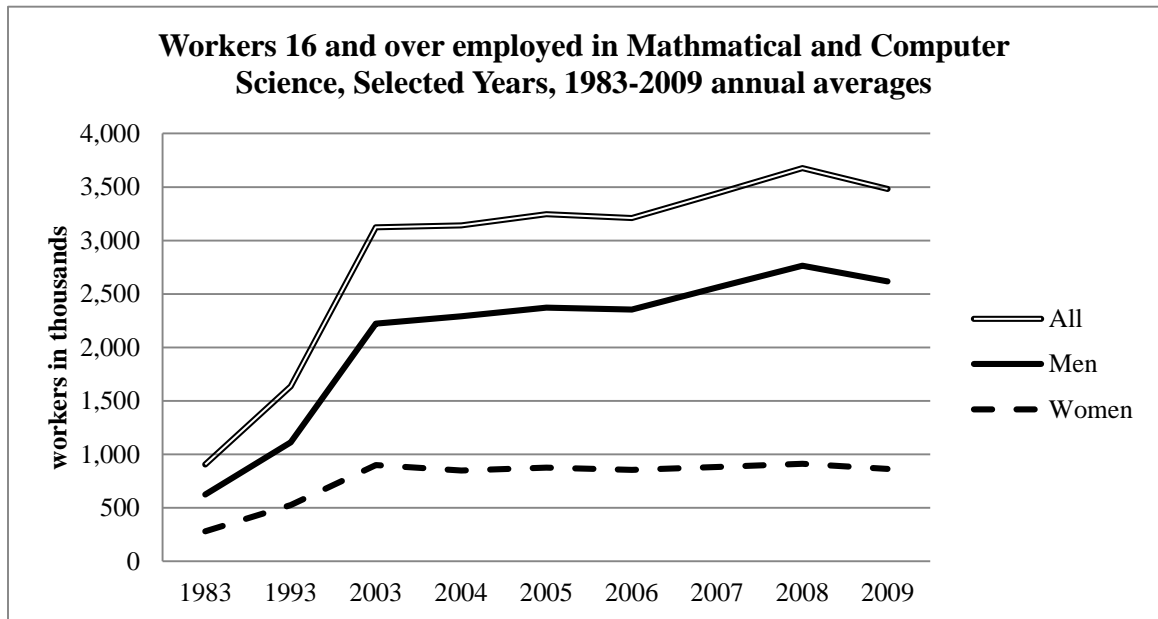


Figure 1. White men as a percentage of workers with at least a bachelor's degree, in selected fields

White men have steadily decreased as a percentage of science workers (see Figure 1). This change, however, does not reflect an exodus of white men. In fact, the absolute number of men, regardless of race or birthplace, in the scientific workforce generally has increased from roughly 625,000 in 1983 to 2,618,000 in 2009 (see Figure 2). The total civilian labor force more than doubled between 1960 and 2009, fundamentally shifting its demographic composition (Lee & Mather 2008). Women increasingly entered the workforce and the easing of immigration restrictions in the mid-1960s, particularly for skilled non-US-born workers, spurred an

immigration boom.



Source: National Science Foundation (2011) Division of Science Resources Statistics

Figure 2. Workers 16 and over employed in Mathematical and Computer Science, Selected Years, 1983-2009 annual averages

In 1960, nearly 90% of scientists and engineers were white men, but this number fell sharply, roughly 10% each decade, until 2000 when the percentage of computing workers who are white men began to level off at about 50% (see Figure 1). In 2009, white men were 43% of all workers, just under 49% of computing workers.

Figures 3 represent the gender-only labor force breakdown common in the literature on the STEM pipeline. Since figure 1 showed that white men are slightly less than 50% of workers in computing, but men are roughly 80% of computing workers, it is clear from these charts alone that a significant portion of men in computing are either underrepresented minorities, US-born Asians, or non-US-born workers. Women, regardless of race or birthplace, account for only about 25% of computing workers.

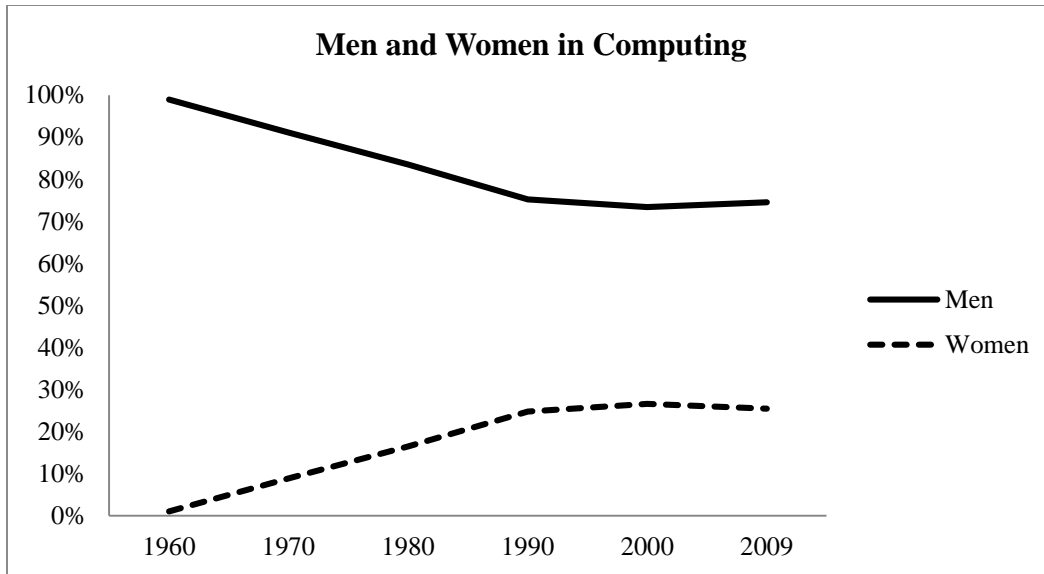


Figure 3. Percent of Men and Women with at Least a Bachelor's Degree Working in IT Fields²

Figure 4 shows the percentage of whites, underrepresented minorities, U.S. born Asians, as well as non-US-born Asians, Western, and other non-US-born men and women in computing.

From these graphs it is clear that white men are still the largest group of workers. While white women are still the second largest demographic, if current trends continue they are likely to be outnumbered by non-U.S. born Asian men in the near future.

² Originally published in Alegria, 2014

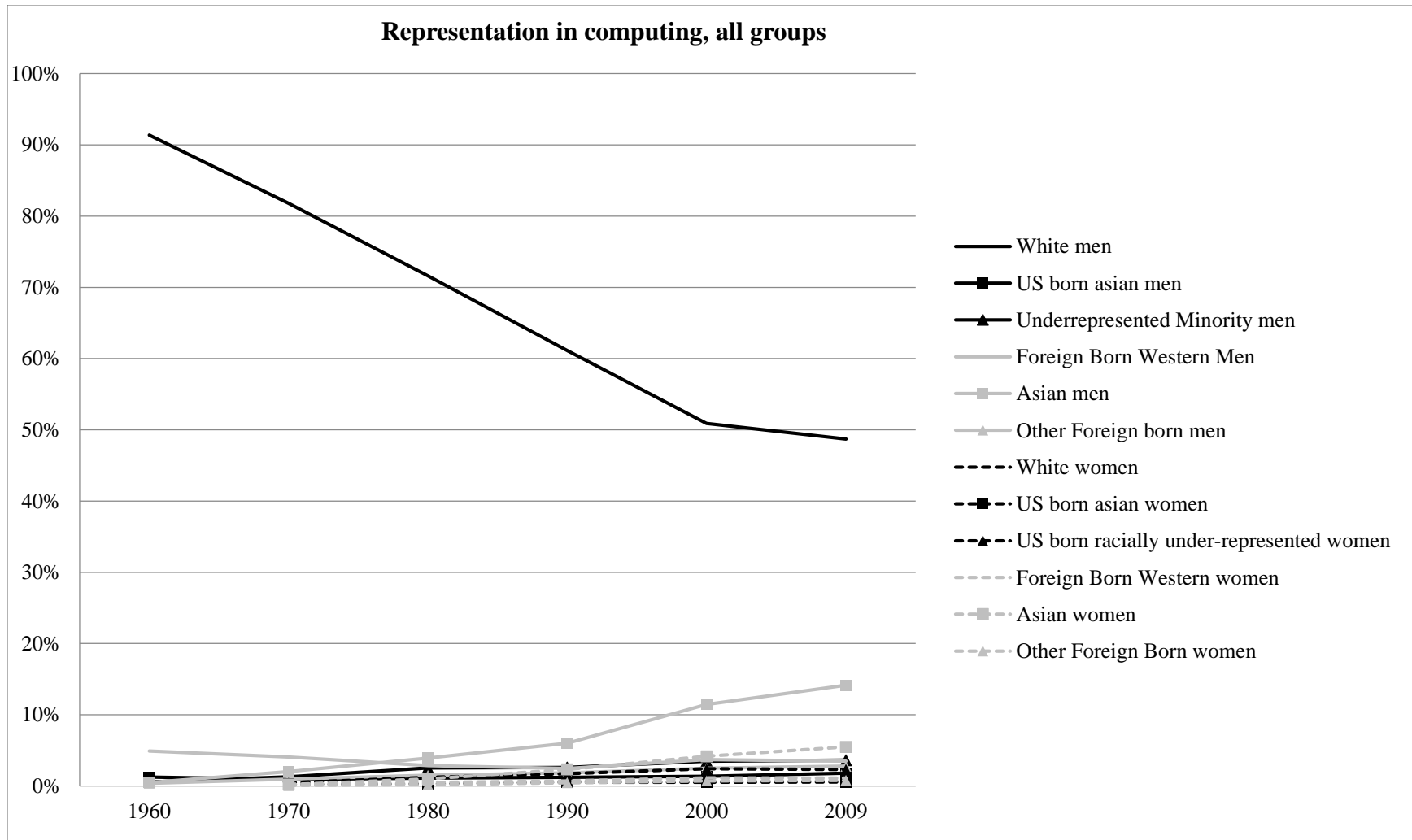


Figure 4. Full disaggregation of computing occupations 1960-2009

Non-US-born Asian men dramatically outnumber their US-born Asian male counterparts as well. In 1960, they made up less than half a percent (.48%) of the computing workforce, by 2009 their representation soared to 14.14%. In contrast, US-born Asian men composed 1.25% of the computing workforce in 1960 and underwent little growth in the intervening decades. In 2009, they still made up only 1.82% of the computing labor force.

The pattern of representation for US-born and non-US-born Asian women is similar to that of their male counterparts. While there were too few US and non-US-born Asian women to count in the 1960s, they diverged dramatically by 2009. US-born Asian women slowly but steadily increase through 2009, composing 0.56% of the computing workforce. Whereas non-US-born Asian women increase dramatically, making up 5.49% of computing workers in 2009, just over three times the representation of US-born Asian men. Not only are non-US-born Asian workers unlike US-born Asians, their participation in computing far outpaces the representation of all other groups (men and women) from around the world, who represent only 8.15% of computing workers combined.

Underrepresented minority men were only 0.58% of computing workers in 1960, but grew almost six-fold to 3.62% in 2009. There were too few underrepresented minority women in computing to count in 1960, but by 2009 they composed 2.33% of computing workers, more than four times the representation of US-born Asian women. These descriptive statistics clearly illustrate the importance of disaggregating trends in representation. They also show that examining only gender does not provide enough information to understand the context of women's low and declining representation in tech work.

Conclusion

The remainder of this dissertation examines women's representation in tech work in the context of race and migration. Chapter 2 asks, how might the wages of tech workers reflect not

only gender, but simultaneously the race/ethnicity and nationality of the workers? I build on the concept of appropriate labor in this chapter to consider how relatively new kinds of work, like computing, may shift and reshape, but also draw on entrenched understandings of race/ethnicity, gender, and work. Workers' value in tech jobs might be different from other jobs as challenges to long-standing race and gender relations play out in this relatively new field. I use quantitative decomposition analysis to find wage penalties or premiums for groups of tech workers by race/ethnicity, gender, and region of origin, controlling for common income-generating characteristics. I find a gender wage penalty for all but Asian-American women, suggesting that some women are more highly valued in tech work than others. At the intersection of race, gender, and migration, I find patterns of inequality that differ from most research on wage inequality. US-born underrepresented minority women experience a smaller wage penalty than US-born white women, suggesting that tech work forms its own context for inequality.

Chapter 3 examines the different jobs tech workers perform. Drawing on interviews with tech workers, I find that white women tend to move into managerial positions where they manage technical teams and coordinate with the business and management side of their companies. I call these "translational" positions because the women in them translate between the technical and business sides of their companies. When men are in similar kinds of managerial positions, they tend to describe their jobs as primarily technical—sometimes describing the technical work their team does rather than their own more hybrid position. White women's promotion into translational management positions was a kind of limited glass escalator that moved them out of masculine engineering positions and into less masculine managerial positions that emphasized communication and interpersonal "soft skills." The glass escalator in this case is limited because women rarely enter the executive management level at

tech companies. Similar to Wingfield's (2009) findings, women of color did not ride the glass escalator. In this chapter, I build on the productive capacity of the appropriate labor concept. Translational management positions are recent inventions in the tech industry. White women's concentration in these positions both defines the skills and requirements of the job and preserves the masculinity of engineering work.

In chapter 4, I examine the tension between how the workers I interviewed imagine engineers work compared to how engineers and managers described their actual work. The imagined "ideal engineer" works very long hours, is hyper-focused on technical tasks, and always puts *his* work first. When engineers describe their work though, they typically work an eight-hour day, occasionally something will happen (a server goes down, they reach a release deadline, a project is understaffed, etc.) that requires them to work longer hours, but they were resentful if the long hours became regular. Managers, on the other hand, routinely took their work home with them. They might spend eight hours in the office, but they worked early mornings, late nights, and weekends from home. Engineers do not work like ideal engineers, nor do they aspire to. Managers might embody a 21st century version of Acker's (1990) ideal worker, but they are not ideal engineers either. They miss their technical work and lament the loss of skills that happens when they do not use their technical skills regularly. The workers I interviewed, specifically imagine immigrant workers working like ideal engineers. This group of workers is subject to labor practices and legal restrictions that make them look like ideal engineers, whether they genuinely embody the trope or not. This chapter builds on the idea of appropriate labor as a trope that can be used to shape production, even in the absence of workers who embody it.

I conclude the dissertation with summary thoughts and policy interventions to consider given the insights that emerge from my work.

CHAPTER 2

WHAT'S MISSING IN THE WAGE GAP STORY? AN INTERSECTIONAL DECOMPOSITION OF WAGES IN COMPUTING OCCUPATIONS

Government agencies and tech companies are contributing millions of dollars to initiatives intended to attract more women to computing work. At the federal level, increasing women's participation is part of an effort to increase the size and deepen the pool of skilled science and technology workers (National Academies 2010). At the industry level, leading companies are making a "business case" for recruiting women as part of an effort to design products that will appeal to a broad range of consumers and to meet demand for workers (Microsoft 2012). These efforts to increase participation in computing are happening with a sense of urgency. The Presidents' Council of Advisors on Science and Technology (PCAST) released a much cited report³ informing the President and the public that demand for workers in Science, Technology, Engineering, and Math (STEM) fields is expected to exceed the number of graduates in these fields by approximately one million workers over the next decade (PCAST 2012). Increasing women's participation in tech is part of federal economic policy and industry profit-maximizing strategy.

Both internal (tech companies) and external (government) forces are working to diversify tech work. One way to understand the patterns of inequality in tech work is to study wages. If companies want to hire women but they face a dearth of qualified women, then the shortage could drive up wage for women with the relevant skills. On the other hand, the research on women in male dominated STEM field suggests that both women and men question women's competence and aptitude in these areas (Hyde et al. 2008; Vekiri 2013; Meelissen and

³ There is some question as to whether demand for workers is as high as the PCAST report suggests. For example, see Matloff 2013.

Drent 2008; Robnett 2013). Biases about women’s competence with computers may drive wages for women down. Beyond sex, the tech industry also employs a large number of immigrant workers, especially those on temporary, employer sponsored, H-1B visas (GAO 2011; Banerjee 2010). Asian workers are not underrepresented like other racial minority workers, and powerful stereotypes suggest Asian workers are especially talented with computers (Shih et al. 1999; Oyserman and Sakamoto 1997; Tashiro 2009). Black and Latina women are so underrepresented in tech they are sometimes referred to as ‘unicorns’ in the industry (Bell 2013). Inasmuch as companies value diversity, they may compete for these underrepresented workers by offering high wages. The tech workforce is emblematic of work in the new economy and may represent 21st century patterns of inequality that break with the gender⁴ and race inequalities familiar from the recent past.

I examine wages among tech workers intersectionally, by sex, race, and immigration, to understand how inequality operates in the tech workforce and to see if there are signs that the patterns of demographic inequality in tech may be different from other fields. I build on theories of appropriate labor to understand how race and gender shape our collective understandings of which people are suited for which kinds of work and, importantly, how these understandings can change. An intersectional analysis is key to this study. I use decomposition techniques that allow me to move away from dummy variables and interaction terms typical of quantitative intersectional research. This approach allows me to examine how the intersections of

⁴ Sex and gender are theoretically distinct concepts—gender referring to socially constructed and enacted performances and understandings of masculinity and femininity and sex referring to differences between men and women typically related to biology. In some places I am referring to socially constructed and enacted masculinity and femininity, therefore I use gender. Since I rely on survey data that asks respondents about sex and allows only two responses, male and female, without any context for the socially constructed and enacted ways that people perform masculinity and femininity, I use sex when referring to this study and others that use similar data.

demographic categories can yield complex inequalities unlike any category alone. With this approach, the whole can be unlike the sum of its parts. Controlling for human capital factors, job related factors, and individual characteristics, I find patterns of inequality that show the importance of an intersectional approach. Sex is related to lower wages for most, but not all women, immigration is related to higher wages, except for workers from the Global South who experience the largest wage penalties, and patterns of racial inequality part from findings in past research.

Inequality at Work

The sex gap in pay in the US workforce is well established. On average, women earn less than men. Occupational segregation, both vertical and horizontal, explains some of the gap; however even when controlling for human capital differences, a persistent sex gap in pay remains (Reskin and Roos 1990; Cotter, Hermsen, and Vanneman 2003; Levanon, England, and Allison 2009; Charles 2011; Perales 2013 [see Misra and Murray-Close 2014 for a review]). Research consistently finds that, since the 1980s, Black and Latino men have earned less than white men and that Black and Latino women have earned less than white women (Browne and Misra 2003, Browne and Askew 2005, Dozier 2010). On the other hand, migration is a more important factor in income inequality than race for Asian workers. Kim and Sakomoto (2010) find that, when Asian-American men are educated entirely in the US, their wages are comparable to white men's; however, wage inequality persists for Asian men educated even partially overseas. McCall (2001) finds lower wages for Asian women compared to white women, particularly around high-tech processing centers, though not necessarily in high-tech work. Moreover, she finds that these wage deficits for Asian women decrease as time in the US increases (McCall 2001).

