Why women 1 tech: what the research says

(Who made this document and why)

There aren't enough women working in tech: the best-available numbers estimate that about 15% of tech company employees in technical roles are women.[1] The numbers were improving through the seventies and early eighties,[2] but since then they've been getting worse: women's participation in the tech industry peaked in the late eighties, and has been dropping ever since.[3][4][5][6] (*See chart*.) The decline is unique to engineering/computer work: elsewhere in STEM women's participation is slowly growing.[7] According to researchers, computer science has the largest diversity gap of "almost any profession."[8]

The underrepresentation of women is a problem because technology has massive, ever-increasing social impact: it shapes our world, and currently we aren't benefiting sufficiently from the contributions of women. A lack of women means missed market opportunities, less innovation, and fewer good products and services. There's lots of research showing that women are more altruistic/societally-motivated than men are (needs citation), which suggests the products and services built by the tech industry might be more societally useful if more women were involved in their creation.

Girls and women are underrepresented throughout the world of technology, and they drop out of the pipeline at every stage.[9][10][11] Ten years after graduation, only 25% of female STEM graduates are still working in STEM.[12] Women

[1] Internal link
[2] Tech's Gender Gap Wasn't Always So Bad. Here's How It Got Worse, Wired magazine, 25 November 2014
[3] In 1991 36% of computer-related jobs were held by women. By 2008 that number had dropped to 25%. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008
[4] In 1985, 37% of undergraduate computer science degree recipients were women. By 2012 that number had dropped to 18%. National Center for Women and Information Technology, 2014
[5] Women Who Choose Computer Science -- What Really Matters, Google white paper, May 2014
[6] The percentage of women software developers in the U.S. has declined from 42% in 1987 to less than 25% today. Agile Values, Innovation and the Shortage of Women Software Developers, 2012 45th Hawaii International Conference on System Science (HICSS)
[7] Disparities in STEM Employment by Sex, Race, and Hispanic Origin, United States Census Bureau, 2013
[8] Women in STEM: Realizing the Potential, STEMconnector white paper, March 2014
[9] In Silicon Valley tech start-ups, only 14% of senior managers, and only 4% of senior managers in tech/R&D departments, are female. National Center for Women and Information Technology, 2010
[10] Women hold 10% of corporate officer positions and make up 11% of board of directors in Fortune 500 technology companies. National Center for Women and Information Technology, 2010
[11] After 10 years of work experience, 41% of women in technology quit the industry, compared with 17% of men. Women in IT: The Facts, National Center for Women & Information Technology, 2009, updated 2010
[12] Women in STEM: Realizing the Potential, STEMconnector white paper, March 2014

working in STEM fields are far likelier to leave their jobs than women working in other professional fields.[13] Researchers say attrition spikes in mid-career, at roughly the age of 35, when women report having received one or two promotions and then finding themselves unable to progress further, isolated in majority-male workforces without a mentor, sponsor or roadmap. They leave because they feel they're treated unfairly; underpaid, less likely to be fast-tracked than their male colleagues, and unable to advance.[14][15] The research says that to increase retention, companies should focus their efforts on women at or near the mid-career level, before they drop out of the industry.[16][17][18][19]

Why do we need more women in tech?

Lots of reasons. The more the tech industry reflects its entire user base, the more broadly appealing its products and services will be. The research shows that mixed-gender teams are more innovative, more creative and more productive.[20] Companies with a diverse group of employees make more money.[21] Companies with women in leadership positions have higher profits, higher sales and higher rates of revenue growth.[22] It's an ethical issue: it is, and should be, embarrassing for companies to know that their workplaces are particularly toxic for women. It is not only a work-related or corporate issue. Tech is influencing our lives more and more; it's about society and democracy as well. That is why tech should be shaped by diverse representative teams, where women contribute their perspective.

How big of a problem is this?

It's a big problem. It's hard to get reliable industry-wide data, but it looks like women make up a little more than 15% of tech staff in most tech companies, on average. A crowdsourced spreadsheet of self-reported data found 15.4% of engineering staff at 191 tech companies were women.[23] EEO-1 data collected by the Open Diversity Data initiative found 15.7% of the technical staff of 10 technical companies that released their data were women.[24] A 2014 analysis by Statista found fewer than one in five tech jobs at Silicon Valley companies were held by women.[25]

	total staff, % women	**tech staff, % women**	leadership, % women	
Amazon	37	--	25	2014
Apple	30	**20**	28	2014
Canonical	13	--	18	2014

[13] "After about 12 years, 50% of women who originally worked in STEM have left, compared to only 20% of professional women." Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010

[14] Women in Tech survey of 1,000 women in technology, November 2014. 45% of respondents believe they've been paid less than their male peers and 29% report believe they've had less opportunity for advancement. 30% say if they were to leave the tech industry, "lack of a clear career path" would be a contributing factor.

[15] "It is well documented that patterns of women's participation in the STEM workforce consistently exhibits underrepresentation, underemployment, depressed salaries, field segregation, and absence at the highest levels of achievement." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[16] "The mid-career level seems to be the breaking-point moment when attrition spikes. The evidence suggests companies would do well to focus retention efforts at this level." National Center for Women and Information Technology

[17] "Women in SET feel that they hit a wall in their mid-30s. Situated on the beginning rungs of management—holding the title of "director" or "staff engineer"—they face the much more difficult career progressions to middle and senior management without a mentor, sponsor, or road map. They are often newly aware of being seriously isolated in hostile macho cultures." The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[18] National Center for Women and Information Technology, 2010

[19] The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[20] Women Technologists Count: Recommendations and Best Practices to Retain Women in Computing, Anita Borg Institute, 2013

[21] How Diversity Makes Us Smarter, 2014

[22] Women Technologists Count: Recommendations and Best Practices to Retain Women in Computing, Anita Borg Institute, 2013

[23] Tracy Chou's crowdsourced spreadsheet of 191 engineering companies, retrieved November 2014

[24] Leigh Honeywell's Open Diversity Data, retrieved November 2014

[25] Women Vastly Underrepresented In Silicon Valley Tech Jobs, 2014

Cisco	23	--	20	2013
eBay	42	**24**	28	2014
Facebook	31	**15**	23	2014
Google	30	**17**	21	2014
LinkedIn	39	**17**	25	2014
Microsoft	29	--	--	2014
Oracle	29	--	25	2014
Salesforce	29	**20**	15	2014
SendGrid	22	**9**	19	2014
Twitter	30	**10**	21	2014
Yahoo	37	**15**	23	2014
Yelp	47	**10**	48	2014
Average	31.2	**15.7**	24.2	

Data taken from Open Diversity Data by Double Union, 2014

Isn't it likely that women are dropping out of tech for work-life balance reasons? Maybe they just don't want to progress in the industry.

Nope. Some research shows that women in tech leave **the workforce** at the same rate women do in other industries. That means women in tech aren't leaving *work* (e.g., for work-life balance reasons); they're leaving *the tech industry* specifically.[26] After leaving, most go to work elsewhere in the private sector, or in government or academia. That means it's not just family-based reasons why people leave tech: it's something else.

Why do women say they leave?

The main reason women give is dissatisfaction with their pay and promotional opportunities.[27][28] However, saying you're dissatisfied with your pay --particularly in a white-collar, middle-class context--is to some degree just another way of saying you feel undervalued. Low pay is the symptom and being undervalued is the disease. And so, being paid more is a necessary but insufficient fix for the problem: for it to be fully solved, the woman would actually need to feel correctly valued by the organization she works for. She would need to be paid appropriately, but also sent the right signals in other ways, for example by being put in charge of high-priority initiatives, being asked for input and having her input given appropriate weight, being given public credit for her ideas and accomplishments, and so forth. (It's worth noting here that the likelihood of a woman having an exaggerated sense of her value is low. It's much more common for women to undervalue, rather than overvalue, their own contributions.

What's a typical career path for a woman in tech, according to the research?

[26] "The disparity in retention between STEM and non-STEM professionals is almost entirely due to STEM women switching out of STEM fields but not out of the labor force." Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010
[27] Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010
[28] Women in Tech survey of 1,000 women in technology, November 2014

The research says that women enter the tech industry empowered by their credentials and filled with enthusiasm and ambition.[29] They go into tech for the same reasons men do: because they enjoy technology and want to work with brilliant people on hard problems.[30] In the early years of their career they love their work.[31] They know the industry is majority-male, but that is nothing new for them and they believe they can handle it.

Over time though, many get worn down by "macho workplace cultures,"[3233] serious isolation[34] and tech media coverage they find sexist.[35] They are paid less than their male counterparts:[36] earning, on average, 12% less. (The wage gap in STEM is smaller than in non-STEM professions, but largest in computers and math.)[37] According to a 2014 Glass Door study, they are paid less than their male colleagues and are less satisfied with their employer.[38] Some find themselves pushed into support or execution roles rather than creative/producer ones, which positions them poorly for future leadership opportunities.[3940]

Once they reach their mid-thirties their careers start to stall, just as those of their male colleagues are taking off.[41] Some reach the beginning ranks of management, but find it tough to move up further because they don't have a strong professional network,[42] mentor,[43] sponsor or roadmap.[4445] Feeling blocked, some then make lateral moves, which often has the effect of propelling them out of line positions (such as engineering or product roles) into staff ones (such as marketing or outreach roles), thereby further limiting their potential to move up.[46]

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[29] "The fact is, young female scientists, engineers and technologists join SET companies filled with enthusiasm and ambition. Empowered by sought-after credentials, many feel that the world is at their feet as they "execute against a particularly valuable skill set," to use the words of a 20-something female engineer who participated in a focus group." The Athena Factor: Reversing the BrainDrain in Science, Engineering, and Technology, 2008

[30] Women in Tech survey of 1,000 women in technology, November 2014. When asked what they like best about working in tech, 79% of respondents cite "the actual work"; 74% say "I like solving problems that are really difficult" and 74% say "some of the people I work with are brilliant."