Decades of research on wages in the US demonstrate consistent racial inequality in wages, which is often gendered as well as raced (see McCall 2001; Cotter, Hermsen, and Vanneman 2003; Avent-Holt and Tomaskovic-Devey 2010; Broyles and Fenner 2010). Further complicating the wage gap story, Broyles and Fenner (2010) find evidence of a racial wage gap among men in chemistry. They find that Asian and Black men in chemistry experience a wage penalty relative to their qualifications, while Latino men receive the same returns to their human capital as white men. Cotter, Hermsen, and Vanneman (2003) not only continue to find a sex wage gap, they find that the effects of occupational sex segregation are not the same for women across race groups. Asian women experience a similar or slightly smaller penalty compared to white women, but black and Latina women experience larger penalties (Cotter et al. 2003).

While race matters for wages, not all non-white racial groups have the same labor market experiences. Hanson (2013) finds that Latino/a workers with at least a bachelor's degree are more likely to hold a STEM degree than their white or Black counterparts. However, Greenman and Xie (2008) find that Latino/as and Blacks have lower earnings than whites, while some groups of Asians have slightly higher earnings; however, sex has a moderating effect on race-related earnings differences. The race wage gap is slightly smaller for women than men in Greenman and Xie's (2008) study, but McCall (2001) finds that migration has a downward pull on wages for Asian and Latino/a workers.

Intersectionality theory has implications for how we might understand income inequality in the context of work in specific occupations. Glenn (2002) demonstrates that "race and gender have been organizing principles and products of citizenship and labor" (p. 236). She traces the locally and historically specific practices through which men and women "enforced and challenged rules and boundaries that maintain distinctions" around race and gender

through labor (Glenn 2002: 236). In other words, the conditions in which people work and the rewards they receive for their labor produce and reinforce distinctions between groups. Labor conditions change, groups of workers challenge the inequalities they face, the nature of work can shift, and, consequently the distinctions between groups can shift as well.

Wooten and Branch (2012) further develop the idea and show that the ideal domestic worker shifted from white immigrant women to Black women around the late 1800s and early 1900s in the eastern US. Glenn's (2002) and Wooten and Branch's (2012) work suggest that workers value in tech jobs might be different from other jobs as challenges to long-standing race and gender understandings take shape in this relatively new field.

I draw from theories of intersectionality using a framework that understands multiple identities as simultaneously constituted and interwoven. Collins (1998) explains intersectionality is grounded in the particulars of experience which cannot be separated into component parts—there is not a “gender effect” and a “race effect” that can be each be separately identified and measured. Researchers also emphasize that intersections produce dynamic inequalities depending on context (Collins 2000; McCall 2001; Browne and Misra 2003; Dhamoon 2011). For example, in their comprehensive review of literature on race and gender intersectionality, Browne and Misra (2003) show how one-dimensional understandings of demographic inequality break down. Their analysis of the empirical research finds some places in which white women out earn Black men and other places where the reverse is true. They argue that, while intersectionality theory would suggest that all demographic attributes matter, there are some instances in which some attributes matter more than others (Browne and Misra 2003). For example, McCall (2001) finds that intersecting patterns of race and sex inequality vary by city. Stainback and Tomaskovic-Devey (2012) demonstrate that race and gender inequality varies at the organizational level. Therefore, I examine inequality in a particular field, information

technology or “tech work,” which includes occupations related to creating, managing, or maintaining computer hardware, software, or networks.

What is Special About Tech?

The tech field has acquired a special status as having potential to strengthening the US economy. For example, President Obama included provisions in his 2012 budget proposal aimed at broadening the pool of high-tech workers to include more white women and underrepresented minority women and men. He described these provisions as strategies to “win the future” (White House 2011). Yet, computing remains one of the most sex-segregated science and technology fields. Women’s representation peaked in 1990 at about 38% of tech workers and dropped to around 20% by 2012 (Hayes 2010). Moreover, as the sex gap in pay narrowed in other parts of the labor force through the 1970s, 1980s and into the 1990s (Heywood and Nezlek 1993), there was no such narrowing in computing related occupations (Blau and Kahn 2006).

Increasing women’s participation is part of government and industry efforts to increase the size and deepen the pool of skilled science and technology workers (National Academies 2010). A number of tech leaders, including Google, Facebook, Apple, and Twitter, have tried to demonstrate their sincerity by admitting that they had failed to recruit women in the past and by releasing data on the sex composition of their workforces (see Forrest 2014). Increasingly, tech companies are expanding parental leave opportunities for men and women—Microsoft and Netflix now offer unlimited leave during the first year after a birth or adoption (Kell 2010).

Meanwhile, the tech field is both becoming more internationally diverse while increasingly sex-segregated. By 2000, the height of the tech boom, demand for H-1B visas (the main temporary work visa for foreign-born workers with specialized skills) routinely exceeded the 65,000 visa limit (Banerjee 2010; GAO 2011). The demand for immigrant workers was

punctuated, at the time, by a series of testimonies provided to the US Congress by leaders in the tech industry, including Bill Gates, CEO of Microsoft. In response, Congress raised the cap on H-1B visas but demand continues to exceed even these higher limits. As of April 7, 2014 the H-1B visa limit for 2015 had already been reached (United States Citizenship and Immigration Services 2014). Now the large number of foreign-born workers is a key characteristic of the tech workforce. Roughly 40% of H-1B visas granted between 2000 and 2009 were granted to companies to hire systems analysts and programmers (GAO 2011)⁵.

Research suggests that the tech industry's heavy use of H-1B visas has a downward pull on wages overall, especially for the workers on these visas (GAO 2011; Matloff 2013). H-1B visas are entirely dependent on employers—the employer must submit the visa application and continuous employment is a key requirement for maintaining the visa. These visa requirements mean that workers on H-1B visas are especially vulnerable to exploitation by employers (Banerjee 2010; Matloff 2013). While employers are technically required to pay workers on H-1B visas the going market rate for their work, a variety of loopholes make it possible to pay lower wages (GAO 2011; Matloff 2013).

Workers coming from regions with high wages and strong social welfare states, like Western Europe and Canada, are likely to be able to negotiate for higher wages and better benefits than those from countries with lower wages and weaker social welfare states, like India and China (Avent-Holt and Tomaskovic-Devey 2010). For workers from countries with pay scales similar to or higher than the US, wages may be higher for foreign-born than US-born workers. Similarly, for workers from countries where pay scales tend to be lower, US firms may be able to entice skilled workers to leave home for lower wages. Stereotypes about Asians' skills with

⁵ The next largest occupation category for H-1B visa holders is college/university education, which only accounts for 7% of H-1B visas (GAO 2011).

computers and technical work may also lead employers to value their contributions more highly than other workers' (Oyserman and Sakamoto 1997; Shih et al. 1999; Tashiro 2009).

The literature on women in computing and related sciences reveals the challenges that women and workers of color face. First, the culture of computing is often described as hostile toward women, valorizing white male "geek culture," diminishing women's ability to do computing work, and leaving non-Asian workers of color virtually invisible (Margolis and Fisher 2002; Dasgupta 2011). Kendall (2011) demonstrates the strong ties between the image of nerds and computers as well the centrality of whiteness and masculinity (and rejection of Blackness and hip hop culture) to the nerd stereotype. Asians are also stereotyped to be particularly talented with quantitative subjects and thus well-suited to computing (Oyserman and Sakamoto 1997; Shih et al. 1999; Tashiro 2009).

Margolis and Fisher (2002) conducted longitudinal interviews with computer science students and faculty, observed classrooms, and surveyed classes at Carnegie Mellon University to find out about students' experiences with computing and their career aspirations. They find that teachers and curricula demonstrate that men are expected to excel and women to struggle with computing (Margolis and Fisher 2002). Research on gender and engineering, a field similar to tech in its small numbers of women and high numbers of foreign-born workers, provides additional tools for understanding the computing workforce. McIlwee and Robinson (1992) find that engineering culture has an expectation that engineers are driven and passionate about their work. They describe reports of job interviews where candidates are asked what they do in their free time and the successful female interviewees knew that the correct answer is some variation of 'tinker' (McIlwee and Robinson 1992). The women they interviewed tended to have low levels of confidence in their technical skills and report at least some disparaging interactions with male classmates, despite having strong academic records (McIlwee and Robinson 1992).

More recently, Cech et al. (2011) find that professional role confidence—belief in one’s ability to meet the role, tasks, and identity of a successful professional—is a significant predictor of women’s persistence in engineering.

Intersectionality, Inequality, and Tech Work

Studies of labor force inequality do not consistently recognize how demographic attributes intersect in particular occupational fields. An extensive review of literature on the sex gap in pay shows that women earn less than men on average and that occupational sex-segregation contributes to income inequality (Reskin and Roos 1990; Petersen and Morgan 1995; Cotter, Hermsen, and Vanneman 2003; Levanon, England, and Allison 2009; Charles 2011; Perales 2013). Yet, a sex pay gap remains even within occupations.

I focus on wages to examine inequality among tech workers. Tech work is a specific context with particular biases around gender, race/ethnicity, and nationality. Although white and Asian men dominate tech work, it has many initiatives to incorporate underrepresented groups. The field is also internationalizing, which adds yet another layer of complexity. Tech occupations employ roughly six times more workers on H-1B visas than the next largest occupation (GAO 2011). How might the wages of tech workers reflect not only sex, but also the race/ethnicity and nationality of the workers?

Data and Variables

I use data from the 2008-2013 American Community Survey (ACS) from the Public Use Micro Series (PUMS) to examine the wages of US-born white men and women, US-born underrepresented minority men and women, US-born Asian men and women, foreign-born Asian men and women, foreign-born Western men and women, and men and women from the non-Asian Global South. The ACS is a national random sample of 5% of households. I limit the

sample to full-time, working-age adults in 1 of 17 computing or related occupations using census occupation categories⁶.

Variables

Dependent Variable

I use *logged average annual hourly pay* as the dependent variable. This measure accounts for the number of hours and weeks workers actually work. I estimate hours worked by multiplying hours worked last week by weeks worked last year. I divide total income by hours worked to create a measure of average hourly income for the year. This is an imperfect measure since usual hours worked may not be the same across the whole year; however, it is preferred in the stratification literature, where wage comparisons are common, because it adjusts for the number of hours worked (e.g., Branch and Hanley 2011). Similar results are achieved when using annual income and including controls for usual hours worked per week and weeks worked last year. The advantage of average annual hourly wage is that the resulting predicted wages are relatively small numbers that can be easily compared.

Independent Variables

US-born white men and *US-born white women* are those born in the US (or abroad to American parents) and who report their race as white or Caucasian. *US-born underrepresented men* and *US-born underrepresented women* are those who were born in the US (or abroad to American parents) and may report their race as Black, Hispanic, Native American, mixed-race, or other. Asians are a small racial group in the US, but they are not underrepresented among tech

⁶ Census computing and related occupations are Computer and Information Systems Manager, Computer Scientists and Systems Analysts, Computer and Information Research Scientist, Computer Systems Analyst, Computer Network Architects, Network Systems and Data Communications, Information Security Analysts, Computer Programmers, Web Developers, Software developers and engineers, Computer Support Specialists, Database administrators, Network and Computer Systems Administrators, Computer Hardware Engineers, Electrical Engineers, Computer Operators, and Other computing occupations not elsewhere specified.

workers, thus they are not grouped with underrepresented minorities. *Asian-American men* and *Asian-American women* are those who identify their race as Asian and were born in the US (or abroad to American parents).

The experiences of migrant workers are likely to vary based on country of origin. To capture this variation, I disaggregate by sending region. Ideally, I would have conducted analyses by country but the small numbers of migrant workers from many countries made such detailed analysis impossible. To balance group size with salient racial and migration experiences, I use three foreign-born categories: *Western men* and *Western women*, *Asian men* and *Asian women*, and non-Asian *Global South men* and non-Asian *Global South women*.

Western men and *Western women* are those from Canada, Europe, Australia, and New Zealand. These workers are likely to be white and come from countries with long histories of migration to the US. Russia is the largest sending country in this group. *Asian men* and *Asian women* include those who came to the US from the Asian continent or the Philippines. While all of Asia is included in the Asian group, roughly 75% of these workers are from China or India.

Non-Asian *Global South men* and *Global South women* workers come from Africa, South and Central America, island nations such as the West Indies, and the Middle East. The majority of these workers are from Mexico, the West Indies, Africa, and South America. Most, though not all, non-Asian Global South workers would be considered racial minorities in the US, although they may not share US based understandings of race. For example, among tech workers in the US, nearly all Egyptians identify their race as white for the purposes of the US Census; however, many Egyptians would not experience whiteness in the US as US-born whites do.

Control Variables

In addition to the demographic measures, I include controls for *education, potential experience, occupation, industry, marital status, and field of study*⁷. *Education* is a categorical variable for highest degree completed. *Potential experience* is the difference between respondents' age and their years of education, which gives the number of years they could have spent not in school and working. *Occupation* and *industry* are coded from the US census designations for each year. *Industry* is collapsed into fifteen broad census categories. *Marital status* is a binary variable where married is coded 1. *Field of study* is coded into five categories: no post-High School degree; Computing Science, Engineering or Math degree; Other STEM degree; and Non-STEM degree.

Methods

The analytic strategy I employ accounts for the possibility that patterns of advantage and disadvantage in wages will be wholly different across intersecting demographic categories. Typical regression methods use dummy variables to literally add a bonus or subtract a penalty from one set of coefficients for being a member of one group as opposed to another. I use the Blinder-Oaxaca decomposition technique, which uses multiple models for each comparison. Consequently, it does not rely on the dummy variable approach and allows me to model sex, race, and migration status simultaneously instead of additively.

⁷ Separate analyses showed that immigration related variables that typically predict wages, completing education in the US, English fluency, US citizenship, and years in the US, were not significant predictors of wages for immigrant tech workers.

Decomposition

I use the Blinder-Oaxaca decomposition technique to examine potential differences in the returns to income generating characteristics. Each group is compared to a base category, in this case, US-born white men. Blinder-Oaxaca decomposition modeling uses a set of OLS regression equations to create a counterfactual framework. In this instance, I ask what income US-born white men would receive if they had the characteristics of and received the same treatment as workers from each sex/race/immigration group. I then compare these wage estimates to the actual earnings of US-born white men. If all factors that contribute to wage determinations are controlled, then the remaining “unexplained” pay gap can be attributed to discrimination. Controlling all contributing factors is unlikely, particularly controlling hard to measure factors such as productivity and motivation; however, the “unexplained” portion of the gap can be thought of as at least an indicator of discrimination.

Using data from the 2008-2013 ACS, I estimate OLS regression equations separately for each of 12 demographic groups of interest and compare each to the regression estimates for US-born white men. These models include controls for *occupation* and *industry*, *education*, *potential experience*, *potential experience squared*, *US region of employment*, and *marital status*. Separate analyses for each occupation are not possible due to small sizes of some groups in some occupations⁸.

Each group is paired for comparative analysis against the base group using a pooled model. Since US-born white men are the majority of computing workers and set the cultural standards in tech work, they are used at the base group. This comparative analysis means that

⁸ I do not include controls for children in the decomposition models. If children have different effects on men’s and women’s wages, that will remain as part of the “unexplained” wage gap, which is to say it could be considered part of any income disadvantage women face. If men experience a bonus related to children and women experience a penalty as the literature suggests (see Hodges and Budig 2010), that is evidence of discrimination.

the effects of independent variables are estimated completely separately across the models, allowing the returns to characteristics such as education and occupation to be different for each group. The resulting models yield a predicted wage for both groups based on mean characteristics on all predictor variables and a percentage gap between the groups' predicted wages. This gap is decomposed into the percentage that can be explained by differences in the predictors and the percentage that cannot. For example, US-born white men earn a predicted wage of \$33.66 per hour and US-born white women earn a predicted wage of \$28.58 per hour. There is an 18 percent difference and, of that, 4 percent can be attributed to differences in the predictor variables (such as having fewer years of education on average or working in lower paying industries). The remaining 14 percent is unexplained. The unexplained and explained differences sum to approximately the value of the pay gap (with a tolerance for rounding).

I perform the Blinder-Oaxaca technique⁹ using the Oaxaca package written by Ben Jann for Stata (2008). Categorical independent variables in Blinder-Oaxaca decomposition present a potential problem since the estimates are sensitive to the choice of base category. Thus, I normalize categorical variables as deviations from a grand mean.

Findings

Descriptive Findings

Figure 5 shows the representation in tech and the US workforce overall for each group. US-born white men are the majority of computing workers. US-born white women are the next

⁹ Since there are more than two groups for comparison in this analysis it is tempting to use Neumark decomposition, which would decompose wages for each group against a pooled model for all workers. However, native born white men make up over half of computing workers thus comparisons to the all workers group would be heavily influenced this group, making the comparison of US-born white men to all workers misleading. Second, as Zhou and Shyr (2009) show, Neumark decomposition only provides unbiased estimates in the non-discrimination case, while Blinder-Oaxaca decomposition reliably provides unbiased estimates regardless of the presence of discrimination and allows for significance tests of the decomposition results.

largest group at 17 percent, followed by Asian men at 10 percent and Asian women at 4 percent. Across all race and migration groups, women make up a smaller share of computing workers than their male counterparts. However, the most dramatic underrepresentation is for US-born white women and minority women whose participation in tech is roughly half of their participation in the overall US workforce. Both Asian men and women have a higher

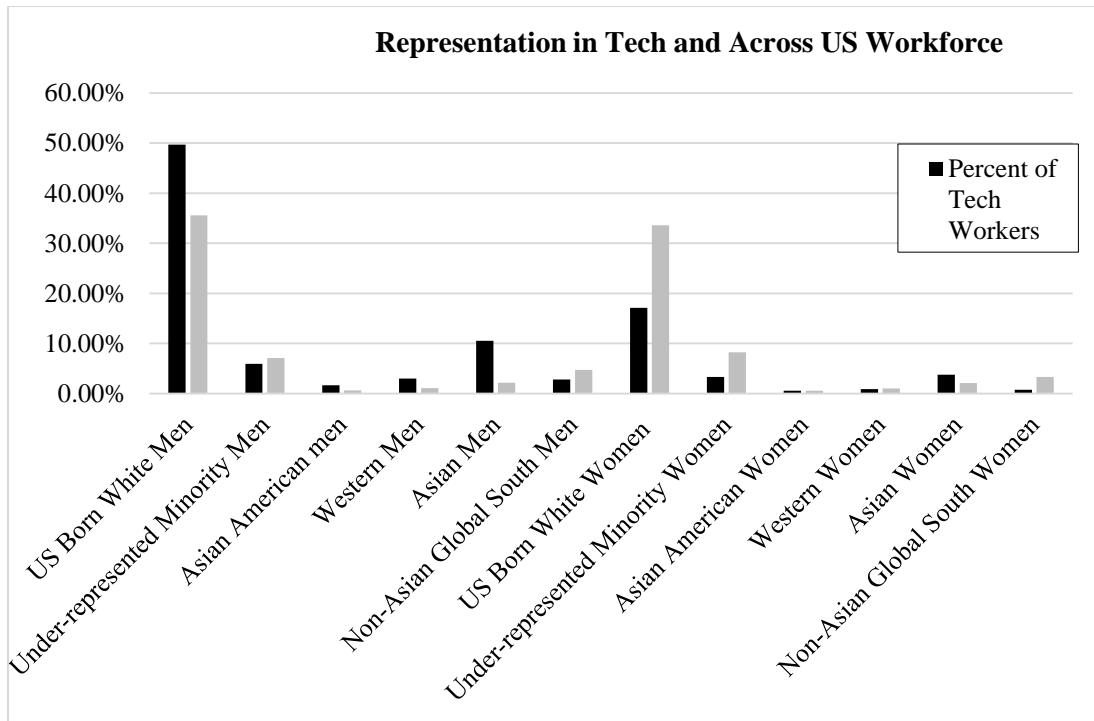


Figure 5. Representation in Tech and Overall Workforce, by group

representation in tech than in the larger US workforce, but this overrepresentation is much more pronounced for men, who are more than four times more likely to work in tech than elsewhere in the US labor force. Western men are roughly three times more likely to work in tech than elsewhere. Asian-American men are two times more likely to work in tech than other jobs in the US workforce. Asian-American women’s representation is nearly equal in tech and the larger workforce. Workers from the non-Asian Global South have lower participation in tech, though men’s representation is much nearer to equal than women’s.

Table 1 shows the means and standard deviations of the average hourly wage for each group. Tables 2 and 3 show the distribution of each group of workers and median hourly wages across occupations, degree attainment, and field of study. While US-born white men are the largest group, they neither command the highest wages nor possess the most education. In general, foreign-born workers tend to be better educated than their US-born counterparts, particularly Asian and Western immigrants.

Table 1. Average hourly wage by demographic group

	Average hourly wage	(Standard Deviation)
US-born White Men	\$39.83	(\$45.02)
Under Represented		
Minority Men	\$34.04	(\$29.88)
Asian-American Men	\$38.58	(\$34.00)
Western Men	\$50.52	(\$61.86)
Asian Men	\$47.05	(\$34.97)
Non-Asian Global		
South Men	\$39.20	(\$30.08)
US-born White		
Women	\$34.12	(\$75.40)
Under Represented		
Minority Women	\$31.02	(\$43.27)
Asian-American		
Women	\$37.19	(\$25.94)
Western Women	\$40.50	(\$24.77)
Asian Women	\$41.83	(\$41.60)
Non-Asian Global		
South Women	\$33.03	(\$22.35)

The modal degree for all groups, except for Asian immigrant workers, is a bachelor's degree.

Though few workers hold doctorates, Western men (6.67 percent) and Asian men (5.55 percent) are the most likely to have one. The modal degree for men and women from Asia is a master's degree. US-born underrepresented minorities are the least likely to hold an advanced degree (11.74 percent of men and 14.26 percent of women), while US-born white men and women hold advanced degrees at only slightly higher rates (16.06 percent of men and 15.09 percent of

women). US-born white and underrepresented minority workers also have less than a bachelor's degree at higher rates than other workers, which is not surprising as it would be more difficult for workers without higher education to attain visas.

As shown in Table 3, the highest paying tech occupations are Computer and Information Systems (CIS) Management (\$42.42) and Software Developers and Engineers (\$42.58). CIS management is not a large occupation for any group, but a larger percentage of US-born white women hold these jobs than other groups (16.06 percent). Software developing and engineering is the modal occupation for all groups except US-born, underrepresented minority men and women, who are more concentrated as computer support specialists, and US-born white women, who are more likely to be CIS managers.

Multivariate Findings

Table 4 and Figure 6 show the results of the decomposition analysis, which shows the portion of the wage gap explained by the factors in the model and the portion that remains unexplained. The pay gap is the percentage above or below the average pay for US-born white men that each group receives. A value of 0 would indicate no pay gap, negative values indicate the percent of hourly pay the US-born white men earn above the group while positive values indicate the percentage US-born white men earn below than the group. For example, the pay gap for US-born white women is -18percent, indicating that US-born white women have salaries that are 18percent below US-born white men on average. The part of the gap that is explained by differences in the variables in the model (age, occupation, geography, industry, marital status, and children) is the percent explained (in this case 4 percent), while the unexplained gap is the gap in wages that is not explained by the model, in this case 14 percent.

Table 2. Distribution of workers and median hourly wage in occupations, by group

	Median Hourly Wage	US-born White Men	Under Represented Minority Men	Asian-American Men	Western Men	Asian Men	Non-Asian Global South Men	US-born White Women	Under Represented Minority	Asian-American Women	Western Women	Asian Women	Non-Asian Global South Women
Degree													
Less than High School	\$21.79	0.40%	1.10%	0.23%	0.41%	0.37%	1.65%	0.45%	1.34%	0.57%	0.27%	0.38%	2.73%
High School	\$26.96	24.94%	35.15%	16.78%	13.11%	4.29%	19.59%	29.79%	36.33%	16.60%	12.13%	3.47%	25.76%
Associate's	\$28.92	11.75%	13.93%	6.29%	6.53%	2.49%	10.02%	11.94%	11.73%	4.31%	6.85%	2.34%	8.30%
Bachelor's	\$37.25	46.86%	38.08%	56.76%	41.43%	42.33%	43.03%	42.73%	36.34%	56.06%	42.47%	42.47%	39.33%
Master's or Professional	\$44.51	14.92%	11.25%	18.37%	31.84%	44.97%	23.08%	14.41%	13.90%	21.89%	34.80%	48.13%	22.48%
Doctorate	\$52.29	1.14%	0.49%	1.57%	6.67%	5.55%	2.63%	0.68%	0.36%	0.57%	3.48%	3.20%	1.39%
Total	--	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Field of Study													
No Degree	\$27.45	34.24%	46.64%	21.76%	18.46%	6.66%	28.95%	38.96%	45.80%	20.02%	18.00%	5.70%	33.45%
Computer Science, Engineering, and Math	\$42.28	31.17%	25.89%	44.23%	53.98%	69.37%	45.77%	15.82%	17.21%	28.15%	41.76%	57.63%	30.73%
Other STEM	\$40.85	4.41%	2.59%	5.16%	6.42%	5.98%	3.07%	5.10%	3.65%	7.89%	5.98%	8.38%	4.12%
Non STEM	\$35.54	30.18%	24.88%	28.85%	21.13%	17.99%	22.22%	40.12%	33.33%	43.94%	34.26%	28.28%	31.70%
Total	--	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

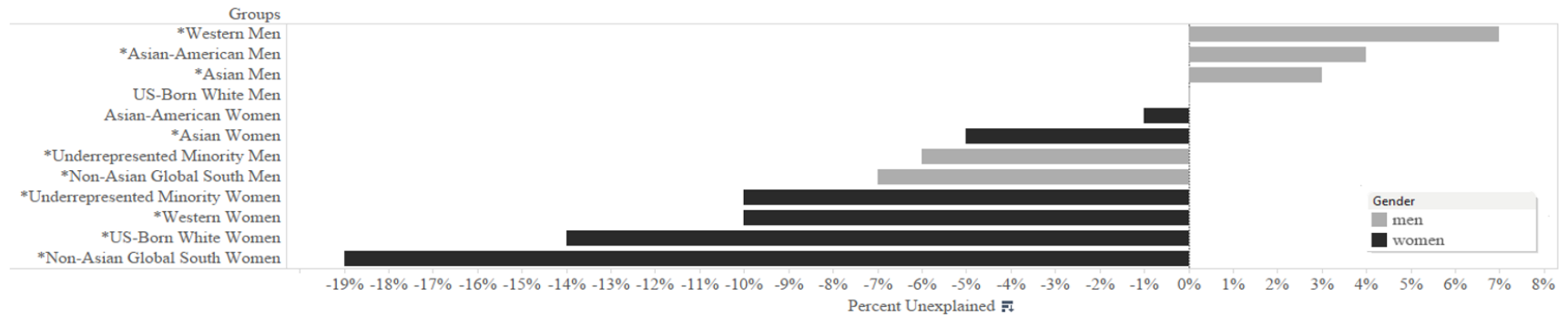
Table 3. Distribution of workers and median hourly wage in tech occupations, by group

Occupation	Median Hourly Wage	US-born White Men	Under Represented Minority Men	Asian-American Men	Western Men	Asian Men	Non-Asian Global South Men	US-born White Women	Under Represented Minority	Asian-American Women	Western Women	Asian Women	Non-Asian Global South Women
Computer and Information Systems Management	\$42.42	12.73%	10.26%	8.60%	12.33%	8.93%	10.80%	16.06%	12.35%	13.34%	13.59%	7.86%	11.70%
Computer Scientists and Systems Analyst	\$34.07	4.39%	5.28%	4.59%	3.57%	4.01%	4.40%	5.84%	6.37%	5.94%	4.95%	4.20%	6.00%
Computer and Information Research Science	\$41.89	0.25%	0.17%	0.26%	0.45%	0.22%	0.20%	0.27%	0.29%	0.08%	0.65%	0.30%	0.30%
Computer Systems Analyst	\$34.93	6.52%	6.98%	7.86%	6.25%	7.53%	7.35%	11.53%	12.16%	14.65%	11.80%	9.65%	12.67%
All other computer occupations	\$29.33	6.14%	9.72%	7.35%	3.70%	4.40%	6.56%	5.62%	7.62%	5.53%	3.32%	3.36%	5.64%
Computer Network Architects	\$41.28	2.01%	2.09%	1.40%	2.01%	1.82%	2.14%	0.57%	0.46%	0.90%	0.44%	0.79%	0.73%
Computer Network Systems & Data Comm.	\$31.00	2.16%	2.73%	2.31%	1.48%	1.10%	1.67%	2.13%	1.86%	1.46%	1.85%	1.19%	1.94%

Table 4. Results of decomposition analysis of wages among computing workers

	US-born White Men	Under-represented Minority Men	Asian-American men	Western Men	Asian Men	Non-Asian Global South Men	US-born White Women	Under-represented Minority Women	Asian-American Women	Western Women	Asian Women	Non-Asian Global South Women
Predicted hourly pay	\$33.66	\$28.47	\$31.91	\$42.14	\$41.34	\$32.78	\$28.58	\$34.82	\$30.64	\$34.82	\$36.51	\$27.41
Pay Gap		-18%**	-5%**	20%**	19%**	-3%**	-18%**	3%*	-10%**	3%*	8%**	-23%**
Percent Explained		-12%**	-10%**	16%**	16%**	4%**	-4%**	12%**	-9%**	12%**	13%**	-3%**
Percent Unexplained		-6%**	4%**	7%**	3%**	-7%**	-14%**	-10%**	-1%	-10%**	-5%**	-19%**

40



* Significantly different from US-born white men, p<.05

Figure 6. Results of decomposition analysis of wages among computing workers

With characteristics controlled, the remaining unexplained wage gap in Blinder-Oaxaca decomposition is generally understood to be a rough estimate of discrimination, although the effects of any unmeasured variables would also contribute to the unexplained gap. For example, in the overall model, US-born white women experience a 4 percent wage penalty due to their characteristics and 14 percent penalty that cannot be explained by the variables in the model. In other words, if US-born white men had the same characteristics (had the same education level, worked in the same industry, etc.) as US-born white women, they would receive pay that is 4 percent lower than what they currently earn on average. On the other hand, even if US-born white women had the same characteristics as US-born white men, they would still get paid 14 percent less.

In the overall model, with controls for occupation and industry, all women experience a wage penalty unexplained by their human capital, demographic, and work-related characteristics compared to US-born white men, except for Asian-American women (Asian-American women's 1 percent penalty is not statistically significant, $p < .05$). US-born, underrepresented minority women have characteristics that, if they were treated the same, should earn them 12 percent more than US-born white men; however, they experience an unexplained penalty of 10 percent. Asian and Western immigrant women have characteristics that ought to earn them higher pay than US-born white men, 13 percent and 12 percent respectively, though both groups experience unexplained wage penalties of 5 percent and 10 percent respectively. Women from the non-Asian Global South experience the largest penalty, a total of 23 percent of US-born white men's wages. Only a small part, 3 percent, is explained by the model. The remaining 19 percent is unexplained.

There are considerable differences among men as well as between men and women. Underrepresented minority men earn 18 percent less than US-born white men. Though most of

this difference, 12 percent, is explained by differences in their characteristics (6 percent is left unexplained). Similarly, Asian men earn 19 percent more than US-born white men, with 16 percent explained by their characteristics and a small 3 percent premium left unexplained. Western men earn 20 percent more than US-born white men and, while 16 percent of these higher earnings are explained, they receive a 7 percent premium that cannot be explained by their characteristics. Non-Asian Global South men appear to have nearly the opposite experience. They are paid 3 percent less than US-born white men on average; however, their characteristics should earn them 4 percent more, which they do not receive due to a 7 percent unexplained penalty.

Discussion and Conclusion

The decomposition analysis shows evidence of race and sex bias in the wages of computing workers. Some, but not all, foreign-born workers receive wage premiums. Women, with one exception, experience wage penalties that cannot be explained by the education they have, the work they do, the part of the country where they work, or other predictors. For women from the Global South this unexplained penalty is 19 percent. Women's work, regardless of education, occupation, field of training, industry, or age, does not garner pay equal to men's in tech work – despite the industry push to recruit more women.

Foreign-born workers might be expected to receive wage premiums since their pay would need to be high enough to compel them to work in the US rather than in their home country or another country with high wages for skilled technical workers. Workers from Western countries come from places with high wages; thus we might reasonably expect Western workers would receive larger premiums. This was the case for Western men but not for Western women.

These findings also show that Asian men receive a race premium compared to all other workers – both for Asian immigrants and Asian-American workers. In stark contrast, women from the non-Asian Global South experience a tremendous 19 percent unexplained penalty. Consider that a 19 percent penalty on the average wage for a tech worker with a bachelor’s degree (\$37.25 per hour) would add up to a little less than \$15,000 annually. Over a forty-year career this penalty amounts to well over half a million dollars—enough to purchase a home in the notoriously expensive Silicon Valley area (National Association of Realtors, 2015)

Race complicates this story further. US-born men of color experience a 6 percent, unexplained penalty relative to US-born white men. US-born women of color experience a 10 percent penalty; this suggests that they are penalized less than US-born white women but more than underrepresented men. Among US workers, there is a slight preference for Asian workers and a race penalty for other workers of color. While white and Asian immigrant workers benefit from wage premiums in most cases, Non-Asian Global South workers, the majority of whom are Latino, Central or South American, or part of the African Diaspora, experience penalties: 7 percent for men and 19 percent for women. The only men who experience a wage penalty are those who would largely be thought of as racial minorities in the US context. Black- and brown-skinned immigrant workers suffer for their race and their nationality in addition to the penalty that women face.

The patterns of inequality found in this analysis do not suggest multiplicative or additive disadvantage. Instead of a coherent queue, or order of preference for workers, the pattern of inequality reflected here is wholly intersectional and cannot be reduced to additives or multiples of vectors of inequality. For example, immigrants do better if they are from Asia or the West. There are very small differences between US-born and foreign-born Asian workers, suggesting immigration status matters less among Asian workers than among other groups. In general, men

earn higher wages except native born minority men and Global South immigrant men, who earn lower wages than Asian-American women. The finding of no wage penalty for Asian-American women suggests limits to the strength of a singular sex effect; for this group, racialized assumptions about Asian-American's proclivities for tech work may undermine gender stereotypes. Underrepresented minorities do worse; yet, underrepresented minority women actually experience smaller penalties than white women, even though they do not fare as well as underrepresented minority men.

This study used an intersectional approach to investigate wages in tech work across race, sex, and migration. The analysis shows that inequality in tech work is shaped by race, sex, and immigration status, but not necessarily in ways that previous research on wage inequality would predict. By employing an intersectional framework, this study showed how sex, race, immigration, and specific fields simultaneously shape inequality in historical context. Tech work is a specific work context where workers regularly work on international teams, rely on skills that change rapidly, and create products for consumer market that span the globe.

The patterns of inequality uncovered in this analysis of tech work differ considerably from other studies of wage inequality, demonstrating the importance of intersectional analysis. A less contingent understanding of intersectionality would predict that all women would be paid less than men, and that women of color would be paid less than men of color. That is not what I found. US-born underrepresented minority women actually experience smaller penalties than US-born white women and Asian-American women experience no discernable penalty.

Computing is a field under pressure, both internal and external, to diversify. These pressures represent challenges to existing gender and race relations in the field. In the case of US-born minority women, the challenges may be beginning to have an effect—while these women experience a considerable wage penalties compared to most groups, they have a

smaller penalty than white women. They may be thought of as “unicorns” in the field (Bell 2013) due to their low representation, but it seems pay for “unicorns” is at least better than expected (relative their disadvantage in other fields at least). This could be due to companies feeling a push to diversify and offering more competitive wages to hard to find minority workers. It could also be that the US-born underrepresented minority women who persist in computing despite the masculine culture of the field and countless messages that they do not belong are highly focused and motivated about their work.

Citizenship seems less important, at least in terms of wages, than it is in other fields; however, immigrant workers still face significant legal constraints that limit their rights compared to native-born workers. The limited supply of skilled native-born tech workers means that immigration is important to the field and citizenship is not serious factor in wage setting. Yet, the conditions of H-1B visas mean that, as Glenn (2002) points out, citizenship still provides boundaries around those whose rights are respected and protected. Immigrants’ wages are not lower, but their documentation to live and work in the US is a privilege that employers grant and can take away.

Tech jobs are arguably the model of work in the new knowledge-based economy. Tech work, in many respects, is different from more traditional work in which workers communicate with coworkers who are primarily in the same building, and rely on skills that, once learned, remain relevant. The labor involved in doing tech work is different from that of manufacturing or teaching, for example. It is an emerging field where race and gender relations are actively being contested and ideas of appropriate labor (1) do not match other professional fields and (2) may be in flux. By examining wage inequality in tech work intersectionally, I found that field context matters for inequality. Patterns of inequality that describe work in the 21st century, knowledge-based economy may be different from the patterns that best described labor force

inequality in the past. As the nature of work and the structure of workplaces in the US change, social scientists must continually re-evaluate what we know about inequality.

This study has implications for efforts to increase diversity in tech work. First, if employers do not value underrepresented workers then efforts to recruit them are bound to fail when these workers leave the field discouraged by low pay. Many major tech companies are leading the way by support broadening participation initiatives, but they need to go further and publically lead the way in ensuring equal pay. Second, considering US-born minority women's lower wage penalty, efforts to recruit and support these women be highly successful for increasing women's representation overall. If advocates for diversity in computing are sincere, a critical step towards inclusion is ensuring that once underrepresented groups enter computing they are treated with respect and their contributions are valued.

CHAPTER 3

TRANSLATORS OR ENGINEERS: GENDERED LABOR IN TECH WORK

Over the past 40 years, women have entered professional work in large numbers, effectively increasing gender integration in professional and managerial workplaces (Stainback and Tomaskovic-Devey 2012). Despite the trend toward integration, there are some fields that are especially resilient to gender integration. Computing, or tech work, is one such field. Women's representation in computing peaked in the early 1990s and has actually decreased since then (Hays 2010)¹⁰. Similar to Kanter's (1977) research on token women (in positions where less than 15% of workers are women), the literature on women in engineering, where they are often tokens, finds that women experience hostile environments, working conditions that do not allow them to balance work and family life, and workplace demands that either cast them as feminine but ineffective or effective but unfeminine (McIlwee and Robinson 1992; Herman, Lewis, and Humbert 2013; Evetts 1997; Etzkowitz, Kememlgor, and Uzi 2000).