[31] "[Y]oung female scientists, engineers, and technologists join SET companies filled with enthusiasm and ambition. Empowered by sought-after credentials, many feel that the world is at their feet as they "execute against a particularly valuable skill set," to use the words of a 20-something female engineer who participated in a focus group. Over time, however, SET women are worn down by macho workplace cultures, serious isolation, and the extreme demands of their jobs. They are also turned off and alienated by their lack of career progress. All too often their ambition seeps away and they downsize their dreams. The data tell us that when young women join SET companies, fully 35% of junior women consider themselves to be very ambitious. By age 45, that figure has fallen to 14%. This fall off in female ambition is much more dramatic in SET than in other sectors of the economy." The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[32] "Studies have documented perceptions of the work environment as hostile to women on several dimensions, including sexist attitudes and comments, dual standards and opportunities, informal socializing, remediation policies and practices, and balancing work and personal obligations." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[33] "Implicated in an inhospitable climate are: a male model of career success that emphasizes competitiveness, combativeness, self-promotion, and aggression; alienating linguistic patterns (e.g., use of masculine images, dirty jokes); the exclusion of females from formal and informal informational and social networks; and resource allocation that favors men and often excludes or disadvantages women." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[34] The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[35] Women in Tech survey of 1,000 women in technology, November 2014. 57% of respondents agree with the statement "I have read tech media coverage I found sexist."

[36] "Differential rates of compensation persist, particularly with increasing years of experience." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[37] Women in STEM: Realizing the Potential, STEMconnector white paper, March 2014

[38] At most of the 25 largest tech companies for which Glass Door compared data, women report lower base salaries than men do, and lower levels of satisfaction with their employer. Glass Door study, 2014.

[39] "In focus groups, SET women repeatedly told us that men occupy the "creative" and "producer" spaces while women are pushed into execution." The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[40] Women in Tech survey of 1,000 women in technology, November 2014. 19% of female respondents say they've felt "pushed out of pure tech into roles such as evangelism or coordination."

[41] [W]omen in SET fall away rapidly after age 35, whereas men gain ground. [...] [I]n SET companies, the falling away of women (and the ascendancy of men) is particularly steep and sharp. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[42] "Professional isolation virtually ensures that women will not obtain knowledge that is critical to success. Research, in fact, indicates that women more than men tend to lack information about what is required for career advancement; as they are often excluded from informal networks, they also receive little performance feedback and therefore are less able than men to take corrective action or position themselves for more desirable outcomes." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[43] "It is exceedingly difficult [for women in STEM] to obtain mentors due to the lack of women (particularly women characterized by other minority statuses) in the upper ranks of most workplaces. Studies indicate that, in general, individuals tend to receive more support for advancement from same-sex workers, and also that men tend to support other men, whereas women support both women and men; taken together, these results suggest that men are far more likely than women to be in relationships in which they are being mentored." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[44] The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[45] "[O]ne computer simulation study of promotions in a hypothetical company demonstrated that small-scale gender bias --accounting for only 1% of the variability in promotion-- resulted in 65% males at the top of an eight-level hierarchy after several promotions." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006

[46] Left to themselves, one strategy employed by many women we spoke was to make a lateral move—accepting a different role at a similar level either within SET or outside. Women do this for many reasons—to show movement on their résumés, for example, or to gain experience that will enable them to advance or to find a "pocket of sanity." [...] [L]ateral moves are more likely to marginalize SET women by propelling them out of line positions, or out of the "business of the business." The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

By the time people with professional careers reach their mid-thirties, it is normal for them to feel increasing job satisfaction, and the fact that women in tech don't is considered unusual and troubling. This is the most dangerous point for women in technology, at which they're likeliest to derail, stall or quit.

How is it different for men?

Many men in tech have had their interest in technology encouraged and supported since they were children. Most of their coworkers are the same gender as they are, which makes it easier for them to fit into the culture and to form supportive professional networks than it is for women. They aren't assumed to be incompetent, or disliked for being competent. When they are young, they may be fast-tracked for advancement.[47] In their mid-thirties, their careers are still accelerating.[48]

What are the barriers to advancement that women in tech face because they are women?

- ➔ Some feel lonely and isolated because there aren't a lot of women around them,[49] and they may feel like they don't fit into the engineering/hacker stereotype of being scruffy, eccentric, antisocial and arrogant.[5051]
- ➔ Workplaces that are majority-male are likelier than others to be hostile for women (sexist jokes and stereotyping)[5253]
- ➔ If women find themselves in workplaces where colleagues or bosses assume they're less competent than men, due to stereotype threat their performance may suffer.[54] Typically they work longer hours than their male colleagues, and cut back outside-work activities, which may lead to burnout.[55]
- ➔ Women are likelier than men to suffer from imposter syndrome. The research shows that typically men are over-confident and women under-confident.[565758]
- ➔ Because women have been socialized to be more harmony-centric than men, they may find tech culture hostile.[59]
- ➔ Women may find themselves working in an inappropriately sexualized environment, being sexually harassed or witnessing the sexual harassment of others,[606162] and they may avoid opportunities to promote themselves such as networking events or speaking at conferences, because they don't want to face gender-related hassles.[63]

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[47] Focus group participants. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[48] [W]omen in SET fall away rapidly after age 35, whereas men gain ground. [...] [I]n SET companies, the falling away of women (and the ascendancy of men) is particularly steep and sharp. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[49] Women Technologists Count: Recommendations and Best Practices to Retain Women in Computing, Anita Borg Institute, 2013

[50] The Computer Boys Take Over, 2012

[51] 38 career women working in tech in southern California in 2008 "articulated an alternate "feminized" version of IT culture that emphasizes female social and collaborative skills, satisfaction in fulfilling users' needs, finishing work on time, and high work quality." Does Culture Matter? A Study of Cultural Influences on the Success of Women in IT, 2009

[52] "A study of 30 academic science departments (including computer science) found that, when senior females were present, overt male behavior toward women improved (for example, invidious public sexual joking and stereotyping declined); this change is a threshold effect of critical mass." The Paradox of Critical Mass for Women in Science, 1994

[53] "Women engineers report that their male colleagues often have "patronizing" attitudes" and that their workplaces have a "locker room culture." CIRCUMVENTING DISCRIMINATION: Gender and Ethnic Strategies in Silicon Valley, Gender & Society, 2006

[54] Women, Science, and Technology: A Reader in Feminist Science Studies, 2013

[55] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company

[56] The Confidence Gap, Atlantic Monthly, 2014

[57] Over-Confident People Are Seen as Smarter, Even When They're Not, Time magazine, 2014

[58] Women in Tech survey of 1,000 women in technology, November 2014. 64% of respondents agreed with the statement "I sometimes feel like I'm a fraud or not good enough at my work."

[59] Women in Tech survey of 1,000 women in technology, November 2014. 51% of respondents agree with the statement "I have been treated in a way I found hostile, demeaning or condescending" at work.

[60] Women in Tech survey of 1,000 women in technology, November 2014. 30% report an "inappropriately sexualized" workplace, 23% report having been sexually harassed at work, 31% report witnessing sexual harassment of others at work.

[61] A 2007 study found that sexual harassment was more common in male-dominated workplaces, and that masculine-seeming women were likelier to be harassed than feminine-seeming women. The study's author theorized that sexual harassment results not from male desire, but from a desire to punish women who violate societal expectations of femininity. The Sexual Harassment of Uppity Women, Journal of Applied Psychology, 2007

[62] In an online survey of 2,493 American SET workers aged 25 to 60, 66% of women working in "high tech" reported they had experienced sexual harassment. Older women were likelier to report it, and younger women less likely. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008

[63] Women in Tech survey of 1,000 women in technology, November 2014. 19% report forgoing networking opportunities "because I don't want to face gender-related hassles."

- ➔ It may be harder for women to attend industry events than it is for men, because of personal obligations.[64] This may also make it harder for women to spend time on voluntary projects outside work, such as open source projects.[65]§
- ➔ There aren't very many female mentors, sponsors or role models.[66] Senior women in the industry may feel overwhelmed by the number of more-junior women who want their help. In some companies, senior women are often asked to take on additional gender-related duties, such as mentoring or recruiting junior women, in addition to their regular work.
- ➔ Women are impeded from forming strong professional networks to the extent those networks ordinarily form around gendered pursuits such as sports, or activities that may be risky for a lone woman among men such as getting drunk. It may be harder for women to form warm buddy relationships with male colleagues, and if they do people may gossip about them.[67] Lack of networks is particularly problematic in environments in which people change jobs quickly, such as start-up cultures.[68]
- ➔ Older men may be reluctant to mentor young women because they worry about seeming predatory.[69]
- ➔ Competent women in disproportionately-male industries are considered by their co-workers to be less likable than both men and less-competent women, and the research shows that being disliked can mean a person is less likely to be given opportunities for advancement.[7071] Women in tech are likelier than men in tech to be criticized in performance reviews as bossy, strident, abrasive or aggressive.[7273]
- ➔ When women advance, they are likelier than men to be offered risky "glass cliff" type positions.[7475]
- ➔ When women fail, they are less likely to be given a second chance than men are.[76]

What happens to women after they leave tech?

The women who leave are 165% more likely to have an advanced degree than those who don't, which suggests those leaving may be the ones with the most options.[77] When women leave tech, they don't leave the workforce entirely, and they are no more likely than women in other industries to cite work-life balance as a motivating factor for leaving.[78] The women who leave tech go into other industries, and the single most important reason they give for leaving tech is dissatisfaction with their pay and promotion opportunities.[79]

Once they leave, they are very unlikely to return to the technology industry.

Why are women who are seen as competent also seen as unlikable?

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[64] Women in Tech survey of 1,000 women in technology, November 2014. 22% of respondents agree that "I have skipped conferences or networking events because of personal responsibilities I couldn't avoid or offload."
[65] The Culture of Open Source Computing, 2007
[66] "The absence of other women who might serve as role models and mentors also constitutes a major barrier to achievement." Career Counseling for Women in Science, Technology, Engineering and Mathematics (STEM) Fields, Handbook of Career Counseling for Women, Routledge, 2006
[67] Women in Tech survey of 1,000 women in technology, November 2014. 30% report their boss is friendlier with or more supportive of their male colleagues.
[68] CIRCUMVENTING DISCRIMINATION: Gender and Ethnic Strategies in Silicon Valley, Gender & Society, 2006
[69] "Junior women and senior men often avoid engaging in mentoring or sponsoring relationships out of fear of what others may think. A study published by the Center for Work-Life Policy and the Harvard Business Review reported that 64% of men at the level of vice-president and above are hesitant to have a one-on-one meeting with a junior woman. For their part, half of the junior women avoided close contact with senior men. .. A senior man and a junior man at a bar is seen as mentoring. A senior man and junior woman at a bar can also be mentoring ... but it looks like dating. ... If women try to cultivate a close relationship with a male sponsor, they risk being the target of workplace gossip. If women try to get to the top without a sponsor's help, their careers will often stall." From Lean In, by Sheryl Sandberg.
[70] Why So Few Women in Science Technology Engineering and Mathematics?, American Association of University Women, 2010
[71] Women in Tech survey of 1,000 women in technology, November 2014. 40% of female respondents say they've been described as bossy, abrasive or aggressive.
[72] A study of 248 performance reviews of 75 women and 105 men working at 28 tech companies found that 71 of the women's reviews and only two of the men's included negative feedback, and that women were described using the words bossy, abrasive, strident, aggressive, emotional and irrational. The abrasiveness trap: High-achieving men and women are described differently in reviews, Fortune magazine, August 2014
[73] In an online survey of 2,493 American SET workers aged 25 to 60, 41% of women working in "high tech" reported perceiving bias in performance evaluation. Older women were likelier to report it, and younger women less likely. The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008
[74] The road to the glass cliff: Differences in the perceived suitability of men and women for leadership positions in succeeding and failing organizations, 2008
[75] The Glass Cliff: Evidence that Women are Over-Represented in Precarious Leadership Positions, 2005
[76] The Glass Cliff: Are Women Leaders Often Set Up to Fail?, 2008
[77] What's So Special about STEM? A Comparison of Women's Retention in STEM and Professional Occupations, Social Forces Journal, 2013
[78] Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010
[79] Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010

The research shows that women, including in disproportionately-male industries, are assumed to be less competent than men, and that when they're perceived as competent they're considered less likable. For example, a 2011 study showed people pictures and text of a man offering to help a woman at a computer with a task the man described as "too difficult and frustrating for a woman." When the woman accepted help, the researchers found, observers perceived her as less competent. But when she declined, she was perceived as less warm. The researchers then flipped the genders, and found that men too were perceived as less competent when they accepted help, but they did not suffer the warmth penalty when they rejected it.[80]

Being disliked hurts women's pay and their prospects for advancement.[81] The research finds that the only way competent women will be found likable is if they behave in a stereotypically-female "communal" style at work (cooperative, helpful and understanding), but if they do that they will no longer be perceived as competent.[82] It's a classic double bind.

Women who negotiate, whether simply or assertively, are also found unlikable and punished for it. A 2005 study found that both men and women were less likely to recommend hiring female candidates who negotiated their pay and benefits. Another found that people were no less likely to want to work with men who negotiated, but much less likely to want to work with women who did.[83]

What is stereotype threat, and how does it apply to women in tech?

Stereotype threat is the label social psychologists use to describe how stereotypes hurt the performance of members of stigmatized groups by forcing them to take on the cognitive load of managing the effects of the stereotyping, and thereby using up energy they'd otherwise have available for the task itself. Stereotype threat has been extensively documented: since 1995, academic journals have published more than 300 papers measuring how it damages performance. The first studies of stereotype threat assessed the damage it causes to African-American students; later studies focused on women in STEM fields.

The research shows that members of stigmatized groups are aware of social stigma, and respond by mentally defending against it and trying to cope with it. As a result they experience a heightened sense of mental vigilance, they ruminate over their level of self-doubt and whether it's justified, they monitor their own performance and aim to suppress their anxiety. This diverts their attention and mental capacity away from the tasks at hand, which has been proven to have the effect of worsening their performance and overall functioning, thereby exacerbating their anxiety and intensifying the vigilance and distraction.[84] If the threat is constant, its effects become an ongoing, chronic part of the person's identity,[85] and can undermine their sense of well-being and happiness as well as contributing to long-term health problems.[86]

The research shows that in limited circumstances, the motivation to disprove stereotypes can actually boost performance and ease of functioning. But the negative effects of stereotype threat kick in when a person hits the limits of their abilities and needs to grow and learn.[87]

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[80] BS At Work: How Benevolent Sexism Undermines Women and Justifies Backlash, Harvard Business School, 2013
[81] Through the Labyrinth: The Truth About How Women Become Leaders, 2007
[82] Why So Few Women in Science Technology Engineering and Mathematics?, American Association of University Women, 2010
[83] Social incentives for gender differences in the propensity to initiate negotiations: sometimes it does hurt to ask, Organizational Behavior and Human Decision Processes, 2007
[84] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 121
[85] It's been theorized that stereotype threat may contribute to the high rates of hypertension among African-Americans. Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 130-1
[86] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 127
[87] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 112

Who experiences stereotype threat?

Most members of stigmatized minorities experience the effects of stereotype threat. It's been shown to affect the performance of people as young as five years old.[88] The more a person cares about performing well, the more capable they are, the higher the stakes and the more elite the institution they're part of, the more their performance will be affected by stereotype threat.[89]

The stronger a person's identification with the stigmatized group and with the domain in which that group is stereotyped, the more stereotype threat will damage them. So, a woman in tech who identifies strongly as female and as working in technology, will be more damaged than someone for whom those attributes aren't a central part of her identity.[90]

Stereotype threat is triggered when a member of a stigmatized minority believes they're at risk of being stereotyped, usually including being in a situation in which most people around them are members of the majority culture.

How do people typically respond to stereotype threat?

People experiencing stereotype threat often say they are, and appear to be, calm and unruffled rather than anxious,[91] but the research has found that stereotype threat conditions cause measurable effects on people's blood pressure[92] and brain functioning.[93]

People experiencing stereotype threat often respond by protectively isolating themselves and over-committing to a strategy of intense, isolated, independent effort (called "over-efforting") aimed at ensuring their success. They're not necessarily otherwise more motivated than others: this over-efforting is specifically aimed at disproving stereotypes about their group.[94] They separate their studies or work from their social lives, do not seek help from people with more experience, and begin to believe they are alone in experiencing anxieties and difficulties. Stereotype threat may be most damaging to people who believe that working hard will lead to good outcomes, because they may tend to persist with an "effortful coping" strategy even when it's causing them stress and hurting their performance.[95]

Many people who consistently experience stereotype threat report getting used to it. They develop coping strategies and may bond with others in their stigmatized group.[96] Eventually though, stereotype threat may lead them to lower their expectations and ambitions, or drop out of the domain in which they're stigmatized.[97]

How should individuals respond to stereotype threat?

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[88] Psychologist Nalini Ambady found that 5-7-yr-old Asian-American girls who'd been given a doll performed less well on a math test than those who'd been given a gender-neutral toy. Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 170

[89] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, p 156

[90] The Social Psychology of Stigma, 2005

[91] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 116-7

[92] A 2001 University of California Santa Barbara study measuring mean arterial blood pressure found that under conditions of stereotype threat, the blood pressure of black students "rose dramatically." Perceiver threat in social interactions with stigmatized others, Journal of Personality and Social Psychology, 2001, pp 253-267

[93] A study using fMRI imaging technology to examine the effect of stereotype threat on brain activity found it dampened activity in the parts of the brain use for mathematics, and increased activity in the parts of the brain associated with vigilance and emotion. The Negative Consequences of Threat: A Functional Magnetic Resonance Imaging Investigation of the Neural Mechanisms Underlying Women's Underperformance in Math, Association for Psychological Science, 2008

[94] A survey of 41 women attending a Silicon Valley conference on women in tech found that the lower the representation of women at a particular company, the more pressure women in that company felt to prove themselves. They responded by working longer hours and cutting back non-work activities. Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 110-3

[95] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 130-1

[96] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 132

[97] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 101-8

The research says that the performance of members of stigmatized groups "dramatically increases" when they deliberately stop isolating themselves and instead work in groups and seek help from others with more experience.[98] Stereotype threat disappears in environments in which the stigmatized minority is the majority: it does not exist for African-Americans in majority African-American schools or for women in majority-female workplaces.[99] Researchers advise members of stigmatized minorities to try to err on the side of trying to feel safe and trusting rather than vigilant, because the hyper-vigilance is itself destructive to their performance.[100] Stereotype threat is reduced if the individual experiencing it de-emphasizes the parts of their identity that are stigmatized and emphasizes those that are not. (For example an Asian-American woman will experience less STEM-related stereotype threat when she focuses on her race rather than her gender.)[101]

How can stereotype threat be reduced?

Stereotype threat is reduced when members of the stigmatized group believe they're not at risk of being stereotyped. It can be diminished by replacing triggering environmental cues (such as marketing materials that only display members of the majority culture) with environmental cues that signal members of stigmatized minorities are valued (such as marketing materials that include members of the stigmatized minority, or explicitly value diversity).[102][103][104] Bosses who want to reduce the effects of stereotype threat may find it effective to tell stigmatized minority employees that they believe the employee is capable of meeting high standards,[105] and to remind them of aspects of their identities that counter the negative stereotype.[106] The effects of stereotype threat are also reduced when members of stigmatized minorities are given information designed to persuade them that everybody (not just members of their group) experiences difficulties, and that difficulties they're experiencing are normal and temporary.[107]

How can stereotype threat be eliminated?

Stereotype threat disappears at the point when critical mass is achieved -- when there are enough members present of the stigmatized minority, such that each stigmatized individual isn't notable by his or her presence. The research suggests that when the percentage of stigmatized minorities is 10% or less, members of the stigmatized group feel intense pressure to keep a low profile, comply with existing norms, and aim to be unobtrusive. When the percentage of stigmatized minorities is between 20-40%, friction between the minority and the majority, including stereotyping, conflict and tension, increases. Once the percentage of stigmatized minorities reaches 40-60%, both minority and majority groups report feeling fully legitimate: neither closely scrutinized nor threatened.[108]

How do efforts to combat stereotype threat affect members of the majority culture?

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[98] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, p 113
[99] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, p 171
[100] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, p 164
[101] Cuing the Gap: Gender and Psychological Orientations to Politics, 2014
[102] A 2007 study found that women who watched a conference marketing video that featured mostly men were likelier than those who watched a gender-balanced video to exhibit cognitive and physiological signs of vigilance, and to report a lower sense of belonging and less desire to attend the conference. Signaling threat: How situational cues affect women in math, science, and engineering settings. Psychological Science, 2007.
[103] A 2008 study found that the vigilance associated with stereotype threat was reduced when a Silicon Valley company portrayed itself as employing a moderately-high number of stigmatized minorities, or as valuing diversity. However, when a company portrayed race, ethnicity, gender and religion as "immaterial," vigilance remained high. Social identity contingencies: How diversity cues signal threat or safety for African Americans in mainstream institutions, American Psychological Association, 2008.
[104] The effects of stereotype threat disappear for black and Latino students in the classroom of a black or Latino professor. The Source of the River: The Social Origins of Freshmen at America's Selective Colleges and Universities, Princeton University Press, 2006
[105] A 2006 study of African-American students found that when professors prefaced their feedback to the students by saying that they had high standards and believed the students could meet them, this ameliorated the effects of stereotype threat on the students' performance. Reducing the Racial Achievement Gap: A Social-Psychological Intervention, Science magazine, 2006.
[106] Claude M. Steele and Kirsten Stoutemeyer found that reminding women math students that they were Stanford students greatly reduced the effect of stereotype threat on their performance in a difficult math test, and R.B. McIntyre, R.M. Paulson and Charles Lord found that reminding women math students about positive female role models had the same effect. Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 94
[107] A 2004 study found the effects of stereotype threat were reduced when African-American students were presented with information encouraging them to believe that all students, not just black ones, had doubts and uncertainties about fitting in at college, and that those doubts and uncertainties would disappear with time. A Question of Belonging: Race, Social Fit, and Achievement, Journal of Personality and Social Psychology, 2007.
[108] Life And Work In Symphony Orchestras, The Musical Quarterly, 1996

Mostly, they don't. Members of the majority culture don't notice stereotype threat as much as members of the stigmatized minority do. They can feel stereotype threat in narrow circumstances,[109] and they may be hostile to attempts to change a culture in which they're comfortable. But for the most part, efforts to eliminate stereotype threat don't affect members of the majority culture.[110]

Who is working on increasing the retention of women in tech?