While women who are tokens typically experience disadvantages, this is not the case for men who are tokens in women-dominated occupations (Williams 1995; Budig 2002; for a review, see Wingfield and Myles 2014). Research on men who are tokens in occupations where women are the majority of workers demonstrates a tendency for men to be pushed into positions of authority that emphasize masculine characteristics such as ambition and rationality (Williams 1995; Budig 2002; Simpson 2004). These counter-examples push researchers to consider how workers and workplace organizations understand the work that token groups perform. Women's underrepresentation, yet high desirability in tech work, offers us an opportunity to examine the relationship between gender and tokenization. Learning about the

¹⁰ Most major tech companies have signed on to campaigns and pledged financial support to initiatives designed to recruit and retain women (see National Center for Women Information Technology members for example).

work women do and the experiences they have in the field can shed light on why some fields have failed to integrate, despite the broader trend toward integration in professional occupations (Stainback and Tomaskovic-Devey 2012).

As tech companies move towards a global business model with teams and business partners across the world, their communication and coordination needs increase (Kelan 2008). The need for coordination across large companies has created managerial jobs that require technical team leaders who can communicate technical information to the rest of the company (Kelan 2008; Guerrier et al. 2009). Women in tech are more likely to be in what Guerrier et al. (2009) describe as “less technical positions” that blend technical and interpersonal skills. Some of these positions are low-wage customer support positions, but others are high-paying, highly influential management positions. If women in tech do move into management, the process could be similar to the “glass escalator” Williams (1995) describes for men who are tokens in occupations dominated by women, but who move into supervisory positions more consistent with stereotypical masculinity. Engineering, especially computer-related engineering, emphasizes masculinized traits—interest in technical detail, ability to work for extended periods, and poor interpersonal skills (Guerrier et al. 2009; Evetts 1998; Powell, Bagilhole, and Dainty 2009). Even though management is typically associated with men, tech management work requires less technical work and emphasizes more social and interpersonal skills than engineering (Evetts 1998; Guerrier et al. 2009). For women in tech, like men in nursing, a promotion into management would ease the mismatch between normative gender expectations and the skills typically associated with the job.

Williams (1995) demonstrates a tendency for men who are tokens to ride a “glass escalator” into positions of authority partly because they seemed “appropriate” for supervisory positions, which is where most of the other men in the organization were located. This early

research on male tokens, like the research on female tokens, did not consider how race might complicate men's gendered advantage in occupations numerically dominated by women.

Harvey Wingfield (2009) demonstrates that black men nurses do not ride the glass escalator into supervisory positions when they are gender tokens. Black men did not engage in the activities and relationships that led to white men's advancement. They did not form strong relationships with supervisors, did not distance themselves from femininity as nurses, and did not identify with the white men in higher-up positions the way that white male nurses did (Harvey Wingfield 2009). Consequently, I examine the intersections of race and gender in this analysis of tech workers' career paths and workplace experiences.

I draw on interviews with 45 tech workers to investigate how women and men understand technical jobs, what skills and activities their jobs require, and the occupational path to their current positions. I consider a tech worker to be someone who is involved with the production of computer hardware, software, or networks. I push this analysis beyond gender and examine how race and immigration status further complicate technical work for under-represented groups. This analysis examines how men and women describe their work as well as the different positions that men and women hold in their workplaces. Women are less likely to enter computing and more likely to leave. When women do persist and work in tech jobs, they work in gendered organizations designed for the unencumbered ideal masculine worker who can work very long hours (Acker 1990). All of these challenges make it hard to imagine how women could work in tech at all—but there are successful women in tech work. This paper asks: what kinds of tech work do women in the US perform? Are the jobs that women do valued? Are there further differentiations among workers by race and nation of origin?

Appropriate Labor

I draw from and build on Wooten and Branch's (2012) concept of appropriate labor to understand how the labor related to occupations and the constructs that shape how we understand identity categories can be articulated through one another to shape which workers are seen as appropriate for certain jobs. Wooten and Branch (2012) argue that in a particular moment in US history black women seemed to be a natural fit for domestic work. They write, "appropriate labor conveys the notion of a negotiated ideal indicating who has been collectively defined as suited for a particular type of work. Importantly, these negotiations provide a justification for why a group is represented in one occupation as opposed to another" (:292). The association between black women and domestic work was part of the racial and gender formation of black femininity. White women were able to move out of domestic work and into factory work at this time, while black women were stuck in jobs that other workers with more options chose to avoid. Glenn (2002) similarly demonstrates that work is important for defining and differentiating racial/ethnic and gender groups. She argues that "race and gender have been simultaneously organizing principles and products of citizenship and labor" (2002: 236). In other words, Glenn, like Wooten and Branch, sees race/ethnicity and gender as integral to how we understand particular labor activities.

Researchers have documented labor preferences tied to racialized and gendered notions of suitability across fields. Hossfeld (1994), in her interviews with employers and workers in Silicon Valley's semiconductor assembly plants, demonstrates that employers have clear preferences to hire Asian women who, they believe, are better suited to the mundane, repetitive tasks and low wages these jobs offer. Similarly, Salzinger (2003) demonstrates global manufacturing's reliance on and production of third-world women's supposedly natural docility and dexterity. Catanzarite (2000) argues that "[E]mployers have some latitude in setting working

conditions and wages; they can manipulate working conditions and worker requirements to shape the occupation for a particular labor source” (2000:48). Salzinger (2003) and Catanzarite (2000) demonstrate that more than managers having ideal workers in mind for specific jobs, the relationship between work and the ideal worker is a productive one. Working conditions and workers’ identities can be mutually constituted: managers can shape the conditions of the work depending on who is doing it (Catanzarite 2000; Salzinger 2003).

The relationship between workers and work is not simply one directional. For Wooten and Branch and Glenn, work is important to defining and differentiating workers. However, how we understand the labor required to work in different occupations is at least as socially determined and subject to change as the formations of the identities of the groups doing the work. This point is particularly salient in regard to the development of computing-related occupations.

Computing is a relatively new field. When the field was developing, it was not yet clear what skills core computing jobs, such as programming, would require (Haigh 2010). Programming involved large amounts of typing and, in that way, resembled keypunch operating (Haigh 2010). Keypunch operating was a clerical job and keypunch operators were overwhelmingly women (Haigh 2010; Branch 2010). Initially, keypunch operators were actively recruited to become computer programmers; however, as computing developed as a field programming became more highly valued, professional organizations emerged, and credentials indicated skilled programmers. Women were effectively pushed out of the field, and, by the early 1990s, women’s participation in programming peaked and had begun to decline (Haigh 2010). Now, there is a greater emphasis on math and logical thinking instead of typing as needed skills for programming. Of course, programming still requires long hours spent at a

keyboard and programming in the 1970s also required logical thinking; however, the emphasis shifted as the demographics of the workers changed.

Programming is not the only occupation where the skills that seemed necessary to do the work and the gender of the workers shifted together. Irvine and Vermilya (2010) demonstrate the work and skills required for veterinary medicine also changed when women entered the field. Women were more or less barred from studying veterinary medicine until the Civil Rights Act made it costly for schools to exclude women on the basis of gender. Women's participation in veterinary medicine began to rise around the time that the profession shifted to a "bond-centered" approach to caring for both the physical well-being of the animal and the emotional well-being of the human pet owner (Irvine and Vermilya 2010). In other words, women's participation in veterinary medicine coincided with an increased emphasis on feminine-typed emotional labor. Irvine and Vermilya (2010) interviewed veterinarians who recalled professional journals publishing articles extolling the benefits of having more women in the field because they would bring a "kinder, gentler element" to the profession (2010:64). The skills emphasized for veterinarians and the demographics of veterinarians shifted together so that, as more women entered the field, veterinary medicine emphasized more feminine-typed emotional labor.

Following Wooten and Branch's "appropriate labor" concept, I demonstrate how the labor and conditions required for the job and the racial and gender identities of the workers are co-constituted. I draw on interviews with a diverse group of men and women in high-tech computing occupations to make the case that tech jobs are gendered in ways that reproduce normative gender ideals for both workers and jobs.

Women in Tech

The literature on women in computing and related engineering positions demonstrates that women face hostile cultures and disadvantages in both educational and workplace contexts. Margolis and Fisher (2002) find that teachers, curriculum, and culture expected men to excel and women to struggle with computing. Science, Technology, Engineering, and Math (STEM) departments with more female faculty members are more successful at attracting and graduating women students. Unfortunately, women's representation in the faculties of computer science departments tends to be very low (Sonnert, Fox, and Adkins 2007).

Engineering, especially computer-related engineering work, is gendered masculine (McIlwee and Robinson 1992; Powell, Bagilhole, and Dainty 2009; Evetts 1998; Kelan 2008). The masculine behaviors associated with engineering include an assumption that an engineer focuses primarily on work, works very long hours, approaches their work as if it were a competition, and possess technical skills to the detriment of interpersonal skills (Geurrier et al. 2009; Powell, Bagilhole, and Dainty 2009; Evetts 1998; Kelan 2008). McIlwee and Robinson (1992) find that engineering culture has an expectation that engineers pursue their work with a single-minded focus that calls them to do engineering-related activities, such as tinkering with cars, even in their free time, to the exclusion of any other pursuit. These characteristics, most often associated with engineers, are at odds with feminine characteristics that emphasize collaboration and teamwork rather than competition, interpersonal skills, and family responsibilities that prevent long work hours or exclusive focus on work (Geurrier et al. 2009).

Kelan (2008) and Geurrier et al. (2009) find that women in computer engineering tend to work in positions such as customer support that emphasize interpersonal, "soft skills." Geurrier et al. (2009) argue that the shift in the UK tech industry toward outsourcing and offshoring has created a need for workers in "hybrid" positions who manage far-flung technical

teams and work with business, sales, operations, and other non-technical parts of the company. While men hold most hybrid positions and are rewarded for “doing femininity” by using both technical and interpersonal skills, these positions allow women to “work in a male dominated environment without compromising what they see as their femininity” (Geurrier et al. 2009:507; Kelan 2008). Companies, however, do not value the “soft skills” needed for these hybrid positions (Geurrier et al. 2009; Kelan 2008). Consequently, women computing engineers find themselves in low-value positions that emphasize interpersonal rather than technical skills (Geurrier et al. 2009; Kelan 2008).

Methods

Over the course of 18 months, I interviewed 45 men and women computing professionals about their jobs and their paths into computing work. I attended three national conferences organized around increasing diversity in tech work. Interview participants were initially recruited from the conferences. Recruiting strictly from conferences about diversity in computing would have resulted in a skewed sample—most of the conference participants were women involved in tech diversity initiatives and many recommended coworkers who were also women with similar interests in tech industry diversity. I used a targeted snowball sample to recruit more men and to recruit women who were not necessarily connected to tech diversity initiatives. Some of the women recruited through the targeted snowball sample were involved in diversity initiatives: they attended conferences for women in tech, joined affinity groups through their companies for women in tech, went to local meet-ups for women or racial/ethnic minority women specifically, volunteered in schools, or participated in other diversity initiatives.

Only a small minority of the women I interviewed had never participated in any kind of diversity initiative and all of the women were at least aware of these initiatives. Most of the men were aware of the initiatives and some had participated in programs for people of color.

The high level of participation for women seemed to be more about the success of outreach efforts for women in the tech industry and less about specific biases in the sample. Some of the women recruited at the conferences for women in tech were not involved in diversity initiatives otherwise. In many cases, their companies were sponsors of the conference and provided funding for any employee who wanted to go—they simply took advantage of an opportunity that sounded interesting and the conference was their first experience with tech diversity initiatives. Throughout the interviews, it seemed that diversity initiatives for women in tech were sufficiently widespread that nearly all women had at least encountered one in school or at work. This was not the case for men, most of whom were at least aware of the initiatives going on around them, although few were involved and some were not aware.

About two-thirds (32) of the interviews were with women. With the exception of two women who had some college education and certificates specific to their jobs, all interview participants had at least a bachelor's degree; eleven had a master's degree; and seven had a doctorate. A little more than one-third (16) were people of color: six were Asian and 10 were African American or Latino/a. About 15% (7) of the interview participants were born outside the US. Most (38) of the interviewees lived and worked in or near the major tech hubs of the west coast, northeast, or Chicago. The majority (30) also worked for tech companies whose primary business was computer hardware or software. Those who did not work for tech companies were members of technical teams working for other kinds of organizations including financial organizations, insurance companies, museums, and educational organizations. About half worked for large, for-profit corporations, six worked for smaller start-up firms, and the remaining participants worked for non-profit, educational, or government organizations. All of the interviewees were involved with the processes of creating or managing hardware, software, or computing networks and infrastructure. About half (20) held primarily technical positions

such as software developers, system administrators, and programmers. An additional twenty held managerial positions with both technical and managerial responsibilities. Five participants held positions with lower technical skill requirements; they were help desk support workers, technicians, and game producers. Interview participants consistently referred to the people who held primarily technical positions as engineers; therefore, I also refer to this group as engineers. This sample captures workers with technical computing skills doing many of the jobs and working in many of the organizational contexts that make up tech work.

Initially, I assumed help desk and IT support specialists were not creating new software, hardware, networks, or contributing to new technologies and thus I intended to exclude these workers from the interviews. As I learned more about the division of labor among tech workers I found that many of these workers who I thought of only as support did in fact build network infrastructure that spanned offices, campuses, and sometimes continents, created software tools to improve workflow for themselves and the users they supported, and in some cases designed or modified software for in-house applications. In short, the help desk and IT support specialists whom I interviewed were responsible for managing the internal computing needs of their workplaces. None of them primarily talked users through running software installation wizards, upgraded computer components, or searched error messages to trouble-shoot user problems.

Interviews were semi-structured and lasted about one hour. In two cases, participants who were co-workers and knew each other preferred to be interviewed together. These focus group style interviews lasted a little more than an hour and allowed for participants to compare and contrast their experience in the course of otherwise normal conversation. When possible, the interviews were conducted at the participant's workplace, which allowed me to observe the workplace environment. If an in-person interview was impractical, the interview was conducted

over video conference. In some cases, participants preferred phone interviews and I respected their wishes. I visited eight workplaces (three in the Silicon Valley area, one in the New York City area, and four in the Boston area) and conducted 20 on-site interviews. In a few cases, I traveled to interview a worker at their workplace and they referred a coworker who I would later interview on a video or phone call. In total, I visited the workplaces of 27 participants. All interviews were audio recorded, and the focus group style interviews were also video recorded to allow for speaker confirmation. Participant and company names have been changed to ensure confidentiality.

The audio recordings were transcribed and coded, line by line, for themes following the grounded theory methods of analyzing qualitative data described by Corbin and Strauss (2008), Charmaz (2004), and Emerson, Fetz, and Shaw (1995). Initially, interviews were coded for descriptions of job responsibilities, how participants became interested in computing, when and why they changed jobs, and general descriptions of how tech jobs are done and the skills and characteristics needed to do them. These initial themes were then coded at a conceptual level for skills and characteristics associated with management and for those associated with engineering, translating technical information between technical and non-technical audiences, degrees, credentials, training, length of a typical day, overwork, and job changes and promotions. Qualitative analysis was completed using the software program NVivo 11.

Findings

Participants were asked about their path into computing and if their path is typical, the quotidian aspects of their work life, specifics of their jobs, who their co-workers and managers are and how they interact, what they want or avoid in a job, and if they feel they are valued at work. This analysis focuses on how the workers described their jobs, their daily activities at work, and what they would seek or avoid in a job. Several themes emerged in how workers

described not only the jobs they perform but also how their jobs compare to other tech workers in their company or social circle. Importantly, participants described their jobs and other tech jobs they did not hold in gendered ways. Notable differences also emerged between white women and women of color.

White Women as Translators

Many white women described their work as communicating and bridging between technical teams and the business/management side of the company. They worked in positions like project management, product management, or product owner in what I call “translational” management positions. They understood themselves as translating knowledge between the business and technical sides of their companies. Alex, a mid-career career white women, described her position as follows:

So, we're called—it's funny. There's an article we read, and the [Business Intelligence] people, we're the purple people. So, if you think of, like, IT as kind of red, where everything is very defined, and then the business is blue, we're kind of in between, where we have some of that technical capability, and then we also have some of the business speak. So, we can kind of bridge both worlds.

Alex had a particularly apt description of her job, but others used helpful metaphors as well; women in “translational management” or “translator” positions described themselves as traffic directors, human interface machines, bridges, and switchboard operators. As Margaret, a project manager for a gaming company, put it “Information comes in then I pass it this way. I’m just kind of like one of those, you know, black and white films with the ladies on the switchboard.”

Translator positions required technical expertise but those are not the primary skills the women in these position described using on a daily basis. Stasya is a management-level security

specialist who moved from a purely technical position. She described her need for technical skills:

You cannot do this role without technical background. I can't design internal controls for an audit if I don't understand how a database works with a server. I have to go in and scope systems and I have to understand how all that works.

For some women, moving into management was an opportunity to get away from the sexism they experienced as members of technical teams, for others it was the next step up the career ladder, and for some it was a result of unexpected promotions and encouragement.

Rebecca works for a large, multi-national tech company as a division director. Her college major was math with an emphasis on computer science. Rebecca's career path was exemplary of many mid-career white women. Despite her college coursework and experience working as a programmer, she felt insecure about her programming skills. Her career path demonstrates the progression away from technical areas towards translational management.

And so, more and more my people skills showed up really well and I was constantly asked to manage and lead and all this. And so, that took me away from the stuff I was insecure about—even though I liked that stuff – and put me more in this leadership role. And so, you know, I did stay leading development teams for seven years. Near the end I actually moved into managing product managers, which to me is actually what designed turned into because we were writing specs and deciding how an application should work . . . But I found that I did gravitate toward leadership and people stuff. So, I think I'm just someone who lands in the middle of where humans and computers interact.

Like many white women I interviewed, Rebecca had the credentials, skills, and experience to do highly technical work and could not have done her managerial job without her technical know-how; however, she found herself moving toward business and management as her career progressed.

Unlike Rebecca, Alex moved into management deliberately to get away from the culture and expectations of her development team after her supervisor suggested she would be good in a leadership position. She explained,

I was an extreme minority, and there were a lot of difficulties that I faced throughout my tenure in IT, I just said, "You know what? I'm not going to fight this battle anymore. I'm just—this person obviously thinks that I'm skilled and can contribute and all that. So, I'm just going to go for it and move into the business side."

Lauren observed the phenomenon Alex experienced as a common trend among the technical women in her company.

I'm in a group for women in leadership (management) at my company. And almost everyone in that group has a really solid technical background and worked in technical engineering groups for a while. And they got to a point that they just had a level of frustration, I think, of working with men and not feeling like they were valued. And so, found paths into other areas that they found more rewarding.

One particularly gregarious white woman with a degree in computer science, Ellen, found herself offered a position as a project manager on her first interview for her first job out of college. She had applied for a job as an entry-level programmer and had no prior experience or training that would qualify her for project management. She explained that the interviewer cited her "people skills" and personality as better qualifying her for project management (for which she had no training) than programming (for which she had a degree). Because Ellen deeply enjoyed programming and had no interest in management she turned that offer down and accepted a position as a software engineer.