Through research on women-in-tech sites, tech company diversity and partnership pages, charity evaluator sites, start-up/investor sites, women-in-tech mailing lists, media stories and general internet searches, I've developed a list of 56 gender-in-tech initiatives that are currently active in the United States. It's definitely incomplete: for example, it only captures a handful of internal company efforts. I included initiatives that were 1) aimed largely or solely at increasing girls and/or women's participation in creating technology and 2) currently active (not defunct). I included a few organizations that stretched these bounds: for example gender is a sideline at ENTELO, and Glassbreakers' scope extends beyond just tech. I included non-profits, tech company projects, private companies, unincorporated collaborative projects, government initiatives and industry associations, but not degree-granting institutions or organizations that mainly/solely do research. A few of the initiatives I included are subsets of other orgs (for example DigiGirlz is a Microsoft project, and I believe Systering is run by the Anita Borg Institute).

Here's the full list: ~~the Ada Initiative~~; Amazon Women in Engineering (AWE); the Anita Borg Institute; AspireIT; Black Girls Code; BRAID; Change the Equation; Code.org!; Codess; ConnectED; Dames Making Games; Dare2BDigital; Glassbreakers; DevelopHer; DigiGirlz; Digital Sisters; eBay Women's Initiative Network (WIN); ENTELO; FOSS OPW; Girl Geek Dinners; Girl Develop It; Girls Teaching Girls to Code; Girls Who Code; the Google Anita Borg scholarships; Google Made With Code; the Grace Hopper Celebration; the Hackbright Academy; HP Helion OpenStack Scholarship; IWITTS; Ladies Learning Code; LinuxChix; Microsoft Research Graduate Women's Scholarship; NCWIT; Palantir Scholarships for Women in Engineering; PyLadies; Red Hat Women in Open Source Award; FEM Inc.; sf.girls; She's Geeky; SHE++; the Society of Women Engineers; STEMinist; STEMout!; Systers; Tech Lady Mafia; Technovation; Tools For Change in STEM, VMWomen; Women 2.0; Women in Games; WEPAN; Women in Technology; Women Who Code; Women Who Tech; Write/Speak/Code. I did not include Tech Liminal in the analysis, but it was brought to my attention afterwards by a commenter here.

What are those organizations doing?

A mix of things. Some teach girls and young women to code, or try to encourage them to be interested in technology. Some offer scholarships to young women in STEM. Some do a blend of advocacy, awareness-creating and research. Some are networking events for women working in technology, or peer support organizations.

What observations can you make about those organizations?

I did an analysis that looked at founding date, who was being targeted, what kind of activities were pursued, and a rough measure of budget/staffing. (I determined participant/target age either by finding it explicitly stated by the organization, or by estimating it based on the material they had on their websites, such as their descriptions of their mission and activities, photos, etc.) (For about a dozen orgs, I was able to find budget/staffing information in their 990s; for the remainder, I guessed based on what I found on their sites, e.g., staff pages, About pages, Donate pages, jobs pages, etc.) What I found is that many organizations and initiatives are very broadly-based -- aimed at, for

[109] A 1999 study found white men's ability to solve math problems deteriorated when they were reminded of the stereotype that Asians outperform white people in mathematics. Signaling Threat: How Situational Cues Affect Women in Math, Science, and Engineering Settings, Association for Psychological Science, 2007

[110] Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do, Claude M. Steele, 2010, W.W. Norton & Company, pp 138-166

example, "girls and young women" or "women in tech" or "girls and women." Many are also small and lightly-resourced: I'd guess about half have paid staff, usually just one or two people, and half are purely voluntary. The median year of founding was 2010. The average is about 7.8 years old, although if you exclude the Society of Women Engineers, a major outlier established in 1950, the average is 6.6 years.

I found that it looks like the average target age for gender-in-tech initiatives today is about 22 years old, down from about 27 in 1986. That's mostly because in 2008 we saw the beginning of a surge of new organizations aimed at teaching girls to code -- initiatives like Dare2BDigital, Technovation, Change the Equation, Black Girls Code and Girls Teaching Girls to Code.

Today about 70% of initiatives seem to be (mostly) aimed at students and women at the start of their careers, with the remaining 30% targeting (mostly) working women established in their careers. (Note that doesn't necessarily mean less effort is going towards working women: new initiatives may well be purely additive rather than cannibalizing existing ones.)

What do we know about initiatives aimed at mid-career women?

I was interested to note that many of the initiatives that include working women seem to cast them partly or solely as resources (e.g., teachers, coaches, evangelists, mentors, recruiters) for girls and younger women, rather than as beneficiaries. Initiatives that do cast working women as beneficiaries tend to be launched by the women themselves, and to be lightly-resourced and volunteer-reliant. It's not possible to put real numbers against that because so many organizations have a very broad approach with multiple constituencies playing multiple roles. But I was surprised by how many organizations --dozens, I think-- seem to use mid-career women as resources for their work with girls and younger women.

What are tech companies themselves doing to retain tech women and develop them as leaders?

Here's a sampling, mostly drawn from tech company's annual reports or CSR reports. Oracle, IBM, Google, Yelp and Salesforce offer peer networking programs. IBM, Cisco, HP, Intel, Yelp and Texas Instruments offer sponsorship, mentoring or coaching programs. Yahoo has a Women in Tech employee group that offers, among other things, skills training. Microsoft and Dell offer professional development programs for women. LinkedIn stages an annual hackathon for women. Many companies, such as Google, Yelp, LinkedIn, Facebook, Mozilla, Automattic, Red Hat, New Relic, the Linux Foundation, Simple, Spotify, Stripe, Gitlab, O'Reilly, Pinboard, Python and Puppet Labs, sponsor conferences and events and organizations aimed at increasing women's participation in technology, such as the Grace Hopper conference staged by the Anita Borg Institute, or the Ada camps staged by the Ada Initiative. Google offers diversity training workshops to all its staff, focused on identifying and eliminating unconscious bias.

According to the research, what would persuade women not to leave tech?

- More opportunity for advancement.[111]
- Better pay.[112]
- Help developing a career plan.[113]
- Help overcoming imposter syndrome.[114]

[111] Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010
[112] Why Do Women Leave Science and Engineering?, National Bureau of Economic Research, 2010
[113] Women in Tech survey of 1,000 women in technology, November 2014. 48% of respondents agreed with the statement that "help developing a plan for my career" would make them happier and more successful.
[114] Women in Tech survey of 1,000 women in technology, November 2014. 46% of respondents agreed with the statement that "help overcoming imposter syndrome" would make them happier and more successful.

- A mentor, a coach, or a stronger network of peers.[115]
- The experience and goodwill of older women in tech.[116]

What do we know about how women can best navigate majority-male environments?

Lots. There's been a ton of research done in this area. *(See bibliography at the bottom of the document.)*

What does the research say about performance assessments?

Generally, in the workplace women are assumed to not be competent until they've proven they are. This is particularly the case in majority-male environments, where people assume women are unlikely to "fit," and they therefore are expected to fail. In performance reviews, in the absence of solid information, people fill the vacuum with assumptions and expectations, which ordinarily aren't favourable to women. This results in women generally receiving less-positive performance reviews than men do, particularly in majority-male environments.[117] Also, we know that women are far likelier than men to be evaluated on the basis of their personality traits, and they are far likelier to receive negative feedback about their personalities.[118]

Why are women so frequently described as "abrasive" (or similar words) in their performance reviews?

A 2014 analysis of 248 written performance reviews of 105 men and 75 women at 28 companies found that men received negative personality criticism in only two of 83 critical reviews, whereas women received negative personality criticism in 71 of 94 critical reviews, with the words used including bossy, abrasive, strident and aggressive. [119] This is due to the conflict between how people are expected to behave at work, and how women are expected to behave in general. At work, people are expected to be clear, direct, task-oriented and assertive, however women are expected to be "kind, sympathetic, interpersonally-sensitive and people-oriented."[120] This means that when women behave in the ways that are expected from people at work, people see them as violating gender norms. In effect, their performance reviews end up judging their femininity, not their job performance.

But not all women get the "abrasive" label.

Yes. A 2012 study of performance evaluations at a Wall Street law firm found women received more positive narrative comments in their formal evaluations (words such as excellent, terrific, stellar) compared with men, but that men received higher numerical ratings, which were what the firm relied on for promotional decisions.[121] This suggests that firm had a lower, benevolently sexist standard for women, and perhaps also that women who behaved in stereotypically feminine ways were praised (but not rewarded) for it.

What should companies do to ensure women are fairly assessed in performance reviews?