Neither Rebecca nor Alex set out to find a career in management initially and Ellen actively avoided management. Alex and Rebecca were exemplary of many of the mid- to late-career women I interviewed. They had technical qualifications, training, and experience, but at some point someone encouraged them to consider management. They were promoted into

project management, team lead, or another position where their main role was translating between the business side of their company and a technical team that they managed.

Moreover, these positions seemed, to their supervisors at least, to be a natural fit. They moved out of highly technical positions where they were token women and into technical management positions that emphasized what the women thought of as feminine-typed interpersonal skills and communication rather than technical expertise.

Translational management positions were generally good jobs that provided career advancement, but they had some drawbacks. For example, some of the women I interviewed who held these positions were very high up in their companies, but none of them were vice presidents or chief officers, nor could they name women with technical backgrounds in these positions. They could identify women in these higher up positions but those women had backgrounds in business management, not in computing or engineering. On the other hand, it was not hard for them to identify men with technical training higher up in their companies.

Lauren summarized another problem.

Today, I feel like technology has moved forward so fast that [my technical skills] are not really part of my skill set anymore. It's really hard to keep up with technology these days. And I find that just focusing on project management, people, coaching skills is really where people are hiring for right now.

The technology behind software development changes so quickly that, after a few years, managers felt their programming skills had atrophied. Rebecca voiced yet another problem, "I actually left management a couple times to go back to just being hands on," because she missed writing code. Meanwhile, Margaret explained that, as a producer in the gaming industry, she received very little respect. "Producers are generally a low-value [position] in the gaming industry, because it's generally seen that managers are very, very [easy to replace]. Like, anybody can be a manager." Margaret felt the lack of respect for her positions was specific to

the gaming industry, which might be the case since she was the only manager to describe her experience this way.

There is no question that these management-level translator jobs are good jobs that are paid well. With the exception of Margaret, most women showed no signs of feeling devalued for the emphasis on “soft skills” in their translator roles, as Geurrier et al. (2009) found. Women in these positions largely enjoyed the autonomy, flexibility, and variety in their work. They had a degree of influence in the company and they showed genuine enthusiasm for their jobs. However, they lost technical expertise, which limited their options for future jobs. They were not doing the technical work that they enjoyed and for which they trained. Despite their dwindling technical skills, many described being recruited to other companies for their hybrid technical and managerial skills. While translator positions were higher up in the corporate hierarchy than engineering team members, these positions showed no sign of leading to an executive suite.

Men in Management

Men in management more often described the technical aspects of their work or their team’s work and did not focus as much on the bridging or translating components of their job. For example, Travis is a lead engineer for a start-up. He works closely with the CEO of his small company and directs the engineering team. He describes the technical work he does in some detail before mentioning the meetings and managerial work.

Some days, you know, I'm doing a lot of heads-down software coding. Other days, I'm collaborating with the team to design, you know, new features to the system. Some days I feel like I'm putting on my research hat again, and I go off to my quiet space and try to work out an algorithm for some aspect of the system that we're trying to optimize . . . And, especially, since I have to, you know, lead people, I never get to just do one thing all the time.

Similarly, Ryan is a division director for a multi-national web-based company. He manages a team of nearly 20 people. In describing his job, Ryan gave me a simplified technical overview of what his team does and where it fits in the company, referencing databases and specific programming frameworks. However, in describing his daily work, he focused on tasks related to managing his team: responding to e-mails, attending meetings, addressing urgent problems, but this is not his “actual” work. He explains,

If I get breaks, I can actually do my work, which usually is creating strategy decks for the team, engaging the VPs (vice presidents), who are our primary clients, and helping people with projects . . . as well as running new technologies for the team.

Ryan and Rebecca are actually in comparable positions, both run specialized divisions that straddle business and technology in large corporate companies and they work closely with their respective vice presidents. Both have technical experience and training. Neither could do their managerial work without a technical background. Yet, how they describe their work is markedly different. Rebecca discussed her role bridging the technical and non-technical at length, while Ryan does not describe his job this way.

Similarly, Richard manages a software development team for a hospital. His team designs software for the hospital to use internally. He meets with hospital staff and vendors and works to devise solutions to problems using software that his team. Richard and Margaret are in similar positions: they both work with non-technical workers to arrive at specifics for software that they will convey to technical teams, but that they will not develop themselves. Richard focused on his role with his technical team. For example, in describing a typical day, he explains he attends meetings and helps his staff with software projects.

So, I might—let's say Peter is working on something and he's ready with it. I can help him test it and just find out if there's any problems with the software, or if there are things not working as expected.

On the other hand, Margaret described herself transferring information like a switchboard operator. It is not clear from the interviews if managerial jobs were different for men. It is certainly possible that the women in these positions did more technical work than they described and/or that the men did more translating than their interviews indicate. What is clear though, is that the men in management experienced and understood their work differently from women in similar kinds of positions. While many of the white women described themselves as bridging, translating, or otherwise straddling technical and non-technical parts of their organization, men, regardless of race, did not describe themselves in the same way. Notably, this was the case for white women regardless of whether they were born in the US or abroad. Immigration was less of a factor than race or citizenship for women pursuing tech careers.

Women of Color Doing What They Trained to Do

While moving into a translational position was an upward career move, either intentionally or accidentally for white women, this move did not seem to happen for women of color. More often women of color worked in a job they had specifically chosen and for which they had trained. They did not experience unexpected and unsought promotions into translational management positions like white women. Few of the women of color whom I interviewed, whether they were from the US or immigrated from abroad, held managerial positions where they translated between technical and non-technical groups and those that did specifically chose those positions. For example, Lizette and Zheng had PhDs focused on user experience (sometimes called “UX”) and design that put them squarely at the intersection of people and computers. Talia had degrees in information systems and business management.

Zheng wanted to be in a position where she had influence over the direction of the company, she said “I came to this job because I can be a bigger impact.” She had to deliberately seek out a job with a company that would allow her to have that influence.

I’m always looking for the impact [I can have on the company]. The reason that my career path is from research to designer to here is I’m still a designer but I’m kind of helping the PO (product owner), influencing the primary judgment more.

In order to find a position where she could have influence over the company, Zheng changed companies. A product owner is typically responsible for how a software product comes together. They coordinate with the technical teams, business teams, vendors, designers, etc. to build and manage the product. This is exemplary of translational management positions because it requires understanding of how the technology works, but product owners do not build software themselves. Product owners coordinate the teams that build software, but they have tremendous influence over the product that is ultimately released. Several of the white women interviewed held this position or one similar (for example, Margaret, mentioned earlier, was also a product owner); Zheng was the only one who moved between companies deliberately seeking it and she was the only who in this kind of position who had a PhD in a related field.

Each of the ten women of color I interviewed had degrees, credentials, and experience specific to her job. None described receiving unexpected promotions or encouragement to pursue management based on the strength of their “people” skills. On the other hand, several of the men and white women I interviewed had degrees unrelated to computing, including degrees in English literature, French, Sports Medicine, and Political Science. None of the women of color “stumbled” into computing as some men and white women did. Kate is a white woman who graduated from college with a degree in English literature and had no specialized training with

computers. After graduating college, she applied for her first job as a tech support specialist at a multinational tech company. She described her interview process:

They give you a huge stack of questions to answer, and then a computer. So, the point of it was to figure out if you could find the answers, not if you knew them, but if you could figure out how to get to them, because when they hire people, they don't do it for technical expertise. They do it for personality, and then they just train you.

Latanya is a black woman who worked in the same position as Kate at a different multinational tech company. She deliberately pursued credentials and experience for the kind of work she wanted to do, and landed jobs for which she was unquestionably qualified.

My dad worked at technical support working on computers . . . He wouldn't help me get a job there, but I got one on my own . . . I started out doing kind of like technical support for video. And then I worked my way up to IT when I started going to school. I [started in] computer assistance administration, got certificates, all that sort of thing. And then I got a job in IT working as a technical support specialist. I was there about nine years . . . I put myself through school again. And I wanted to go to the programming side, which is computer science and programming . . . And so, I started going and taking computer science classes and learned how to do programming and C++.

Latanya explained that she was one of only two African American women working in an office with hundreds of employees. Both Latanya and the only other African American woman in her office worked as help desk specialists and she described how they spoke and strategized about how to gain and keep the respect of their white supervisors who, they believed, would punish them for doing things that other white employees do.

Far from unexpected promotions into management, Latanya described feeling isolated by the lack of diversity and targeted for unwarranted scrutiny in her job because of her race. She opined, "There's this thing that I know I would not be able to get away with that my coworkers could." Nearly every African American worker I interviewed, men and women, described similar

feelings of undeserved scrutiny or questions about whether adverse job experiences were motivated by race.

Translators and Engineers as Gendered Laborers

Throughout the interviews, particularly with women in translational management positions, participants repeatedly connected success in management with feminine-typed, communication-related “soft skills.” They often contrasted these jobs with the single-minded focus and ability to work for very long hours they associated with masculinity and engineering. Several of the women also remarked that men who are good engineers are often poor managers, lacking social skills and the ability to see the big picture of the business. Marina, for example, explains, “I think one of other reasons to that could be that women are more interested than men, in my opinion, in seeing the big picture in taking on leadership hats.”

Stasya goes a step further and explains, in her experience, that male engineers are ineffective when they become managers because they tend to be overly focused on technical details and uninterested or unable to grasp business strategy and management. She continues,

I’ll tell you some of the men in our IT division, I’m surprised that we have a management team full of these guys who are so clueless from an emotional, managerial kind of standpoint, and also from a strategic standpoint. We did a presentation on something about strategic planning, and the management team has 60 people on it, and I would say maybe 10 out of 60 really understood what that meant. The rest of them, whenever we present, it’s like, why even bother? They’re so, “Let’s manage the servers,” and there’s all so hands on, that there’s a huge gap.

On the other hand, interviewees sometimes described the skills needed for management—communication, collaboration, ability to work with other people—as skills that women gravitate towards or have naturally. Rebecca, mentioned above, stated that she had strengths in leadership and people “stuff” that nearly all her male coworkers did not. “I found

that I did gravitate toward leadership and people stuff. I know I have a strength that is harder to find in super technical people. So, that was part of, I think, why I kept landing in management.”

Later in the interview, Rebecca went on to explain that she had attended assertiveness training and leadership (management) training classes for women. She had a strong mentorship from a senior woman early in her career that helped her navigate through the tech industry and into a leadership position. Rebecca thought of these skills emerging from within, even though she took classes and worked to cultivate them.

Several participants contrasted the different characteristics of men and women in tech to explain why they thought men were more likely to become engineers while women, in their experience, found themselves in other roles. Vanessa explains,

I think that women are probably by nature more creative in a results, in a more of an immediate results-driven environment. Meaning we like to see the fruits of our labor we want to see that flower, you know, grow and bloom. We want to see that and we want to see it quickly because we're in a rush, because we're having kids or we're going here or we're going there or we're doing stuff, we don't want to be sitting around. I think men are much more analytical in their mindset and so therefore can think more—they just seem to be more interested in that engineering role.

The descriptions of engineers were highly consistent across the women participants, as were the explanations of why men were more suited for engineering than women. Andrea's description is characteristic of how many women described engineering and why few women worked as engineers.

There are certain personality types that are needed for some of these fields. Programming has the stereotype of 2:00 a.m. cold pizza and warm beer mentality, and avoidance of the sun, and various other types of things . . . There are certain personality types that just don't fit. Most women I know are a little bit more social than some of the programmers that I know for that.

Consistently, women described engineers as being dedicated to their work “heart and soul,” working in a very focused way for extended hours, and spending their free time writing code

rather than enjoying the sunshine. Women who were currently engineers themselves tended not to use this description; however, most of the women who described engineering this way had the skills to be engineers and some had even worked as engineers in the past. They understood engineering as requiring an approach to working that structurally excluded most women. This understanding of how engineering work gets done made the transition into translational positions seem natural for women since, as they explain, they did not want to work the long, focused hours that engineering required and they had better social skills than the men on their teams.

Interestingly, none of the participants who worked as engineers at the time of the interview described their jobs as requiring very long hours focused on programming tasks. On the occasions when they did work long hours they were resentful. Ten of the 45 interview participants named work/life balance as an important quality they looked for in a job, with both engineers and non-engineers valuing work/life balance. Some of the engineers would have deadlines or problems that required them to work long hours for a period of time and, like Travis, they resented it. Travis found himself on an understaffed project. When his manager tried to acknowledge his work after the project was completed, he was resentful and ultimately left the company.

I mean, if you really wanted to recognize my contribution, then maybe you could have put a few more people on the project. I mean, I didn't have to—there was really no reason for me to have to work 80 hours a week because there was no one else to do the work.

Non-engineers sometimes worked very long hours too. Janie is a video game producer who found herself working 75 hours per week on her last major project. She explained that the long hours took a toll on her mental health and eventually she got a dog “in large part to help define work-life boundaries.” Many of the managers worked on global teams that required conference

calls that could accommodate team members in Europe and Asia. When this happened, they could have very long days that might start with a 7 a.m. phone meeting and end with a 10 p.m. phone meeting.

For the engineers and technicians, overwork was a response to a deadline or problem, it was sometimes unexpected, possibly required, for the duration of a big project and it was largely beyond their control. The engineers described themselves typically working about an eight-hour day, unless “something broke,” as they put it. Managers also overworked, but they had more control and flexibility in the hours and conditions. They could take their 7 a.m. call with the Europe team at home before going to the office and their 10 p.m. call with the Asia Pacific team after they got home, then spend Sunday prepping for the next week’s meetings. Although many participants thought of engineers working very long hours, it was not clear from the interviews that they worked more than managers. The managers’ additional flexibility allowed them to more predictably balance work and family. Engineers had to be willing and able to overwork when asked while the managers had more flexibility and could at least choose which hours they would spend overworking. Regardless of whether engineers really do work longer hours, the perception that they do ran strong across the interviews with non-engineers. Moreover, the stereotype of engineers offered in these interviews casts engineers as decisively male, even by women who had been engineers themselves. Engineering, as described by the interview participants, is incompatible with significant non-work responsibilities.

Discussion and Conclusion

The translator position that many white women held moved them out of a masculine-gendered engineering role into roles that emphasized feminine-typed social and interpersonal skills over technical know-how. While women in translator positions emphasized that they had more flexibility in their work hours, workers in traditional engineering positions valued standard

work hours as well. In translator positions, white women describe themselves communicating technical information between technical and non-technical audiences and relying on interpersonal skills to present the needs and constraints of their team to clients and the business side of their companies. As managers bridging technical and business teams, they emphasized a need for feminine “people skills” in their daily tasks. Conversely, men in management positions emphasized technical work over interpersonal work.

Meanwhile, women of color were nearly invisible. Many participants had never worked with a black or Latina woman in a technical position. The women of color in this study had credentials to do the exact job they were doing. There was no promotion to a different position for which these women had “natural strengths.” It is noteworthy that this was the case for Asian and Asian American women as well African American women and Latina women. Two of the white women interviewed were from outside the US and both held translational management positions. In other words, translational management positions, and the underlying communication and interpersonal skills, are both raced and gendered. As with black men in feminine occupations (Harvey Wingfield 2009), I found no evidence that women of color received preferential treatment for promotion to management as I found for their white counterparts. The seemingly natural progression into management reflected a racial “glass escalator” for white women. It is possible that the lack of evidence of a glass escalator for women of color is peculiar to the women interviewed for this qualitative study; however, considering the concerns that the black women voiced over simply being seen as competent, it is unlikely that they are unique in not being singled out for unrequested promotions.

Past research on women in tech in the UK has found that women move into less technical positions that allow them to do femininity by emphasizing feminine interpersonal skills over masculine technical skills (Guerrier et al. 2009; Kelan 2008). I found strong evidence of this

trend as well; however, unlike the earlier UK-based research, I found white women moving into translational management positions which were promotions that gave them greater autonomy, more influence in the company, and better pay. There was one clear exception. Margaret's description of working as a project manager in gaming closely resembled the low status, "soft skill" based, lightly technical managerial work in the UK-based research.

The research on male tokens suggests that men are likely to move out of jobs that require feminine-typed skills and into positions where the work is more closely associated with masculinity, without leaving the broader field in which they are trained (Budig 2002; Williams 1995). Male nurses become nurse managers, elementary school teachers become principals, etc. These positions require the knowledge they developed as nurses and teachers but have more authority and executive functions and thus seem more appropriately masculine. Similarly, tech occupations require managers who communicate with customers and other, non-technical parts of their companies. Management may serve a similar function for women in tech as it does for male tokens in other occupations. Women in tech management still need the training required to understand the technology; however, the primary skills they described using emphasize communication rather than technology. Similarly, men in management needed interpersonal skills and, while they acknowledge this part of their jobs, they emphasize the technical over the interpersonal. Like male tokens, white women in tech are able to ride a glass escalator into translational management positions (Williams 1995). They are still subject to the glass ceiling that keeps most women out of the highest levels of management and, unlike male principals or nurse managers, they cannot return to engineering since their skills deteriorate quickly with non-use. Also, like the promotions that white, but not black, male tokens experience (Harvey Wingfield 2009), the glass escalator into translational management is both gendered and raced—it is only available for white women.

Here, I extend Wooten and Branch's (2012) concept of appropriate labor to include not just the ideal and justification that a certain group of workers is suited for a particular job, but also the idea that the qualities of workers and the skills needed for jobs are articulated through one another in ways that reinforce underlying race and gender ideals. It is not simply that the appropriate worker for translational management is a white woman because interpersonal skills seem to come naturally to white women. The skills needed for the job are shaped by the ideal of the workers who hold the job too. When men are in management positions they understand, if not perform, the job differently, emphasizing the technical work over interpersonal work. Gender and race are both organizing principles and products of work (Glenn 2002). The same job held by differently gendered workers may have different requirements and expectations. Translational management jobs and their responsibilities are inventions. They reproduce the normative expectation that white women have social and interpersonal competence at the same time that white women's presence in these positions produces the emphasis on communication and "soft skills" rather than technical skills.

As white women with technical skills move into translational management positions, their removal from engineering teams relieves the pressure on those teams to incorporate women. In many cases, the women in translator positions had exactly the same degrees and training as their male engineering teammates. A combination of frustration with the masculine culture of the team and encouragement from managers pushed them into translator positions. In other words, translational management positions reinforce white femininity at the same time that they allow software engineering to reinforce masculinity by emphasizing technical expertise, devotion to work, and the absence of non-work responsibilities. Normative expectations for white femininity shape translational management positions at the same time that these positions reinforce white femininity for the women who hold these positions. Just as

black women seemed to be a natural fit for domestic work in the late 1800s and early 1900s (Wooten and Branch 2012), white women tech workers seem to be a natural fit for translator positions.

White women's movement into translational management positions presents both a challenge and an opportunity for gender integration in the tech workforce. Translational management positions are undeniably better jobs than the positions the women in them held previously. They pay better wages, have more influence over the direction of the company, are higher up the corporate ladder, and they shield women from the unwelcoming and at times hostile environments of the engineering teams. On technical teams, women's experience was similar to the experience of token women in Kanter's (1977) work and the research of other scholars in her tradition. By moving out of technical teams, they shielded the engineering teams from having to address issues of sexism and thereby stall efforts to diversify tech work.

The findings in this study have implications for gender-segregated occupations more generally. First, it is not simply the case that women who are tokens suffer—white women in tech arguably had an advantage from their token status that allowed them to easily move into management. This advantage did not extend to women of color. Second, occupations will not integrate simply as a result of previously underrepresented workers entering. Many of the white women in this study moved into positions that removed them from the specific jobs where women have the lowest levels of representation. As white women moved away from these teams, the underlying ideals about whose labor is appropriate for engineering are reinforced. Women with engineering skills convey and justify the association between engineering and masculinity. Despite women becoming engineers, as they move into translational management positions, the appropriate labor for engineering is even more strongly masculine. Finally, not all women benefit from gendered labor processes. Women of color did not have managers who

saw their “natural” talent for leadership or who offered them promotions into management. Consequently, efforts to attract and retain women in fields where they are under-represented that do not consider how femininity may be different for women of color may only succeed in reaching white women.

In sum, I find that men and women managers tend to describe their work differently, emphasizing the parts of their jobs require stereotypically gender-appropriate skills. White women, including white women from outside the US, described paths into management that resembled the glass escalator that token men ride into positions of authority (Williams 1995). This advantage did not extend to women of color. While managerial positions were clearly promotions for white women, they required the women to give up much of the technical work that they enjoyed and these positions showed little promise of leading to the executive management level.

CHAPTER 4

THE PRODUCTION OF THE APPROPRIATE ENGINEERING LABORER: GENDER NORMS, MIGRATION POLICY, AND THE MAINTENANCE OF AN IDEAL

US tech companies are among the US firms offering generous family leave, flexible scheduling, and remote work opportunities. For example, Amazon offers 20 weeks of paid leave to new mothers and six weeks to new fathers. Facebook offers 16 weeks of paid leave to all new parents and Netflix offers unlimited paid leave for salaried staff in the first year of becoming a parent. Considering the Family Medical Leave Act only requires companies to allow for up to 12 weeks of unpaid leave for parents, these policies are comparatively generous. Many tech companies allow at least some workers to work from home at least some of the time. Other companies allow for “flex-scheduling,” in which workers are free to pick which eight hours they will work so long as the work gets done. These policies are promoted by the companies and some academic researchers as making tech work more appealing for women. Goldin (2014) is highly optimistic that tech companies are leading the way with flexible work policies that better allow women to balance work and family life. She argues that policies that allow workers to work from home and set their own hours give women the flexibility to work around their family and household care responsibilities, contending that such policies have the potential to reduce the gender wage gap.

Even though many tech companies offer flexible work policies, they are not available to all workers. Flexible work policies often exclude hourly, contract, and temporary employees. Given the prevalence of contract work in the tech industry, these excluded workers are a considerable part of the computer-related engineering workforce (GAO 2011). Without understanding the context of tech work and the race, gender, and immigration regimes that inform how and why some workers seem to be appropriate labor for some tech jobs rather than

others, it is not possible to make sense of the potential impact of flexible work policies. Often, as is the case with the unlimited parental leave policy at Netflix, flexible work policies only extend to professional, full-time, salaried employees. The tech industry is the largest employer of workers on temporary, non-immigrant H-1B Visas, and many of these workers are hired on a short-term, contract basis (GAO 2011; Banerjee 2006; Banerjee 2010; Matloff 2013; Luthra 2009).

At the same time that tech companies offer flexible work policies to a select groups of workers, they also hire flexible workers, that is, contract labor that can quickly expand to meet high work demands and contract when big projects end (Banerjee 2010). Recent research has shown that, even though companies offer parental leave and formal flexible work arrangements, the policies effectively do not apply to men. Additionally, company culture stigmatizes employees, men and women, who attempt to use flexible work arrangements to balance work and family as not committed to their work (Cech and Blair-Loy 2014; Reid 2015). Contract workers make up a sizable portion of the tech workforce and many flexible work policies do not apply to them at all (Banerjee 2006; Luthra 2009). Moreover, these policies directly conflict with the ideal of how engineering work is done—with long hours spent at computers by workers who are devoted to working with technology (McIlwee and Robinson 1992; Powell, Bagilhole, and Dainty 2009; Evetts 1998; Kelan 2008).

Drawing on interviews with 45 tech workers, I examine how tech workers describe their jobs, their co-workers' jobs, and tech work generally. I am especially attentive to how ethnicity, race, gender, and migration status appear in workers' descriptions of technical work. I consider a tech worker to be someone who is involved with the production of computer-related hardware, software, networks, or systems. Across the interviews, workers generally refer to people whose work is primarily technical, such as software developers and system

administrators, as “engineers.” I follow their lead in calling these workers engineers. Most of the non-engineers I interviewed were managers of technical teams. The managers had technical know-how and could not do their jobs without their technical background, but on a daily basis they would be responsible for coordinating their teams’ work and communicating with other parts of their companies more so than doing the technical work themselves. Through this examination of appropriate labor in tech jobs, I ask if flexible hours and family leave policies are likely to allow women to participate more fully in tech careers.

Ideal Workers and Appropriate Labor

I build on the concept of “appropriate labor” to understand different technical jobs and the expectations for the skills and labor practices workers bring to their jobs (Wooten and Branch 2012). Wooten and Branch (2012) use appropriate labor to argue that we have collectively negotiated ideals for the race and gender of workers best suited to specific jobs, though these ideals may change over time. I draw on the work of Glenn (2002) and Salzinger (2003) to broaden “appropriate labor” to include not just the ideal for which workers are best suited to particular jobs, but also the idea that the conditions of the job and racial and gender formations that define groups of workers are co-constitutive.

Appropriate labor differs from Acker’s (1990; 2006) ideal worker. The ideal worker is disembodied, focused primarily on work, and does not have non-work responsibilities that conflict with work. Acker (2006) argues that this is the kind of worker that organizations imagine when they organize labor practice—the worker with this kind of orientation to work and family is a heterosexual white man. On the other hand, appropriate labor refers to the raced and gendered ideals applied to specific jobs. For example, we generally think of nursing as feminine work because it requires caring and emotional labor, but the labor practices for nurses also

require spending long shifts away from home and enduring physical exhaustion. Women's labor is appropriate for the specific demands of nursing, but the labor practices still call for the ideal worker who has no physical limitations and no non-work responsibilities.

The idea that employers and managers see some workers as appropriate for some jobs is not merely descriptive, it is productive. Glenn (2002) shows that citizenship and the associated legal coercion, in addition to race and gender, shape work opportunities. She demonstrates that ethnicity/race and gender were primary logics organizing labor in the American South, Southwest, and Hawaii as these areas incorporated free blacks, Mexicans and Native Hawaiians, Asians, and Pacific Islanders. Managers, ranchers, and employers in each area limited ethnic minorities to managing other minorities. In contrast, whites managed, oversaw, and owned the means of production while minority workers received low wages and upward mobility was implausible (Glenn 2002). Many minority workers technically were citizens, but their rights as citizens were severely restricted and they could be coerced to work by targeted vagrancy laws (Glenn 2002). In some cases, such as agricultural labor, men and women did the same work with the same expectations for productivity. Some farmers hired or rented farm land to Mexican men with the expectation that the whole family would contribute their labor, while vagrancy laws sometimes pushed black and Mexican women, but not men, into domestic work (Glenn 2002).

Similarly, Wooten and Branch (2012) show that vagrancy laws requiring black women to work, often as domestic workers, in the pre-civil rights era prevented them from achieving the same kind of femininity and male-bread-winner family structure as white families. They show that white femininity and black femininity were co-constituted against each other. As black women became appropriate labor for domestic work, white women did not work outside the

home or engage with the dirty, heavy, or otherwise laborious realities of running a household. This set them apart from black women (Wooten and Branch 2012).

Appropriate labor as a concept helps justify why a particular group is especially qualified for a certain job (Wooten and Branch 2012). Black women were meant to be excellent servants because they were naturally gentle, cheerful, docile, hardworking, and “knew their place” (Wooten and Branch 2012: 300). Salzinger (2003) argues that part of the appeal for companies to locate assembly plants in Mexico’s export processing zones was the belief that “Third-World” women are naturally docile, dexterous, and cheap. The “*maquila-grade female*” was not an actual person – it was a trope against which labor was measured (Salzinger, 2003:46). Salzinger (2003) shows that counter to the trope, each of the four factories she studied produced a different set of gender relations. The trope was powerful in shaping how the export processing industry understood workers, but it had little to do with actual people. Likewise, black women were not naturally cheerful, docile, and hardworking with an innate sense of subservience; however, employers could judge black domestic workers against this trope to assess their fit for the job. In my interpretation, appropriate labor includes a set of expectations for who workers are, how they work, and why they work in particular ways. These are normative expectations that signal the behaviors, attitudes, and qualities associated with race/ethnicity and gender through labor. These expectations are the standard against which workers are measured for fit in a job, but they are also productive and potentially coercive—telling workers who they should be and how they should work based on their race/ethnicity and gender and directing them to the appropriate jobs either through normative or legal coercion. The labor practices in those jobs can still call for ideal workers who put their job first and willingly work all the hours their employers ask without concern for family care work responsibilities.

Masculinity and Engineering

Engineering, especially computer-related engineering work, is gendered masculine (McIlwee and Robinson 1992; Powell, Bagilhole, and Dainty 2009; Evetts 1998; Kelan 2008). Engineers are expected to focus primarily on work, work very long hours, approach their work as if it were a competition, and possess technical skills to the exclusion of interpersonal skills (Geurrier et al. 2009; Powell, Bagilhole, and Dainty 2009; Evetts 1998; Kelan 2008). In their now-classic study of women in engineering, McIlwee and Robinson (1992) argue that engineering has a culture that expects engineers to pursue their work with complete devotion, as if the work were a vocational calling. When asked what they do in their free time the only appropriate answer for engineers is some version of “tinker” (McIlwee and Robinson 1992).

Cooper (2000) finds that masculinity is an important labor control mechanism for Silicon Valley knowledge workers. The men she interviewed measure themselves against an imagined “super engineer” “who works when they are asleep, who cuts code that doesn’t have bugs, who scores the deal that they just lost, who takes his company public while they struggle to get theirs off the ground” (Cooper 2000:390). This super engineer is model of a particular kind of masculinity that dominates Silicon Valley and connects the success of worker’s gender performance to their work performance through heroic feats of technical brilliance, long work hours, and complete dedication to the project.

The expectations that engineers will work long hours, have poor social skills, and devote themselves to work are at odds with normative femininity, which prescribes collaboration and teamwork (rather than competition), strong interpersonal skills, and family responsibilities that conflict with long work hours (Geurrier et al. 2009). Several UK-based studies have found that women in tech firms tend to work in positions that distance them from engineering and

emphasize the feminine-typed interpersonal skills that the ideal engineer lacks, but which managers expect women to possess (Kelan 2008; Geurrier et al. 2009). These positions include customer support and project management where workers need to understand the technology, but rely more on interpersonal skills than technical expertise to do their jobs (Kelan 2008; Geurrier et al. 2009). Although these positions are important for companies to be able to coordinate work, especially among a globally distributed workforce, they tend not to be as highly valued as engineering (Geurrier et al. 2009). The move into “hybrid” technical-interpersonal positions for women who have technical skills preserves the masculinity of the ideal engineer trope and reinforces gender inequality.

Professionals and Work/Family Balance

Even if women are likely to move into hybrid positions that take them out of engineering per se, they are then working in managerial-level professional jobs that tend to require long work hours and constant availability (Reid 2015; Cech and Blair-Loy 2014; Moen et al. 2016; Cha and Weeden 2014). Reid (2015) interviewed consultants and studied the workplace culture of a large professional services firm. She found that the company expected workers to adopt an identity around prioritizing work, over-delivering for clients, and being constantly available. Many workers found ways to pass as embracing this ideal while employing informal strategies to structure their work in ways that allowed for more balance. However, women were more likely to take advantage of formal flexibility programs, such as parental leave or reduced schedules, which signaled their lack of commitment to the company (Reid 2015). Ultimately, workers who revealed their conflict with the ideal were not promoted and had lower ratings on their performance reviews (Reid 2015).

Similarly, Cech and Blair-Loy (2014) find that, in many academic science departments, workers who take advantage of formal flexible work policies experience stigma as a result—they are seen as less serious and less committed to their work. Cha and Weeden (2014) show hourly wages tend to rise for over-work and even attribute 10% of the total gender wage gap to men’s higher rates of over-work, especially in professional and managerial jobs. Meanwhile, Kelly, Moen, and Tranby (2011) offer optimistic observations from their study of a results-only work environment at a US tech firm. They find that when workers have more control over their schedule so that they can be more flexible about their time without stigma from their managers and co-workers they report better fit between their work and family lives. In a later study, Moen et al. (2016) push these findings to show that workers with more schedule control also have better health outcomes than those working in more traditional environments.

Migration and Tech Work

The tech industry relies heavily on foreign-born labor (GAO 2011; Matloff 2013; Banerjee 2006; Alegria and Branch 2015). It is an important part of the field that must be considered in order to understand how tech work gets accomplished. The tech industry leads the US in employing workers on temporary H-1B Visas, which are issued to companies to recruited skilled workers. Foreign-born tech workers in the US are overwhelmingly men (Alegria and Branch 2015). More than half of all H-1B Visas granted from 2000 to 2009 went to Asian workers, with India and China best represented (GAO 2011). In 2009, electrical engineering and computing professionals held half of the 85,000 approved H-1B Visas, which is nine times more than the industry with the next largest number of H-1B Visas (GAO 2011).

Critics point out abuses and problems with the visa system in tech. The evidence of a labor shortage in tech is weak: wages for tech workers did not increase as expected for hard-to-find employees and the unemployment rate for tech workers is similar to other industries

(Matloff 2013; Luthra 2009). Even the Government Accountability Office (GAO) (2011) reports that the widespread use of H-1B Visas and migrant contract labor in the tech industry has had a downward pull on wages. Temporary visas like the H-1B allow workers to come to the US, where about half eventually obtain permanent residence (Lowell 2001). In the tech industry, employers commonly sponsor employees for Green Cards; however, Matloff (2013) argues that, by sponsoring Green Cards for immigrant workers, companies can dramatically reduce the risk that those workers will leave for better offers or because their working conditions are unacceptable. Luthra (2009) finds that recent immigrants, which include H-1B workers by definition (since they are three-year visas), are more likely than permanent residents to be employed as contingent workers. Immigrant workers, especially contingent workers like contractors, are unlikely to receive full benefits from their employers. This means that, even though wages tend to be comparable to domestic workers' wages, immigrant workers still cost companies less to hire (Luthra 2009). Matloff (2013) goes so far as to call the working conditions for recent immigrant workers in the tech industry "indentured servitude" since they are beholden to their employers not only to maintain an H-1B Visa, but possibly much longer if they want to obtain a Green Card.

Staffing companies are important players in the landscape of tech work. While even the GAO is not certain how many H-1B Visas are held by staffing companies, at least 10 of the 85 firms with the most H-1B Visas are staffing agencies and six of those are headquartered or operated in India (GAO 2011). Part of the reason it is unclear how much tech work is actually done by contract labor is because US-based tech companies hold far fewer H-1B Visas than there are tech workers with H-1B Visas (Banerjee 2006). The staffing agencies recruit skilled workers primarily in India and contract to place them on projects in the US (Bannerjee 2006). Hiring contract workers through staffing agencies allows companies to ramp up production

quickly when a big project begins then decrease labor costs immediately when the project ends (Banerjee 2010).

The terms of temporary work visas and the practice of hiring workers on short term contracts puts migrant tech workers in vulnerable positions. Because employers hold these visas, legal standing in the US is contingent upon continued employment. Consequently, workers have little recourse against long hours and expectations that they will be completely devoted to their work. It is possible for workers on H-1B Visas to obtain dependent visas for their spouses, but these visas prohibit spouses from working in the US. Since migrant tech workers are overwhelmingly male (Alegria and Branch 2015), this often means that there is a woman in the home taking care of household and family work or workers have a spouse in their home country, making care work in the US effectively moot.

The ideal engineer, completely devoted to work and content to work very long hours, is an unrealistic ideal for virtually any embodied person; however, the terms of temporary work visas and the practice of hiring contract labor provide conditions that push migrant contract workers to work like ideal engineers. Research on work-family balance in professional jobs shows that men and women alike value time spent with family away from work (Reid 2015; Kelly et al. 2011). The combination of visa policies and labor practices in tech may create the conditions where work always wins over family, at least for some migrant workers.

Methods

I explore how tech workers—engineers and non-engineers—understand the work they do, their co-workers' work, and tech work more broadly. I ask how they understand the ideal engineer and how they describe engineering work. Most workers had experience working on international teams, with migrant workers, and in companies that employed contractors. Over

the course of 18 months, I interviewed 45 men and women computing professionals about their jobs and their paths into computing work. I attended three national conferences organized around increasing diversity in tech work. Interview participants were initially recruited from the conferences. Recruiting strictly from conferences about diversity in computing would have resulted in a skewed sample—most of the conference participants were women involved in tech diversity initiatives and many recommended coworkers who were also women with similar interests in tech industry diversity. I used a targeted snowball sample to recruit more men and to recruit women who were not necessarily connected to tech diversity initiatives. This strategy allowed me to interview tech workers from across the country who worked at a wide range of companies.

Unlike studies that focus on one firm, I can be certain that findings do not reflect the idiosyncrasies of one unique organizational environment. Since I was able to interview several workers at most firms and, in many cases, visit the workplaces, I was able to get a deeper understanding of the organizational cultures of each workplace than I would have through interviews alone. Interviews were semi-structured and lasted about one hour. In two cases, participants who were co-workers and knew each other preferred to be interviewed together. These focus group style interviews lasted a little more than an hour and allowed for participants to compare and contrast their experience in the course of otherwise normal conversation. When possible, the interviews were conducted at the participant's workplace, which allowed me to observe the workplace environment. If an in-person interview was impractical, the interview was conducted over video conference. In some cases, participants preferred phone interviews and I respected their wishes. I visited eight workplaces (three in the Silicon Valley area, one in the New York City area, and four in the Boston area) and conducted 20 on-site interviews. In a few cases, I traveled to interview a worker at their workplace and they referred

a coworker who I would later interview on a video or phone call. In total, I visited the workplaces of 27 participants.

About two-thirds (32) of the interviews were with women. With the exception of two women who had some college education and certificates specific to their jobs, all interview participants had at least a bachelor's degree; eleven had a master's degree, and seven had a doctorate. A little more than one-third (16) were people of color: six were Asian and 10 were black or Latino/a. About 15% (seven: six women and one man) of the interview participants were born outside the US. It is a weakness of this study that it includes few interviews with foreign-born workers; however, my focus in this analysis is on workers' experience with and perception of contract work. Most (38) of the interviewees lived and worked in or near the major tech hubs of the west coast, northeast, or Chicago. The majority (30) also worked for tech companies whose primary business was computer hardware or software. Those who did not work for tech companies were members of technical teams working for other kinds of organizations including financial organizations, insurance companies, museums, and educational organizations. About half worked for large, for-profit corporations, six worked for smaller start-up firms, and the remaining participants worked for non-profit, education, or government organizations. All of the interviewees were involved with the processes of creating or managing hardware, software, or computing networks and infrastructure. About half (20) held primarily technical positions such as software developers, system administrators, and programmers. An additional 20 held managerial positions with both technical and managerial responsibilities. Five participants held positions with lower technical skill requirements: they were help desk support workers, technicians, and game producers. Interview participants consistently referred to the people who held primarily technical positions as engineers; therefore, I also refer to this group as engineers.