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[115] Women in Tech survey of 1,000 women in technology, November 2014. 43% of respondents agreed "a mentor or coach" and 40% agreed "a better stronger network of industry colleagues" would make them happier and more successful.
[116] The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology, 2008
[117] The Handbook of Research on Promoting Women's Careers, Edward Elgar Publishing (Elgar Original Reference), 2013 | Chapter Three: Gender Stereotypes and their implications for women's career progress
[118] The Abrasiveness Trap: High-achieving Men and Women are Described Differently in Reviews, Fortune magazine, August 2014
[119] The Abrasiveness Trap: High-achieving Men and Women are Described Differently in Reviews, Fortune magazine, August 2014
[120] The Handbook of Research on Promoting Women's Careers, Edward Elgar Publishing (Elgar Original Reference), 2013 | Chapter Three: Gender Stereotypes and their implications for women's career progress
[121] BS At Work: How Benevolent Sexism Undermines Women and Justifies Backlash, Harvard Business School, 2013

Companies should set up their performance assessment systems so they're as clear and unambiguous as possible. It's in the interests of fairness for the information provided in performance evaluations to be both abundant and job-relevant. Research suggests that supervisors are pretty reliable in rating productivity and work quality, but less reliable when rating communications competence and interpersonal competence. Ambiguity in what's rated is problematic, because research shows that under conditions of ambiguity people will redefine "good performance" to fit the qualities that men tend to possess, and will then downwards-prioritize those same attributes when they are exhibited by a woman. So, as much as possible, companies should aim to define the criteria for assessment up-front, through the lens of the requirements of the position, rather than focusing on the person occupying the role. (This will prevent bosses from accidentally over-focusing on communications and interpersonal issues with a woman, while ignoring them for a man.) And, companies should aim as much as possible to be assessing people on the basis of productivity and work quality (where evaluators tend to evidence less bias), and to use objective inputs as much as possible. They should aim to only assess people on job-relevant criteria, and to check themselves to ensure the criteria and material they're including is actually relevant.

What should supervisors do to ensure their female direct reports are fairly assessed in performance reviews?

Make sure all the criteria you're using to evaluate performance are relevant. Once you've done the assessment, read it over and ask yourself if you'd say the same things if the person being assessed were male. Particularly, if you are giving the person negative feedback on her personality, ask yourself if there are men on your team who exhibit the same characteristics, to whom you're *not* giving similar feedback. The research shows that women don't get as much credit for improved performance as men do, and they are penalized more for decreased performance than men[122], so you should ask yourself if you're under-crediting or over-penalizing your female direct reports. Also, the research shows that when a team project succeeds, women often are under-credited, but when a team effort fails women are often blamed more than men.[123] So when you're parceling out responsibility for teamwork, try to be fair.

What should an individual woman do to ensure she is fairly assessed in her performance review?

Women should keep a record of what they're accomplishing at work, and should aim to provide their boss with as much information as possible prior to their formal assessment. (Because information fills the vacuum that might otherwise be filled by unfavourable assumptions.) Women should also aim to be explicit with their bosses about what role they played in team efforts, particularly if they played a leadership role: otherwise they risk their boss (or other higher-ups) assuming otherwise. It's also important for women to make it clear that they have a track record of solid performance, particularly when dealing with people who don't already know that about them.[124]

What about team versus individual assessments?

Lots of companies evaluate individual performance partly based on team achievements, because companies work in teams, and also because assessing the performance of the group is felt to be less likely to have the accidental side effect of encouraging people to be interpersonally competitive. But, team assessments are generally bad for women. Research shows that performance reviews that include assessment of teamwork hurts fairness, because ambiguity about the source of the performance leaves a hole that's filled by unconscious bias. "Thus, when a woman works with a man on a traditionally male task, a successful joint outcome is more likely to be attributed to the man." When the level of individual task contribution is unclear, women are evaluated more negatively than men: this is called

[122] The Handbook of Research on Promoting Women's Careers, Edward Elgar Publishing (Elgar Original Reference), 2013 | Chapter Three: Gender Stereotypes and their implications for women's career progress
[123] No Credit Where Credit is Due: attributional rationalization of women's success in male-female teams, Journal of Applied Psychology, 2005
[124] No Credit Where Credit Is Due: Attributional Rationalization of Women's Success in Male–Female Teams, Journal of Applied Psychology, 2005

"attributional rationalization." Women receive less credit than men for a successful joint project, and are blamed more than men when a project fails.[125]

How do women feel about all this?

Unanswerable because of course there is lots of variability. But here is some of what we know:

- Some women may prefer overt hostile sexism to so-called benevolent sexism. That's because hostile sexism can motivate women to resist and to prove themselves, increasing their performance. Studies have shown that benevolent sexism, which often manifests as kindness, praise, or help, often depresses women's performance and makes them doubt themselves. Women may prefer being angry, to being made ineffective.[126]
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[125] Handbook of Research on Promoting Women's Careers, Edward Elgar Publishing (Elgar Original Reference), 2013
[126] BS At Work: How Benevolent Sexism Undermines Women and Justifies Backlash, Harvard Business School, 2013

Who made this document, and why

This document was written by Sue Gardner. (SuePGardner on Twitter.) I'm interested in why women are so underrepresented in the tech industry, and particularly in why attrition spikes at mid-career, and so I've done a bunch of reading and research on the topic.

This document is a summary of information from more than 200 academic studies, surveys and industry white papers, as well as roughly 25 books and about 100 news stories and analysis and opinion pieces. About 25% of the material that fed into this document was tightly focused on women in the tech industry, and the remainder had a broader focus (women in STEM, women in majority-male environments, women at work, etc.).

I also ran a Google Docs survey that has 1,491 responses as of 22 November. Please feel free to take the survey if you haven't already, or read the raw results. This document is a draft -- I'll be refining it as I continue reading and thinking. ~~If you want to comment or help with revisions, you can do that at the editable version. Consider it to be kind of like Wikipedia: I would be happy to have you be bold and make changes :)~~ It turned out to be too much trouble to maintain an editable fork so I have deprecated it. Instead, I'm going to turn on comments on this, the version of the document that I'm actively editing, so please comment if you like.

If you suggest a change that I accept and incorporate into the document, I'll resolve your comment afterwards. If you make a substantive comment (or ask a substantive question) I'll reply to your comment and then edit the document to reflect what I said in my reply.

What you can do with this document. Anything you want: I'm releasing it under CC BY SA, which means you can quote from it, republish it, use chunks of it in other works, put it into Wikipedia -- whatever you want. If you're a journalist please feel free to use the material here in your stories, or use the original sources to do your own analysis/interpretation.

What will happen to this document next. I'll continue revising and refining it, and eventually I'll probably publish it at my blog. I'm also planning to do an analysis of the survey, which I'll also publish.

This document is currently about 50% done. I am still doing research, still adding material, and still adding to the sections titled Emerging thesis and Advice for women in tech.

I'm reachable at susanpgardner@gmail.com, or feel free to just leave comments here.

Emerging thesis

This is the very beginnings of me forming/documenting a thesis, and I'm actively revising it as I learn more stuff and think through stuff I already know. It's mid-process and probably shouldn't be taken too seriously yet.

- Currently women in tech are at the "token minority" stage, where they represent less than 20% of the total. That means that at this point they're mostly aiming for their gender to be invisible -- in effect, many are trying to "pass" in a majority male culture. (We know this from critical mass theory, from what we've seen in studies of tech and other industries, and from observation.)
- For a lot of reasons, many women in tech don't want to have their gender highlighted or called out as important. Partly this is because they may have never identified strongly with gender as something important to their self-image (like, maybe identifying more strongly as a geek, or science-interested person). Also having their gender highlighted can trigger unconscious bias in other people. Also, especially as diversity initiatives ramp up, people may start assuming that women are present only because of the diversity initiatives, and they don't want people to believe they got their position because of their gender.
- What's unusual about tech relative to many other majority-male industries is that tech is a very hot labour market right now, with the demand for engineers and other tech workers outstripping the supply. This means that, unlike other majority-male industries such as bricklaying or roofing[127],
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[127] "Roofers" and "brickmasons, blockmasons and stonemasons" are among the top 10 most male-dominant industries in the United States. United States Department of Labor, Bureau of Labor Statistics, 2010

Advice for women working in tech

Based on everything I've read, here's some advice for women working in tech.

If you aren't yet working in the industry, **choose your first job carefully**. The research says that when women enter a majority-male industry, their first job matters, a lot, to shape their future prospects and happiness in the industry. Try to pick a place that seems like it treats women and men equally. Good signs include the visible presence of women in the organization's HR and "about" materials (particularly in technical roles), women being in leadership positions at the organization, the organization having greater than 20% women in technical roles, women being included (in decision-making roles) in your hiring interviews, and the presence of women in technical roles on the specific team you're considering joining. Although there are definitely exceptions, larger companies are generally considered to be more gender-equitable than very small ones.

Whenever you get a job offer, do not accept the salary you're first offered. Instead, negotiate. For advice on negotiating your salary, try reading What Works for Women at Work, by Joan Williams, or Women Don't Ask, by Linda Babcock. Over the course of your career, researchers say the cumulative effect of never having negotiated can add up to as much as a million dollars.[128] One study found that of graduating students, only 7% of women negotiated their first salaries whereas 57% of men did: in that study, the men made on average 4K more than the identically-qualified women. If you feel "selfish" negotiating salary, be aware that one of the top reasons mid-career women give for quitting the tech industry is unhappiness with their pay. Better to negotiate and be happy, rather than accumulating resentment to the point where you want to quit the industry.

The research says that people at work will tend to assume that you are "feminine" -- which means they will assume that you tend to be passive and compliant, not very interested in your career, not competitive, and that you will likely step back from work at some point to focus on your family. All those assumptions hurt you, because they mean people will be less likely to invest in you by giving you training and opportunities. Therefore, you need to be explicit about your goals. **If you want to be considered for promotion, or given training, or sent to conferences, or given opportunities to travel: tell people that's what you want.**

The research says that men tend to be over-confident about their abilities and women tend to be under-confident. And, women in majority-male industries have their confidence undermined over time, because of the unconscious bias they face. **If you're a woman in tech, it's pretty much guaranteed that you are better at your work than you believe you are. You need to internalize that, and develop mechanisms to remind yourself of it regularly.**

If you are a woman in tech, it wouldn't be unusual for you to feel like the work comes easily to everyone else, and you're the only one who ever struggles with it. That's not true: other people struggle too, and they are probably less competent than they appear. It's common for members of stigmatized minorities to internalize feelings of inadequacy and respond by hiding or denying those feelings, and working extra hard, alone. The research, though, recommends that you be open about any difficulties that you're having. **Find people you trust, ask questions, make friends at work, go out socially and talk shop, help other people and let yourself be helped.** Casual, informal, collegial relationships are a big part of how people develop expertise.

When you say you work in a technical role, people may seem surprised. You may get mistaken for an admin, a recruiter, a marketing person, a security guard or a cleaner. It's likely that you will be interrupted more than men in

[128] Women Don't Ask: Negotiation and the Gender Divide, Linda Babcock & Sara Laschever, Princeton University Press, 2003

meetings, your ideas will be taken less seriously than theirs, and you will need to repeatedly prove that you're competent. Because of all this, you may spend a lot of time analyzing what you're doing wrong. Should you dress differently. Do you need to change the pitch of your voice, or the words you use. talk more, talk less. Etc. The first thing you need to realise is that as a woman in a majority-male field, there is no "right way" for you to self-present at work. That's because many people who see you as feminine will tend to believe you're incompetent, and many people who see you as competent will tend to want to punish you for seeming (to them) non-feminine. It's important to note that what's happening to you happens to all women regardless of how they dress or speak, which means you can **relax and stop worrying about your self-presentation (what you wear, how you talk) at work**, because you didn't create the problem and your ability to resolve it is limited. Letting go of the feeling that you're 'doing it wrong' can be remarkably freeing. You can also tweak your self-presentation too if you want: there's good advice on that in What Works for Women at Work.

The research says that when performance assessment criteria are muddy or missing, supervisors often default to evaluating women on the basis of their personalities rather than the quality of their work. It's in your interest to **talk with your boss about what he or she expects of you, and then keep track of how you're doing against those measures.** Keep a file or folder of what you've accomplished: deliverables created, milestones achieved, etc. When it comes time for your performance review, give your boss as much information as possible about what you've accomplished, before the review takes place. If your boss doesn't have information about how you're actually doing, he or she may fill the void with assessments of your personality or your femininity. (That's how women so often end up being told they are "too abrasive" or "too passive.") It's best for everyone if your boss has actual information to work with, and it's better for your boss to have it *before* your performance is formally evaluated, rather than afterwards.

If you work mostly with men, you may find that the performance or personalities of women at your work are criticized unfairly. If you contribute to that, you make it harder for those women, and you also contribute to upholding a culture that is unfair for all women, including yourself. **Don't reflexively agree with or affirm criticisms of other women at your work.** If someone says or implies that a woman isn't technically strong, or that she is abrasive, or similar criticisms, don't accept the assessment without thinking it through. Ask yourself if the same criticism would be made if she were a man, and think about the actual facts: her credentials, her years of experience, etc. Don't smile or nod or agree without thinking hard, first, about the implications of doing that. Try to lean towards being generous in your evaluation of other women, to help rebalance the scales towards fairness.

Majority-male environments tend to devalue work that's perceived as feminine. That's partly why the tech industry values typically-male contributions (e.g., writing code, designing architecture) over ones that are less strongly majority-male (e.g., user experience, interface design). This is probably not something you can affect much. But, you can contribute to a less sexist environment overall, if you **refrain from participating in the devaluing of work that's coded as female.** That means stuff like not making fun of the design team.

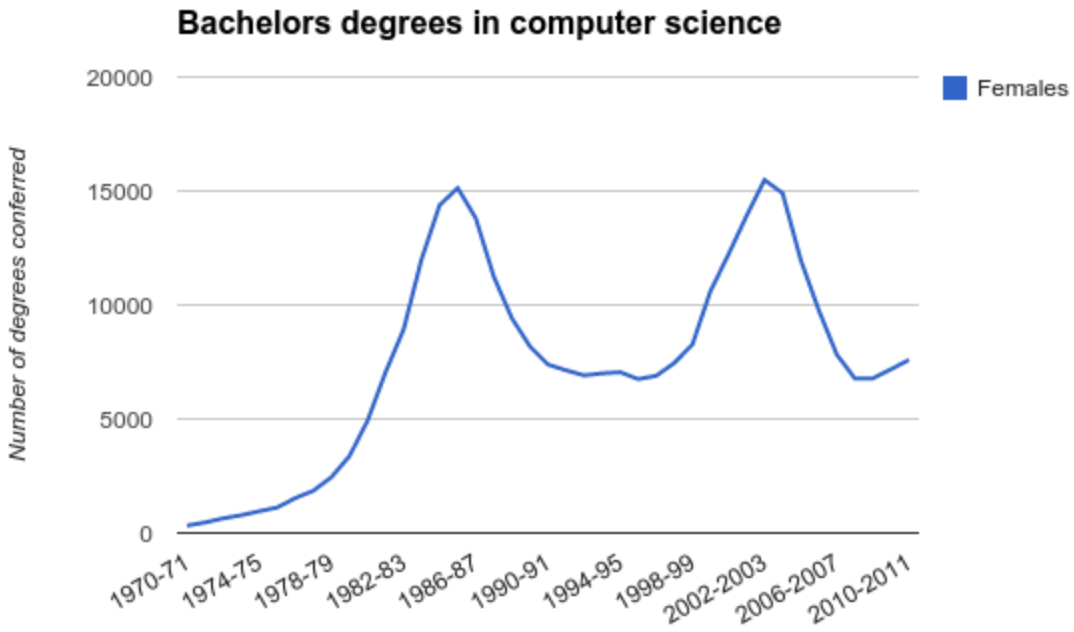
People at work may assume that you enjoy coordinating-type functions, that you're an excellent communicator, that you have a nurturing style and are good at mediating disputes, or that you are highly organized and happy to carry out secretarial-type functions like taking notes or scheduling meetings. People make those assumptions because they are not seeing you clearly: instead, they are seeing your gender, and imposing on you their understanding of "what women are like." To combat this, **learn to describe yourself and your preferred contribution style clearly and explicitly**. This might mean saying things like "I'm not actually very good at outreach and evangelism. I see myself as a structured, logical thinker, and what I really enjoy is writing code" or "I am actually terrible at coordination and don't see myself moving into a scrum master or product manager role. What I really care about is architectural design," or whatever. Once you've figured out how to describe yourself, do it all the time: in hiring interviews, in one-on-ones with your boss, in meetings with colleagues. Help other people to understand early what you're actually good at and what you enjoy, rather than risking them pigeonholing you based on your gender.

People at work may assume that you are willing to volunteer your time and energy to support initiatives designed to encourage girls and young women to study engineering, to recruit female engineers to your organization, or to arrange or participate in social or networking activities for women at your workplace. Some women like doing this and some don't, and some initially enjoy it and then later wish they hadn't done it. (Because they come to believe it wasn't effective, or come to resent having been expected to do it for free, or eventually wish they had invested their time in developing their own careers, rather than helping others develop theirs.) Rather than falling in line with other people's expectations, **make your own decisions about how much of your volunteer time and energy you want to dedicate to working towards gender equality in tech**. Whatever your answer is, you don't owe anyone an apology or an explanation.

People at work may assume they can load "emotional labour" onto you, because they see emotional labour as female. Emotional labour is stuff like resolving interpersonal disputes on a team, remembering team member birthdays and keeping on top of who's having trouble in their personal lives, advising people on their dating or relationship difficulties, organizing celebratory events when teams achieve milestones, and counselling people when they're having difficulty with their boss or direct reports. It can feel good to be valued for this, especially if you're undervalued in other ways. But you may not enjoy this kind of thing, and even if you do, it may pull your focus from your core work in ways you don't want. Just because people expect emotional labour from you doesn't mean you need to provide it. **If you don't want to be responsible for emotional labour, figure out who it actually belongs to, and redirect responsibility there.** Like, "I think it's too much to expect our team to resolve this dispute by ourselves. It's probably time to pull in [Boss]." or "I actually don't have any expertise related to what you're going through. I think you should probably talk to HR."

Stuff that has yet to be integrated into the main document

[Chart of bachelors degrees in computer science awarded to women, 1970-2011]



Source: U.S. Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS), "Degrees and Other Formal Awards Conferred" surveys, 1970-71 through 1985-86; Integrated Postsecondary Education Data System (IPEDS), "Completions Survey" (IPEDS-C:87-99); and IPEDS Fall 2000 through Fall 2011, Completions component. (This table was prepared July 2012.)

From Good Intentions, Imperfect Execution? Women get Fewer of the "Hot Jobs" Needed to Advance, Catalyst, 2012

"There is a great deal of evidence that stereotypes about women continue to exist in work settings (Dodge, Gilroy, & Fenzel, 1995; Heilman, Block, & Martell, 1995; Heilman, Block, Martell, & Simon, 1989; Schein, 2001). However, why and how do they impede women's career progress? Empirical evidence indicates that these stereotypes depict women as caring and relationship-oriented but not forceful and achievement-oriented." Thus women are perceived to be deficient in the attributes thought to be required for success at male sex-typed tasks. The "lack of fit" between perceptions of women's attributes and perceptions of male sex-typed job requirements leads to the conclusion that women are ill equipped to handle male sex-typed work and the expectation that they are unlikely to succeed in traditionally male roles. These performance expectations are powerful in their impact. They create a predisposition to view women in a way that detrimentally affects how they are regarded and how their work is evaluated."

Male Advantage and the Gender Composition of Jobs: Who Rides the Glass Elevator?, Social Problems, 2002

"Kanter's theory of tokenism posits that people, distinguished by some salient individual characteristic, who constitute a very small proportion of a group, are faced with unique interactional pressures including higher visibility, contrast, and assimilation. The resolution of these pressures is critical to one's career advancement. Although Kanter's theory was developed to explain the effects of token status on women's careers in male-dominated jobs, she concluded that the same processes are likely to occur for all token individuals, no matter what their distinctive characteristic: white, black, old, young, male or female. Many interpret Kanter's token theory to imply that all tokens will suffer negative outcomes from the unique interactional pressures they face: indeed, Kanter's (1977) discussion of Segal's (1962) study of male nurses indicates she thought men could be disadvantaged by token status. However, applications of Kanter's tokenism theory do not find that male tokens suffer from their minority status. Instead, qualitative studies of male tokens imply than men may even benefit from their scarcity in female-dominated jobs."

"The earnings of all workers in male-dominated industries benefit equally from the fact that the job is associated with the more valued gender. The wages of men and women in balanced jobs average less than those in male jobs, and the wages of men and women in female-dominated jobs are the lowest. Despite this hierarchy of earnings, the relative distance (in percentage terms) between men's and women's earnings within each category is equivalent."