All interviews were audio recorded, and the focus group style interviews were also video recorded to allow for speaker confirmation. Participant and company names have been changed to ensure confidentiality. The audio recordings were transcribed and coded, line by line, for themes following the grounded theory methods of analyzing qualitative data described by Corbin and Strauss (2008), Charmaz (2004) and Emerson, Fetz, and Shaw (1995). Initial themes were analyzed for broader themes and recoded up to more conceptual level when multiple themes described a similar concept. For example, descriptions of contract work and temporary work were clustered together under the broader code, flexible workers. The qualitative data analysis was done using the software package NVivo 11.

Findings

The Ideal Engineer Trope

All of the workers interviewed for this study had technical training and either worked closely with engineers or as engineers themselves. They had personal experience with the ideal engineer trope, which many invoked at some point in the interview. Women in particular identified, and were critical of, the notion of the “ideal engineer.” The women I interviewed did not see themselves or other women in this trope. For example, Nina explains her understanding of the engineering education and culture that pushes engineers to be devoted to their work and willing to work for very long hours:

It’s definitely partially expectation as well as, I think, it’s part of the structure that they were brought up in . . . To be a good engineer there is an expectation that you will be teaching yourself various things on your own and that for the most part you’re not going to get it all from school . . . You’re going to be doing research time by yourself you’re going to be doing coding time by yourself to figure things out . . . And yes, there’s definitely pressure from the job of like, oh my god deadlines, and we have to get this done and sometimes that is definitely taken advantage of. . . I feel like—and this might actually be more cultural than gender, possibly as in we emphasize on boys that they should pay attention and care about these things.

Nina holds an intermediary position between the art and engineering departments at a gaming company. She is trained as an animator, but she also took coding classes with an emphasis in robotics as an undergraduate student. Not only does Nina describe at least part of the ideal engineer trope, she explains why engineers would work the long hours and clearly genders these behaviors masculine.

Andrea works as a teacher and consultant on open-source system administration. She describes the “personality type” needed for programming based on her experience:

There are certain personality types that are needed for some of these fields. The programming has the stereotype of 2:00 a.m. cold pizza and warm beer mentality, and avoidance of the sun, and various other types of things. And luckily, I know a few guys that don't follow those rules as well. But, I know plenty. . . there are certain personality types that just don't fit. Most women I know are a little bit more social than some of the programmers that I know.

The “personality type” that Andrea describes is decidedly masculine—she implies that programmers invert day and night, suggesting they do not have day time family care responsibilities (possibly because they do not have children or because they are not primary care providers). She is also clear that most women are too social and thus they do not have the personality needed for programming, even though she does know (presumably men) programmers who do not have this personality and she herself has the skills to be a programmer. The issue is not that programmers need to have this personality, but rather this personality is part of the ideal engineer trope against which potential engineers are measured. While this personality is decidedly masculine, it is a variant of masculinity akin to the heroic masculine engineer—closing deals, writing flawless code, and working 24 hours a day—who rejects athletics and embraces gender equality that Cooper (2001) identifies in Silicon Valley.

Femininity is inconsistent with the trope and thus women, insomuch as they perform normative femininity, fail to measure up. This does not mean that women are not or cannot be

engineers. Like the *maquilas* Salzinger (2003) observed, not all tech workplaces had the same gender relations and some provided space for women to fit in better than others. Throughout the interviews and fieldwork, I heard about “brogrammers,” particularly from young women engineers. Donna is a young engineer who used the term brogrammer. When I asked what she meant by brogrammer, she explained that it was part of a workplace culture that she preferred to avoid.

So, there's a term in the English language, I believe, which is a bro, which I believe— anyway, has a certain connotation and we bind that to programmer, especially in the environment where almost all the programmers are guys, which I thankfully haven't been in much. Then you get “let's do some pushups” type of thing. Very masculine. Some people say it's that culture. And I don't think that that is a terribly welcoming work environment for me. And I haven't been in one, but I have read a lot about it on the internet.

Ellen, another young engineer, also described avoiding workplaces with cultures that reflected the kind of masculinity described above by Andrea. For Ellen, avoiding men with the “personality type” that Andrea described was part of the reason women tend to stay away from computing, which she explains in terms of her experience as an intern for a gaming company:

The more I think about it the more I suspect that the dearth of women is as much because there's sort of a tacit [understanding that] it's not really acceptable for women to be interested in these things, as it is a fear of working closely with smelly men. Although I actually had one of those smelly men experiences. I did work an internship for a month senior year of college at this computer game company. When I did my internship five years ago, there were like five people and they were just every inch your stereotypical computer guys. Every inch. Like we went to go do a pitch at some big gaming studio and one of them had clearly been there all night. Someone says it's time to go and he opens up his drawer and takes out this ball that turns out to be a button-down shirt. Shakes it out. Puts it on and says ok 'I'm ready to go.' I was like, I want to be out of here so fast I can even tell you. Take me away! Take me away! I don't want to be here anymore. It's dark and scary!

Ellen and Donna both avoided working in places where the masculine ideal of engineering featured prominently in the workplace culture. Other women described changing companies

and moving into different positions where the team culture would be different to avoid people who embodied the ideal engineer trope and workplace environments that emphasized the same. Places organized around expectations that workers would embody the ideal engineer trope certainly exist, as Ellen demonstrates; however, this trope does not describe all engineers or all engineering workplaces.

Long Work Hours

The ideal engineer trope may be a metric against which potential engineers measure up and an idea that shapes some workplaces, but the idea that engineers work exceptionally long hours was not borne out by tech workers' descriptions of their work. Instead, I found that engineers occasionally overworked, but when they were expected to do so over a prolonged period, they were resentful. Most worked something like an eight-hour day the majority of the time. Managers overworked routinely, but they had more control over their schedules. Many described checking e-mail at night, working on Sundays to prepare for Monday meetings, and sometimes scheduling very early or very late phone meetings with co-workers in offices in Europe, South America, or Asia. They described working conditions that resembled the always-available expectations for professional service workers that Reid (2015) identified.

Marina and Vanessa described their work days in ways that were typical of managers. Marina is a project manager, meaning that she coordinates a technical team's work on a software product. Some of the work she coordinates happens in offices overseas, which she describes as "distributed applications." She explains what a typical day is like for her:

Because of distributed applications, I might have really early meetings or really late meetings. Depending on that, I basically have to adjust my daily schedule and I can take some meetings from home in the morning and then it takes me about an hour to commute to the office. I try to arrive early before my next meeting so I can search through my e-mails and understand what's happening in the world today. Then I usually, per day I have about 3 meetings, I take a lunch break and when I have time I try to go to

the gym during lunch . . . And then I do the rest of the day in the office, go home have dinner with my husband and perhaps have some more meetings [after dinner].

Vanessa is a manager of a technical team. She describes her habit of using weekends to catch up on e-mail and prepare for meetings.

I look at my e-mail that's pretty much my first thing. So Sunday night for example I will look at my e-mail and I will look at my schedule for the next week especially Monday morning to see if I need to get prepped for anything and then I will prep for it. I always go through my e-mail especially on Saturday and always on Sunday to get ready for Monday

Marina and Vanessa have some control over which of their non-work hours they will spend working and Marina is able to make time during the day to go to the gym, but they both routinely work more than a standard, 40-hour week. On the other hand, most men and women engineers described working close to an eight-hour day. Stanley is a software engineer for a medical device company. He explained that he often arrives at work late in the morning but has flexible hours and can choose which eight hours he will work.

We do have flex time so it's like as long as you do your time no one cares. My supervisor is very relaxed about and he's like hey listen, if you get your project done come in at 11 just make sure the hours are on the schedule and yeah so

Interviewer: so you work 11-7 instead of 9-5

Stanley: Exactly.

Ellen explained, "I usually get to work just a smidge behind my coworkers" and "at 6 o'clock the go-home-time bell rings and we go home." Some engineers did work longer hours. Three interviewees worked at gaming companies and explained that everyone—engineers, artists, managers and technicians alike—worked 75-80 hours per week when big project deadlines were looming. Ron is a senior system administrator. He explained how his work hours ramp up during production times and slow down when projects end:

I probably work about 60 to 80 hours a week. I've tried to scale that back to 45 because it's unhealthy. This is a curve, that golden curve. We just went through a production . . . So, we're kind of rolling back a little bit and now we're taking a breath a little bit.

Travis is a senior engineer who found himself on an understaffed project working 80 hours per week. He felt resentful and disrespected when his company tried to recognize his contribution.

I mean, if you really wanted to recognize my contribution, then maybe you could have put a few more people on the project. I mean, I didn't have to—there was really no reason for me to have to work 80 hours a week because there was no one else to do the work. I mean, and I was doing that, like, for three months.

After he completed the project, Travis left for a different company. Some engineers, like Ron, did work long hours, but I found little evidence that they worked more than the non-engineers, especially when compared to those in management. Both engineers and non-engineers had considerable flexibility and control over their schedules. The managers had more autonomy to make their own schedules, but that autonomy often turned into night and weekend work. It is possible that tech organizations all have a culture of long work hours and the engineers did not recognize how much they work; however, the culture of overwork among professionals and managers is well documented (Cha and Weeden 2015; Reid 2015).

Work Family Balance

Men and women alike made choices to prioritize family, but with different consequences. Men were unlikely to make changes to their work lives that marked them as prioritizing family over work. Keith, a senior engineer, describes cutting back on his work hours when he became a parent:

A typical day is a I wake up I try to get to the computer it used to be by 7 o'clock I like to try to start early leave mid-afternoon then I actually sometimes go back to work around 8 o'clock and work until maybe 10 so that's dwindling more now that we have a daughter.

Keith's description of his work hours is strange because he does not describe his current day, he describes his pre-parenthood day. He explains his 10-hour days "have dwindled" but does not explain how much. Keith presents himself both as an ideal engineer and a father with reasonable work/life balance even though the two identities are at odds. Keith is able to use the flexibility in his job to spend time with his family, while presenting himself as the ideal engineer devoted to his job. Rebecca also makes a priority to leave work in time to see her kids in the evening, but she feels some stigma for doing so.

One of the big challenges I face is, frankly, I get—I leave at 7:00 in the morning. I leave work at 5:00 and I'm usually the first one to go to somewhat dirty looks. And I still take an hour before I get home to my kids. And so, I see my son for an hour a day, that's it, Monday through Friday.

Keith seemed to diminish his work/family conflict by describing his pre-child schedule and appeared to be more of an ideal engineer in the process, but Rebecca highlights her conflict and distances herself from the ideal engineer. She is a manager, relatively high up at a multi-national tech company, and she has the flexibility to work from home or alter her schedule to accommodate early morning or late night meetings. She explained earlier in the interview that she had worked as an engineer and moved into management both to escape the masculine culture of the engineering team and to have more flexibility in her schedule for parenting. Keith and Rebecca work virtually the same hours and both make time to spend with their children but Rebecca ends up feeling stigma because she leaves the office at 5p.m.

Rebecca was not the only mid-career employee to have moved into management. Many of the mid-career women I interviewed were in management positions and several noted that this is a common trend. For example, Janethe, a young engineer, observed that many of the women she knows in the tech world are often managers:

I feel like a lot of people I meet who are women in technology often are managers which is interesting they are not the technical people they're not the programmers or maybe they started off being a programmer and shifted away from it and then they became managers.

Management positions offered more schedule control, but moving into management meant that workers would effectively lose their technical skills. Tim explained why he would not want to move into management. "I feel like that would just be a way towards ending my career. Eventually, my technical skills would get so bad that I wouldn't be able to go back and get a technical job." Many managers had been engineers and moved into management with the expectation that they would lose their technical skills and could not go back into an engineering position. Since women more often left technical for managerial positions, this one-directional move has the consequence of removing women with technical skills from engineering positions. This in turn reinforces the masculinity of the ideal engineer. They gained flexibility and moved into positions that emphasized communication over technical skills, but they became less mobile in the process.

Women with technical skills also sacrificed their engineering careers to take parental leave. None of the men I interviewed even mentioned taking parental leave, although many of them had children and worked in companies that offered parental leave. It is possible that they just did not mention taking leave in the interviews, but one clear difference is that men did not take leave long enough that it hurt their technical skills. Loss of skill was a serious concern for women taking leave. Karen maintained a relatively light workload as a consultant when her children were young to maintain her skills.

I could still be around and be a mom and still, but the thing about tech too as a woman is if you are going to have kids, you have to be careful. And I was kind of conscious of that because you can't step out of it because it's very hard to step back in. So, I kept my hands in the whole time.

Vanessa had a child with a disability and felt she could not stay in her tech position and care for her son so she took a new job as a paralegal. She explained, “I had been out of the high tech area—you’re out for 2 or 3 years and you’re out for a long time—you’re out for 11 years and it’s a whole new world.” When Vanessa’s son was older and in good health, she returned to the tech industry, which she loved, but she returned as an “executive administrator.” She returned as an administrative assistant and worked her way back into a position managing a technical team. Despite this experience, Vanessa felt that her company was deeply committed to work/life balance and cited the company’s “bring your dog to work policy” as evidence:

[My company] is a huge believer in work/life balance. Huge believer in that. They always have been. As a matter of fact, that’s why the dogs became such a big thing here. The rule was we can bring our dogs [to work] here and the reason why is because way back in the day people would spend their lives here . . . So what they ended up doing was because people couldn’t go back to let their dogs out at their home they said just bring your dog in and that’s how bring your dog to work came . . . It wasn’t just a great benefit there was a real reason for why it started.

Vanessa’s case was extreme. She was out of tech for 11 years, even though she was not out of the workforce. When she returned it was to a low-status administrative position at a company where bringing your dog to work counted as a policy to help employees balance work and family. The ideal worker, who put work first and could work very long hours with no rest, but not a mother of a child with disabilities, could thrive in this environment.

Ideal Engineers

The workers I interviewed did not match the ideal engineer trope, regardless of whether they were men or women, US-born or immigrants. Workers at big, multi-national companies especially explained that teams of contractors consisting mostly of Indian migrant workers and “APAC” (overseas, Asia-Pacific teams) were very involved in software development work.

Contract workers do not enjoy the same benefits as full-time, salaried employees. Angela works

as a consultant for a multi-national software company. She explains that she likes being a consultant because she can turn work down if she wants a vacation, but she does not have benefits through the company:

I mean, there's certain things I can't do here because I'm not an employee. I can't participate in certain meetings. They have--if my manager has a meeting with his entire staff, and everyone that works for him, I can't attend, and neither can any of the other consultants . . . I get less benefits that way, but for me, I love the freedom.

Angela went on to explain that the company for which she consults has moved most of its software development work to India and Singapore.

[The APAC teams] pick up the code and push it to production. There's a good coordination between the U.S. and APAC. I mean, they have different functions. But, that—again, like I said, it's the strategy of a company . . . to please stockholders, to have the right flexibility in keeping your budgets lean, having the right expertise.

Angela's reference to expertise is noteworthy. Her point is that different teams have different skills and the company locates each part of production in the geographic location with the team that has the relevant skills. The company can keep its budget lean by distributing different parts of production to teams that have the exact skills for the job at the lowest cost. Some of those teams are in the U.S. and some are overseas. Rosemary is a project manager for a software development team at multinational finance company. She explains how her company uses contract labor for software development.

When I first started at Asset Base, we didn't have any contract labor from overseas at all, none. And I can remember when we first started this, the numbers were, like-- maybe the first year, it got up to 15 percent . . . And I think we're about half and half right now, honestly, in our workforce . . . I think economically that almost every company of, say, medium or large size, to compete over the last—especially last 10 years, almost has to use contract labor. And a lot of those were from the H-1[B] Visas. Now, our company will not sponsor. They do not sponsor. So, the labor pool that we have that's from offshore is—are contracted through companies.

Rosemary's belief that big companies need to hire contractors because they are less expensive and increase profits was common among workers at similarly sized companies. Angela's comment above demonstrates a version of this. It is significant that interviewees observe contract and overseas labor used primarily for development and production work.

Rajni is an engineer on a large software development team at a multi-national software company. She explains that the majority of her teammates are from overseas, "[F]oreign born people on our team are definitely more than half." Software development is the core engineering work needed to build software products. It is the computing-related occupation that employs the most workers (ACS 2014). In other words, interview participants shared a perception that the core engineering work needed to create software is now primarily done by migrant contract workers.

Even employees on small technical teams at non-tech organizations had experience working with contractors. Some workers at larger companies noted that their companies did not hire the contractors directly, but went through staffing agencies to hire workers who would already have the exact skills they needed and who could appear when a project started and disappear when it ended. Lauren is a mid-career manager who started her path into tech work with on-the-job training. She reflected on the practice of hiring contractors:

And then there's--it's cheaper for companies to hire people from India. They get hired through a contracting company . . . Indian people want to get their Green Card so they can stay here, a lot of them, so that they can continue to work and have freedom, and they will stay with whatever company has hired them in order to get their Green Card . . . They will put up with anything because the Green Card is the most important thing.

Contract workers do not have labor protections and they are vulnerable to employers in ways that domestic workers are not. If they lose their job their visa can be revoked. Not being hired onto a new project could jeopardize contract workers' visa statuses (Banerjee 2006). This

vulnerability may lead to the belief that Indian workers are willing to put up with difficult working conditions. Several workers voiced a belief that Indian workers are willing and able to work long hours because they had stay-at-home wives who were fully responsible for the household labor. Alex explains her observations about her Indian co-workers on a software development team.

So—and one of the things that I really noticed once I had a child—it didn't—I could put up with all that other stuff. But, when I had a child, what I really noticed was one of my male Indian colleagues would have a child. And it's—like, in their culture, the woman stays home. The parents or the in-laws come, and they help her. And that guy doesn't have to worry about taking care of his baby.

Alex's explanation of gendered norms casts Indian culture as more traditional than American culture, in which she is expected to balance work and family. She is understandably frustrated when her co-workers make her feel uncomfortable for leaving at 5 p.m. after she has a baby, while they stay at work with their wives at home caring for children. Alex was a single mother on a technical team with a young child at home. Eventually, she left the technical team for a management position that gave her more flexibility over which hours she worked, though she still routinely worked nights and weekends. If her Indian colleagues are on temporary work visas, as many Indian tech workers are, there is a good chance that their wives are in the US on dependent visas which prevent them from working at all. They may not be staying home and caring for children by choice, but because the migration policies that commonly affect Indian tech workers coerce Indian families into a male breadwinner model. Engineers are expected to work long hours fully immersed in highly technical tasks. The combination of work environments and visa requirements create conditions for migrant engineers to match the ideal engineer trope.