Men and Women of the Corporation, Rosabeth Moss Kanter, Basic Books, 1977

From Handbook of Research on Promoting Women's Careers, Edward Elgar Publishing (Elgar Original Reference), 2013

From Chapter 6: Gender stereotyping and women's career progress:

"Descriptive stereotypes promote negative expectations about women's performance by creating a "lack of fit" between the attributes that women are thought to possess and the attributes considered necessary for success in male-typed positions (Heilman, 1983, 2001)." .. "Because descriptive stereotypes about women are seen as incongruent with the requirements of male-type jobs, the degree to which a given occupation is seen as "male" is likely to influence whether women encounter negative expectations about their performance. This "maleness" is typically determined by the degree to which the job is thought to require stereotypically male characteristics (Gaucher et al., 2011; Heilman et al., 1995) or by the perception that a greater proportion of men inhabit the field (Pazy and Oron, 2001)." .. "Numerous studies illustrate that women are most likely to encounter negative career outcomes in male-typed occupations and fields. Lyness and Heilman (2006), for example, found that women were evaluated less favorably than men in male-typed jobs, but not in staff jobs. In addition, Pazy and Oron (2001) examined the effect of sex proportions on performance ratings in a sample of high-ranking military officers. They found that women were deemed less competent than men in male-dominated units, but not in units where women were represented in larger numbers." "According to the Lack of Fit model, women are considered ill-equipped for male-type jobs because they are seen as stereotypically female, thus lacking the requisite masculine conditions for success (Heilman and Parks-Stamm, 2007). Therefore, conditions that heighten the salience of a woman's gender are more likely to activate stereotypes and generate a greater lack of fit. This heightening of salience occurs when a woman's gender is emphasized and her femininity is underscored. Indeed, evidence suggests that women are evaluated more negatively than men when gender-related attributes such as motherhood and physical attractiveness are highlighted. Structural factors that heighten the salience of women's gender also have been found to lead to negative evaluations. For example, women who bear token or minority status tend to be viewed more stereotypically and are less likely to be promoted. Similarly, affirmative action policies and diversity initiatives -- both of which draw attention to gender -- also have been shown to result in inequitable outcomes for women."

It's important that performance be evaluated in clear and unambiguous ways, because otherwise the vacuum of information will be filled by cognitive distortion and pre-existing biased expectations. It is in the interests for fairness for the information provided in performance evaluations to be abundant and job-relevant. Research suggests that supervisors are pretty reliable in rating productivity and work quality, but less reliable when rating communication competence and interpersonal competence. Ambiguity in what's rated is problematic, because research shows that under conditions of ambiguity people will redefine "good performance" to fit the qualities that men possess, and will then downwards-prioritize those same attributes when they are exhibited by a woman.

Research shows that when people's performance increases over time, evaluators upwards-revise their assessment of men's overall performance, more than they do women's. When people's performance declines over time, evaluators downwards-revise their assessment of women more than they do their assessment of men.

Research shows that performance reviews of teams rather than individuals hurts fairness, because ambiguity about the source of the performance leaves a hole that's filled by unconscious bias. "Thus, when a woman works with a man on a traditionally male task, a successful joint outcome is more likely to be attributed to the man." When the level of individual task contribution is unclear, women are evaluated more negatively than men: this is called "attributional rationalization." Women receive less credit than men for a successful joint project, and are blamed more than men when a project fails.

Good for fairness in performance reviews:
- clarity about what's being assessed
- lots of information to fuel the review
- reviews that focus on productivity and quality rather than communication/interpersonal skills
- reviews that focus on individuals not teams

Women are expected to be communal and non-agentic; men are expected to be agentic.

Women who don't demonstrate communalism are seen as cold and interpersonally hostile. They are disliked and interpersonally derogated. When women display autocratic or directive styles of leadership, they are disliked. Women who communicate using a tentative style are more influential than women who communicate using a direct, assertive style. Likability is an important determinant of influence for women. When women self-promote they are seen as less socially attractive. When women seek a pay raise, evaluators are less likely to hire and want to work with them. When men express anger or pride at work they experience a status increase: when women express anger or pride they do not.

Women are expected to be kind and considerate at work. Women who refrain from exhibiting "altruistic citizenship behavior" are judged negatively, whereas men are not. Men who exhibit altruistic citizenship behavior are rewarded for it with higher salaries and more promotional opportunities, whereas women exhibiting the same behaviors are not rewarded.

At work people are expected to behave politely and respectfully with each other. When women violate this expectation they're violating both a workplace norm and a gender norm. When behaving impolitely or disrespectfully at work, women are punished for the violation more than men are.

"People make inferences about highly successful women. They not only assume that they have the agentic characteristics necessary for success, but they also infer they lack the communal attributes that are typically associated with women." Competent female managers are disliked and seen as interpersonally cold and hostile,

particularly in male-typed domains. (They experience this bias less in female-typed domains.) Also, people assume that successful women have more agency than they do, and are more dominant than they are.

From Chapter 7: Women's occupational motivation

Women do not leave majority-male occupations because they lack intrinsic motivation (no stamina, no grit, don't have what it takes, won't sacrifice, have other priorities). They leave because they believe they don't fit: they are too different from the dominant, highly-masculine culture.

Research shows women leave their majority-male industries because they feel they are undervalued and don't have enough opportunity to advance, more than because of family-related reasons.

Research shows that motivation diminishes when a person does not have a realistic prospect for progressing. Motivation increases when a person is in a group perceived as high status, and when they have realistic opportunity to advance. If people perceive themselves to be similar to the people they see as leaders in their occupation or organization, that increases their motivation.

From Chapter 8: Women's impact on women's careers in management: queen bees, female misogyny, negative intra-relations and solidarity behaviors

In the 1970s, academics theorized that as women became more numerous in supervisory and middle management positions, then women's career advancement into senior management should improve as well. That hasn't happened: the research shows that the slow progress made by talented, educated, ambitious women is now having a negative effect on younger women's views of management and the professions as a career option. In the 1970s, it was argued that as the relative size of a minority increased, its members should experience a reduction in stress and other performance measures, and opportunities to demonstrate competence and potential should increase. Women should become more able to become allies, form coalitions, affect the overall culture, develop support networks and act as role models and mentors to enhance the success of other women. (This is called sisterhood or solidarity behavior.) However, the nature of senior management and the behaviors and actions required to gain entry to it don't do much to support solidarity or sisterhood behaviors, and some academics have argued that women at the top are better viewed as exiles from their gender rather than representatives of it. "Queen Bee" theory suggests that senior women have advanced by dissociating themselves from their gender and contributing to the gender stereotyping of other women (by for example turning against other women, disparaging other women, and ignoring other women's disparagement by others), thereby undermining the progress women make.

Sharon Mavin and Jannine Williams (chapter authors) describe the Queen Bee construct as inherently sexist, noting that there is no corresponding derogatory term for men. In contributing to the perpetuation of the label, its users are positioning the senior women as gender-deviant, because they aren't demonstrating the expected behaviors of being understanding, nurturing, giving and forgiving. Research suggests this is because both men and women are unused to seeing women as bosses, and therefore experience women bosses primarily as women, rather than as bosses.

From Chapter 20: The Case for Women's Leadership Programmes

In 1975 researchers argued that women-only leadership programmes are important because women are silenced in a coed classroom and issues of importance to women aren't addressed. In the 1990s researchers argued that ordinary leadership development is designed based on a "masculinised set of practices" which reinforce male dominance. The conundrum: women are overwhelmingly positive after having participated in a woman-only programme, and yet young women shun such programmes for fear of being stigmatised by their male colleagues.

"Engaging men as champions of change in gender equity is a critical part of driving organisational change for greater gender diversity and inclusion. When gendered dynamics that are embedded in work practices are surfaced, both women and men can engage as change agents and as "tempered radicals". Tempered radicalism is a proactive approach to surviving in an organisation while keeping one's sense of self intact and pursuing changes to make the workplace more equitable and inclusive. It arises from a desire for authenticity or from a conviction that change is needed. Women and men whose identities or ideals do not fit with the dominant culture where they work can relate to this delicate balancing act: fitting in just enough to stay in the game while while using an insider's leverage to change the game. Navigating between conformity and marginalisation, tempered radicals preserve their distinctive identities and engage productively in change efforts."

"Participants from these programmes have reported greater recruitment, retention and promotion of high-performing women employees, increased job satisfaction among participants, increased productivity among participants and their departments, shared learning and better communication across the organisation, improved interpersonal dynamics that enhance group effectiveness, increased confidence of women leaders and stronger peer and mentoring networks for women in their companies."

Principles for design and delivery of women's leadership programs.

Principle One: In helping women to advance into leadership positions, we recognise that both women and management need to take joint responsibility for the changes required. The programme, therefore, must be fully embedded in the organisation and ideally engage men as strategic partners.

Principle Two: Establish a safe space for women to work on their leadership development. This is achieved by helping participants make sense of their work experiences in a positive way and by providing a sense of belonging and identification through the coaching groups. This is relatively straightforward as the woman are all carefully chosen as highly talented potential partners.

Principle Three: Focus women on leadership self-efficacy. Self-efficacy is an important aspect of agentic leadership and is particularly important to women as they claim their leadership value and envision their own future, as well as that of their organisation. These programmes are a leadership "readying" process. Women do not jump forward as spontaneously as males when leadership roles are promoted. Women in our experience want to take the time to think through the leadership opportunity.

Women in Management: Delusions of Progress, Harvard Business Review, 2010

A 2010 Catalyst study that tracked more than 4,100 MBA students who graduated between 1996 and 2007, found that 27% of the women left their first jobs because of a "difficult manager," compared with 16% of the men. Catalyst believes that suggests than women and men may be treated differently by their first managers. "It's very important who your first or second supervisor is," said Rick Waugh, president and CEO of Scotiabank, one of the sponsors of the research. "Many times, that determines whether you're going to stay with that organization and how far you're going to advance. That first landing spot --whether you get coached, developed, and mentored or you get a bad manager-- casts the die. Companies need to put more emphasis on manager-direct report relationships in that first job."

The larger the company the more women. Start-ups have fewer women than non-startups, according to a dataset of more than 20K companies from Namely, a global HR and payroll company.

High-Potentials in Tech-Intensive Industries: The Gender Divide in Business Roles, Catalyst, 2014

[and] Feeling Different: Being the "Other" in U.S. Workplaces, Catalyst, 2014

Surveys of women in business roles find that those in tech-intensive industries are significantly less likely than those in non-tech-intensive industries to report feeling similar to most people at work (27% versus 49%). (Surveys were conducted of 5,916 female MBA graduates, in 2007, 2010, 2011 and 2014. "Tech-intensive industries" were defined as high tech, telecommunications, resources, chemical and energy, utilities, automotive, and manufacturing. "Business roles" was defined as administration, general management, consulting, consumer affairs, public relations, finance, accounting, purchasing, healthcare delivery, human resources management, marketing and sales, policy, legal and teaching/training.)