Discussion

Throughout the interviews, I found no evidence that engineers worked especially long hours. If anything, the engineers described working closer to 40-hour weeks than the managers. The important difference was the managers had more control and flexibility over their schedules. They could leave work and pick up their kids from school, take early morning phone meetings at home, and return to their e-mail after their kids went to bed. When the engineers worked long hours, they had less control over when and where they worked. For example, if the server went down at 2:00 a.m., they had to go into the office and fix it. Flexible work policies, such as the ones Goldin (2014) advocates, make sense for managers. Control over their schedules allowed managers to overwork without feeling resentful or feeling that they were missing out on spending time with their families. Many of the mid-career women I interviewed had moved into management from technical positions and enjoyed the increased flexibility that came with the move. This kind of flexibility is antithetical to the ideal engineer trope.

Meanwhile, software development work, as imagined and described by the interview participants, increasingly happens in teams made up of foreign-born contractors in the US or else the work is done overseas. Regardless of whether contract and overseas workers really are primarily responsible for software development and production, the perception that they are is important. Inasmuch as domestic workers observe how contractors work, they likely have work habits that reflect the ideal engineer trope. Conditions of temporary work visas allow employers to determine workers' immigration statuses and prevent dependent spouses from working. These workers can be asked to work long hours and prioritize work over family; the employer can literally revoke their visa if they refuse. Although the engineers I interviewed do not work

like ideal engineers, the core engineering work in the tech industry is imagined to be done increasingly by workers who work under legal restrictions that can easily coerce them into working in ways that match the trope. It is a weakness of this study that it does not include interviews with contractors.

The ideal engineer trope does not reflect the real preferences of embodied people. Instead it is a guide, a standard against which potential workers can be measured for fitness as engineers. Without migrant labor and the accompanying visa policies, it is difficult to imagine the trope surviving. Even the one engineer among the interviewees who was content to work 80-hour weeks explained that his ideal job would be working on his farm. It turns out that most people, women and men alike, do not want to work very long hours focused on single tasks. It is hard to imagine that the engineers I interviewed would have accepted these working conditions for long. Several engineers explained that finding a new job would be easy and a few described changing jobs to reduce time demands. The perception that software development is increasingly done by contractors keeps the ideal engineer trope alive even though it does not reflect the work preferences of most engineers who can freely choose other work arrangements.

The ideal engineer trope is different from the ideal worker as described by Acker (1990; 2006). Acker (2006) clarifies that the ideal worker who, she argues, is a heterosexual white man is the worker around whom labor practices are organized, but not necessarily the worker who employers expect will actually perform every job. The ideal tech manager would also be able and willing to work any and all hours of the day, but they need additional interpersonal skills that ideal engineer does not have. Of these positions, management is the more gender neutral, emphasizing feminine-typed communication skills over technical skills. Unlike engineers, managers were not expected to be in the office at their desk writing bug-free code and

immediately fixing broken technology. Dedication to their jobs could not be measured in hours spent at their desks. They were free to take early morning calls from home, go to the gym at lunch time, respond to e-mails after dinner, and prep for meetings on the weekends. Managers had considerable schedule control, though like Rebecca, they sometime felt pressure to show their face in the office. Like the consultants at the professional service firm in Reid's (2015) study, the ideal manager was one who adopted an identity of devotion to work, constant availability, and extreme competence. They were free to work anywhere, anytime, but that also meant they could work everywhere all the time—and some did. These are the workers best positioned to take advantage of flexible work and family leave policies, but their additional freedom and schedule control might actually mean they work more, not fewer hours. They are able to bring children to school in the morning after their call with the Berlin office, able to end their day at the office in time to have family dinner before the calls and video meetings with the APAC team, and able to catch up on e-mail during Saturday morning soccer games. Engineers did not have this kind of schedule control, but they also did not have these kinds of demands. Managers could take parental leave without worrying about their skills declining, but they could, and likely feel an obligation to take calls with important clients and respond to e-mails while on leave.

The flexibility and demands of managerial jobs are not organized with Acker's ideal worker in mind. This ideal manager is a fundamentally different and new kind of ideal worker, one who is fully responsive, available, and devoted to both work and family. Many managers worked with teams that were spread across the globe and could not possibly put in the face time at all of the offices. Instead they can respond to

e-mails quickly, hold multiple meetings in their local office each day, over-prepare, and over-deliver. They can adopt their job as part of their identity and take on the company culture

as part who they are as a person. I argue that, at least in professional jobs that provide schedule control and flexibility, work is organized around a worker who fully adopts their work as part of their identity and therefore does not always discern between work and personal life, company goals and personal goals. This is a set of labor practices that was not possible in the 1980s when Acker was developing her theory of the ideal worker. It is only through a combination of technologies that allow workers to stay plugged into work everywhere all the time, business models that distribute production around the globe, and tools that let workers communicate instantly with counterparts thousands of miles away that this new ideal worker can emerge.

Conclusion

The flexible labor policies tech companies are introducing mostly help women who are already in managerial, not engineering, positions. These policies do not impact the conditions of work for contract workers. I do not wish to downplay the real relief that many women are likely to feel as a result of these policies. Paid leave and flexible hours would certainly help women in management positions. For men and women on engineering teams, the pressure to complete projects, fix bugs, and stay up to date with the latest technology is likely to make flexible work policies difficult to leverage. By attempting to officially use these policies, women reveal that they are in fact not ideal engineers—they are not completely devoted to their work above all else. Even if they are able to work from home, writing code is not a task one can do while holding an infant. Women engineers could best utilize these family-friendly policies by moving into management positions, where they risk losing their technical skills and their job mobility. These positions are promotions and, if the goal, as Goldin (2014) states, is to close the gender wage gap, women engineers moving into management may be the answer. Of course, if the goal is diversifying engineering, it does not help when women leave engineering for management.

This study suggests flexible work and family leave policies may help women balance work and family, assuming women move into managerial positions where these policies are most applicable. Unfortunately, to the degree that these policies are more accessible to managers, they also reinforce engineering as masculine and they conflict with the efforts to recruit and retain women in tech. It may have the effect of decreasing the gender wage gap because promotions into management are likely to come with pay increases.

This study demonstrates a complex set of trade-offs. Men and women value time with their families and away from work. Domestic engineers have choices: they can leave jobs that demand too much and find new ones relatively easily. They do generally spend a full day at an office and they have to be careful to keep up with changes in technology that prevent them from taking breaks from the labor force. The engineers I interviewed worked in jobs organized for workers who had limited family care responsibility and could prioritize work for at least eight consecutive hours per day. These working conditions are challenging for workers with family responsibilities generally, but engineering also has a masculine culture that suggests women are a poor fit. The combination of the push by masculine culture and the pull of increased flexibility in managerial positions draws many women away from engineering into management. Migrant workers, especially if they are working as contractors, do not have the same freedom to demand reasonable work hours or the opportunities to move into management. If the goal is to decrease the gender wage gap, the current trends may help. If the goal is to increase women's representation in engineering, then engineering work needs to become more like managerial work.

The current model serves companies' interests by replacing empowered domestic engineers with exploitable migrant engineers and by managers willingly adopting their jobs as their identity and working nearly constantly. If the goal is to maximize profits, the model of

managerial work should extend to domestic engineers so that they willingly work nearly constantly too. It is worth noting that strategies for increasing women's participation and for increasing profit align. The companies, policy advisers, and academics advocating for women's participation in tech and for more family-friendly policies as a way to reduce barriers for women constitute powerful voices. It is important to recognize the consequences of these policies in the context of how tech work currently gets done.

CHAPTER 5
WHAT DOES IT MEAN TO BROADEN PARTICIPATION IN THE CONTEXT OF CONTEMPORARY
TECH WORK?

This dissertation began by asking why women’s representation in tech has decreased despite investment and seeming buy-in from both the public and private sector to increase women’s participation. There is not just one answer to this question, especially when we examine not only gender, but race and migration too. In the introduction, I showed that the simplest answer to why women’s representation decreased is that the number of women entering tech did not keep up with growth in the field. The tech industry grew dramatically after 1990, when women’s representation peaked, but the number of women remained relatively stable thereafter. To be clear, stagnant numbers in a growing field mean that the field masculinized and became more gender segregated over this period. It still means that women are not fully participating in tech jobs that offer good wages. However, by broadening the lens beyond gender, I showed the increase in the number of tech workers is mostly driven by immigration—primarily men’s immigration. The number of US-born tech workers, men or women, changed relatively little over this time. Instead, the workers who fueled growth were immigrant workers who have considerably less power to negotiate for benefits and working conditions.

Across the three substantive chapters, I developed different aspects of the appropriate labor concept. The term “appropriate labor” comes from Wooten and Branch (2012) who use it to describe the shared understanding about who is appropriate to do which kinds of work and why. They are advancing a concept developed most fully by Glenn (2002). By tracing the labor relations and citizenship of blacks in the South, Mexicans in the Southwest, and Haole and Japanese in Hawaii, Glenn (2002) demonstrates that gender and race are principles that

organized both labor and citizenship. Labor is a means of reinforcing, formalizing, and even creating racial/ethnic and gender hierarchies. Throughout this dissertation, I built on the concept of appropriate labor to understand whose work is valued, why women tend to move into managerial positions, and who the ideal engineer is. The idea that some race and gender groups are better suited to some jobs than others is productive in that it allows us to make meaning of race, gender, and work at the same time.

In chapter two, I used appropriate labor to consider how constructions of race and gender may change as labor relations shift and how the reverse may also be possible. Tech work, especially engineering, is gendered masculine. The engineer of the ideal engineer trope is, without doubt, masculine; however, the emphasis and business case companies are making to motivate their efforts to recruit women has the potential to shift how tech work is gendered. The business case holds that the teams that make technical products should reflect the demographic diversity of the people who buy the products, ensuring that the products work for the diverse range of consumers. The logic behind the business case disrupts the idea that masculine labor is desirable for tech engineering. It sets a diversity imperative for the industry that it has failed to achieve, but one that has the potential to meaningfully change how employers imagine who engineers are. The majority of tech workers are white and Asian men, which does not bode well for the business case. However, the smaller wage penalty for US-born, underrepresented minority women than US-born white women provides a least a glimmer of hope. Black and Latina women in tech are so underrepresented they are sometimes referred to as “unicorns,” a phrase I heard used several times in the course of my fieldwork. If companies are making a special effort to recruit these workers with higher pay than they would offer white women, it could be a sign that how we think of engineers may be changing.

Building on Appropriate Labor

For appropriate labor in tech engineering to change, there would need to be a shift in how we understand either engineering or femininity. As chapter four argued, the engineer of the ideal engineer trope is focused primarily on work, works very long hours, approaches their work as if it were a competition, and possesses technical skills to the exclusion of interpersonal skills. As chapter three showed, we imagine that women prioritize time with family over extra time at the office, prefer to work collaboratively, and, even if they have technical skills, they are still good communicators with strong interpersonal skills. Chapter three also provided an example of the how the skill requirements for programming changed already in the not-so-distant past. That change coincided with a shift in who recruiters targeted for programming work, from mostly women keypunch operators to men bound for management-level jobs (Haigh 2010). We can imagine tech work changing again to be more inclusive where workers have more control over their schedules.

Rather than changing tech work, chapter three showed that many white women with technical skills and training find themselves in what I call translational management jobs. Tech jobs have expanded to include new jobs where women's labor seems more appropriate. These jobs offer schedule control, but the white women in these positions emphasize interpersonal over technical skills. In this chapter, I further developed the idea that appropriate labor is productive in that it shapes our understandings of race, gender, and work. If more women moved into tech, it could have the consequence of changing how we understand femininity, how we understand tech workers, or, more likely, shift both in small ways. White women who enter tech are promoted into managerial positions where the work seems to require feminine-typed interpersonal skills (the same jobs did not seem to require these skills when men held

them, however). This shift seems to provide for a new kind of white feminine tech worker without threatening the masculinity embedded in the ideal engineer trope.

Importantly, when men worked in management, they did not describe their jobs as translational. They emphasized their technical skills, not their interpersonal skills. Whether or not they actually did the same jobs, how the men and women managers imagined their jobs was different. Men imagined their work aligned with engineering while white women emphasized feminine skills and activities, especially communication. White women managers describe themselves doing jobs and their supervisors promoted them into jobs where the work aligned with normative feminine expectations. Black, Latina, and Asian women's femininity did not seem to present the same normative mismatch; they were not offered unexpected promotions into jobs that emphasized feminine labor. Engineering remains masculine while a new set of translational jobs shuffle white women into positions where race, gender, and labor expectations align. Meanwhile, women of color are virtually invisible or mythical—unicorns.

Chapter four explored the ideal engineer trope further. In this chapter, I developed the relationship between appropriate labor and coercion. I showed that family-friendly work policies miss the mark for broadening participation in engineering positions. Tech companies frame these policies as if they are strategies to recruit and retain women. Realistically, these policies are most available to managers, since managers have considerable control over their schedules and need not worry about their technical skills dulling if they take parental leave. Inasmuch as we expect women to prioritize family, they can perform normative femininity more easily in a managerial job. Normative coercion helps to channel white women out of engineering and into management.

Chapter four also showed that US-born engineers tend not to work like ideal engineers. They typically work something close to an eight-hour day unless they need to tend to an

immediate crisis or deadline. Despite the relative regularity of the workday for engineers, they had considerably less flexibility than the managers. They may have been able to start their work day when they liked, but most engineers spent an eight-hour work day in the office. Engineers were constrained enough that management offered better opportunities to balance work and family, but not so constrained that they embodied the ideal engineer trope. Glenn (2002) demonstrates that citizenship is an important factor that shapes and is shaped by labor relations and chapter four finds evidence of this as well. US-born engineers, regardless of race, do not look like ideal engineers, but as the interview participants observe, US-born engineers make up a decreasing proportion of software developers and programmers.

Immigration and Exploitation

The tech field would not be what it is without immigrant labor. In the US, we often think of immigrant labor in terms of low-wage work and we fear immigrant workers taking jobs away from Americans. Immigration in the tech industry is completely different. Wages for migrant workers are high and, as chapter two showed, most migrant men earn more than US-born men and most migrant women earn more than

US-born women, net of controls. Gender, race, and migration shape wages in the tech industry in profound ways. Immigrant men from the global West are the best paid tech workers, relative to their characteristics, followed by Asian immigrant men and Asian American men, then US-born white men and Asian American women. Race is powerful in shaping how we value tech workers. US-born, underrepresented minority men and men from the non-Asian global South (who often become “people of color” in the US) experience wage penalties relative their positions and credentials unlike any other men. The penalties for women from the non-Asian global South are notably extreme.

Women are consistently paid less, relative to their characteristics, than men in their race/migration group. Yet, US-born, underrepresented minority women had a smaller penalty than US-born white women, while Asian American women had no measurable penalty at all relative to US-born white men. This was not the case for men. Asian American men had a slight premium relative to US-born white men, while US-born, underrepresented minority men experienced a penalty. These processes become more complex for immigrant workers who are enmeshed in US-based understandings of race, histories of colonial legacies, and international relations that shape immigration policies and labor practices.

Companies increasingly contract with staffing agencies to hire migrant contractors, primarily from India, to work on short-term projects. These workers often do not receive benefits from the companies who purchase their labor. Since the tech industry primarily uses H-1B Visas, which employers hold, to hire migrant workers, the workers can lose their visa if they lose their job. In the longer term, about half of workers on H-1B Visas eventually get Green Cards and stay in the US (Lowell 2001). Many of these Green Cards will be sponsored by employers (Matloff 2013). This practice allows employers to keep migrant workers immobile for possibly 6 to 10 years, regardless of working conditions, while they wait for their Green Cards. Since migrant tech workers are overwhelmingly men and spouses who come to the US on dependent visas cannot work, these men have wives who have little choice but to manage household labor if they come to the US. The combination of migration policies and labor practices that emphasize project-based contract work form a basis of legal coercion whereby non-citizens become ideal engineers, whether they want to or not. Through these chapters, I demonstrate that appropriate labor can be productive, shaping our understandings of race, gender, and work; coercive—both normatively and legally—but potentially transformational as well.

Broadening Participation

Broadening participation efforts need to acknowledge that immigrant workers are a piece of the puzzle and labor practices in tech need to be addressed. Glenn (2002) pointed out that farmers in the Southwest in the mid-1900s claimed they had a shortage of agricultural workers, but closer examination demonstrated that what seemed like a labor shortage was a result of labor practices. The farmers wanted to hire a huge, cheap workforce to harvest all of their crop in just a few days so they could get it to market immediately when it was at its peak. Then they wanted that very large workforce to disappear as soon as the harvest was over. In order to accomplish this goal, they needed to have a vast supply of surplus labor, people who would willingly work for low wages on short-term projects then move on to the next farm and the next harvest. The practice of hiring contractors through staffing agencies and outsourcing programming to overseas offices to prepare software “just in time” for production deadlines is the modern tech equivalent of what the farmers in the Southwest tried to do. The tech workers earn high wages, roughly the same as US-born workers, but they are still cheaper since companies do not owe them benefits and only pay them for the short period of time when their labor adds the most value. Workers who have better options do not want to work under these conditions. These labor practices exploit vulnerable migrant workers, artificially explode demand while depressing working conditions, and hurt broadening participation efforts.

US-born engineers have more leverage and they do not work under contract labor conditions unless it suits them for other reasons (for example some mothers left full-time work for limited consulting when their children were small because it allowed them to keep their skills current and they could choose which projects to accept). Meanwhile, managers had considerably more control over their schedules and used their flexibility to put in more work

hours. Managers, where white women were concentrated, contributed labor constantly. The policies that made management jobs more appealing to white women also made them more profitable for companies. In some important ways, broadening participation initiatives have allowed companies to extract more labor out of workers, especially white women workers. Expanding flexible work policies to engineers would likely help to shift the ideal of who engineers are to better align with normative femininity. In which case, engineers may contribute more and more labor just like managers. On one hand, white women are better able to balance the competing parts of their lives, and on the other hand, they become more valuable as employees because they work more hours. It is easy to see how flexible work and schedule control for engineers would benefit companies since they would likely get more labor from workers and they could more easily recruit or retain more women, especially white women, in engineering positions.

These findings have implications for broadening participation efforts. First, and most simply, the gender and race gaps in wages need to be addressed. Companies need to ensure that workers in the same job with the same experience and education receive the same wages. Several tech companies made news for releasing the demographic profiles of their workers as a show of their commitment to incorporating women. Ensuring gender and racial equity in pay would make even bigger headlines and allow them to double down on initiatives they already publically embrace. Second, inasmuch as flexible work and family-friendly policies help women, they should be practical for engineers. Kelly, Moen, and Tranby (2011) demonstrated that, with some commitment to avoid judging and stigmatizing employees who take advantage of flexible work policies, it is possible for men and women to use and benefit from these policies. Workers were more satisfied and had better health outcomes when they had more schedule control (Kelly et al. 2011; Moen et al. 2016). This dissertation suggests that increased schedule control is

likely to increase the hours that workers spend working, making these policies even better for companies. Third, the practice of contract labor needs to be limited so that migrant contractors are less exploitable. Allowing dependent spouses to work and allowing workers, rather than employers, to hold work visas are two steps that would help. Migrant contractors keep the ideal engineer trope alive. If this system were less powerful and migrant engineers had the same power in the labor market as domestic engineers, it would become clear that real people are not naturally inclined to prioritize work over everything else in life. Ultimately, the idea that masculine labor is appropriate for engineering needs to shift if broadening participation efforts are to be successful.

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