On immigration in Silicon Valley / tech industry generally:

"Census data confirm the presence of a large technically skilled, foreign-born workforce in Silicon Valley. Although one-quarter of the total Silicon Valley workforce in 1990 was foreign-born, 30 percent of the high-technology workforce was foreign-born. These immigrants were concentrated in professional occupations: One-third of all scientists and engineers in Silicon Valley's technology industries in 1990 were foreign-born. Of those, almost two-thirds were Asians--and the majority were of Chinese and Indian descent. In fact, according to the 1990 census 5 percent PUMS, more than half of the Asian-born engineers in the region were of Chinese (51 percent) or Indian (23 percent) origin, and the balance included relatively small numbers of Vietnamese (13 percent), Filipinos (6 percent), Japanese (4 percent), and Koreans (3 percent).

> The disproportionate representation of Chinese and Indian engineers in Silicon Valley's technology workforce explains the focus on these two groups in the balance of this study. This reflects broader national trends: Foreign-born engineers and computer scientists in the United States are significantly more likely to come from India, Taiwan, or China than from other Asian nations. The presence of large numbers of Chinese and Indians in Silicon Valley is a recent phenomenon, mirroring the timing of the changes in U.S. immigration legislation.: 71 percent of the Chinese and 87 percent of the Indians working in Silicon Valley high-technology industries in 1990 arrived in the United States after 1970, and 41 percent of the Chinese and 60 percent of the Indians arrived after 1980. Although we must await the 2000 census data for confirmation, Asian immigration to the region almost certainly accelerated during the 1990s, particularly among highly educated professionals, as a result of the higher limits established by the Immigration Act of 1990.

The Chinese engineering workforce in Silicon Valley was dominated by Taiwanese immigrants in the 1970s and 1980s. In the 1960s, there were very few Chinese technology workers in the region prior to 1970. In the two subsequent decades more than one-third of the region's Chinese immigrant engineers were from Taiwan. Immigrants from Mainland China are a growing presence in the regional workforce.

The University of California at Berkeley, for example, granted graduate degrees in science and engineering to a fast-growing proportion of students from Mainland China between 1980 and 1997, whereas the proportion granted to students from Taiwan declined correspondingly during the same period. By the mid-1990s, over half of the degrees (53 percent) were granted to students from China, compared to 35 percent in the late 1980s and only 10 percent in the early 1980s. The number of graduate degrees granted can be seen as a leading indicator of labor supply in Silicon Valley, as most graduates find jobs in the region's technology companies.

Not surprisingly, Silicon Valley's Indian and Chinese workforce is highly educated. In 1990, they earned graduate degrees at significantly greater rates than their white counterparts: 32 percent of the Indian and 23 percent of the Chinese employed in Silicon Valley in 1990 had advanced degrees, compared to only 11 percent for the white population. Their superior educational attainment is even more pronounced in technology industries: 55 percent of Indian and 40 percent of Chinese technology workers held graduate degrees, compared to 18 percent of whites.

This educational attainment is only partially reflected in occupational status. Indians and Chinese working in the region's technology sector were better represented in professional and managerial occupations than their white counterparts, with 60 percent of Indians and 57 percent of Chinese employed as professionals and managers, compared to 53 percent of whites. However, these groups were significantly more concentrated in professional than managerial occupations: 45 percent of the Indians, 41 percent of the Chinese, and 27 percent of the whites were in professional occupations, but only 15 percent of the Indians and 16 percent of the Chinese were managers, compared to 26 percent of the whites. In
other words, although Indians and Chinese accounted for 2 percent and 6 percent of Silicon Valley's technology professionals, respectively, they represented less than 1 percent and 4 percent of the managers.

The relatively lower representation of Chinese and Indians in managerial positions could be due to several factors: biases favoring technical, as opposed to business, education, or to the linguistic and cultural difficulties of many new immigrants. It could also be a reflection of more subtle forms of discrimination or institutional barriers to mobility based on race--or the "glass ceiling". However, income data provide little support for the glass ceiling hypothesis. Our analysis documents that there is no statistically significant difference between the earnings of Chinese and Indians in managerial, professional, and technical occupations and their white counterparts (Saxenian, 1999). This is consistent with the findings of other researchers who document greater disparities in managerial representation and upward mobility than in wage levels between Asian and white engineers with comparable skills and
education (Fernandez, 1998; Tang, 1993).

"Whatever the data show, many Chinese and Indians in Silicon Valley believe that there is a glass ceiling inhibiting their professional advancement. A 1991 survey of Asian professionals in the region found that two-thirds of those working in the private sector believed that advancement to managerial positions was limited by race. Moreover, these concerns increased significantly with the age and experience of the respondents. This perception is consistent with the finding that in technology industry at least, Chinese and Indians remain concentrated in professional rather than managerial positions, despite superior levels of educational attainment. It is notable, however, that those surveyed attributed these limitations less to "racial prejudice and stereotypes" than to the perception of an "old boys' network that excludes Asians" and the "lack of role models." (AACI, 1993)."

"Chinese and Indians were at the helm of 13% of Silicon Valley's technology companies between 1980 and 1984, but they were running 29% of the region's high-technology companies started between 1995 and 1998."

...

"There is an interesting sectoral division among these businesses. Chinese-run firms are more concentrated than Indian-run firms in computer and electronic hardware manufacturing and trade, whereas Indian-run companies are disproportionately in software and business services. This difference is likely due to the differences in language skills between the two groups. Indian immigrants tend to be proficient in English, but most first-generation Chinese immigrants are not. This means that Indians can move more easily into software development whereas Chinese immigrants gravitate toward sectors where language skills are less important. It is worth noting, however, that this appears to be changing. Two well
known public technology companies started by Taiwanese immigrants--Broadvision and AboveNet--are in the software and Internet sectors, respectively. Moreover, in absolute terms, there are more Chinese-run than Indian-run software and service companies."

...

"The fastest growing groups of immigrant engineers in Silicon Valley today are from Mainland
China and India. Chinese, in particular, are increasingly visible in the computer science and engineering departments of local universities as well as in the workforces of the region's established companies. Although still relative newcomers to Silicon Valley, they appear poised to follow the trajectory of their Taiwanese predecessors. Several have started their own companies. And they are already building ties back home, encouraged by the active efforts of Chinese bureaucrats and universities--and by the powerful incentive provided by the promise of the China market. Ties between Silicon Valley and India will almost certainly continue to expand as well. Whether the emerging connections between Silicon Valley and regions in China and India generate broader ties that contribute to industrial upgrading in these nations-- as well as creating new markets and partners for Silicon Valley producers--will depend largely on political and economic developments within those nations. Whatever the outcome, the task for policymakers remains to maintain open boundaries so that regions like Silicon Valley continue to both build and benefit from their growing ties to the Asian economy."

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http://graphics8.nytimes.com/packages/pdf/technology/SVCIP_2015_PDFfinal.pdf

In 2013, 56 percent of Silicon Valley's STEM workforce and nearly 70 percent of its software developers were foreign born, the highest among the key innovation regions. In Silicon Valley, 3 percent of new residents in 2013 moved from other parts of the U.S. and 97 percent moved in from abroad, while in Austin, 83 percent of new residents previously lived in other parts of the U.S.

And, 43.9% of Silicon Valley startups that were founded between 2006 and 2012, were founded by foreign-born entrepreneurs.

Gender-Dominated Industries: Bridging the Gap, 4th Annual International Business Conference, 2013

Taylor (2010) introduces the concept of an occupational minority, defined as a worker
who is a numerical rarity in his or her occupation. Examples of occupational minorities include: male nurses, female construction workers, male teachers, and female surgeons. This concept focuses on minorities at the occupational level and does not take into account actual gender composition of their specific organization. This view involves perceptions of appropriate gender roles, interactions, and support. It suggests that gender compositions have different effects on both men and women in the workplace.

Furthermore, another form of this type of discrimination is evident in the formation of network ties in which women in male-dominated industries are at a disadvantage in the creation of these ties because in order to establish networking opportunities, one would need to express similar interests and characteristics to the target population. This is difficult for women to reach out to their male supervisors whom they do not express shared interests. Men, on the other hand, do share interests with their same-sex supervisors and therefore have more resources available to obtain assistance/information than their female counterparts (Taylor, 2010).

From "No Credit Where Credit Is Due: Attributional Rationalization of Women's Success in Male–Female Teams" Journal of Applied Psychology, 2005

In a 2005 study, researchers gave 60 undergraduate students (25 men and 35 women) packages of information about a Finance VP who had worked in a mixed-gender team to create an investment portfolio, which the students were told was "excellent." The only difference in the packages was the employee's gender. A VP presented as male was rated by students as more competent, more likely to have influenced the successful outcome, and more likely to have taken a leadership role in the task, compared with when the (otherwise identical) VP was presented as female.

A followup study found that this effect only disappeared when information was included in the package that attested to past on-the-job performance excellence. Researchers noted however that "vague information" about past performance wasn't sufficient to overcome the gender effect, and concluded that "without a compelling reason for the rater to believe otherwise, negative expectations of women who work in male sex-typed tasks persist even in the face of clearly successful joint outcomes, resulting in the devaluation of women's competence and their contribution to the work product."

The researchers wrote: "Taken together, the results of these studies indicate that working together with men in traditionally male domains can be detrimental for women - even when the work outcome is highly favourable. We found this to be the case unless a) there was specific information about the female team member's individual performance excellence on the team task (Study 1), b) the female team member's contribution to the joint task was irrefutable because of the structure of the task (Study 2), or c) there was definitive information about the excellence of the team member's past performance effectiveness (Study 3). In the absence of these conditions, women were thought to be generally less competent, less influential in arriving at the successful team outcome, and less apt to have taken on a leadership role in the task than were their male counterparts."

The researchers also wrote this: "If women in nontraditional work domains who work in situations in which source ambiguity flourishes, such as successful mixed-sex teams, are denied credit for their part in bringing about the success, and are devalued simply because they are women, then there is a potential price to be paid."

From STEM Women Full Professor Focus Group: Summary Results, Brown University, 2010:

"Women currently comprise only 15% of full professors in STEM fields at Brown University. As a result, STEM women full professors serve on a large number of committees, including search committees that require a full professor. Focus group participants reported that in addition to serving on a large number of committees, they are frequently the only woman sitting on a committee, and often take on a disproportionate amount of responsibility for note taking and administrative tasks."

From Globalization, Gender and the Workplace: Women and Men in an American Multinational Corporation in India, a chapter by Winifred Poster from Globalization and the Evolving World Society, Brill Academic Pub., 1998

An observational study of an Indian subsidiary of an American multinational tech company in Delhi, which employed an all-Indian staff, in which 60 female and male employees were interviewed, found that the subsidiary adopted American gender ideologies internally inside the organization, and Indian gender ideologies outside it. This meant that inside the organization female employees experienced what's called normative control, whereas outside it they experienced what's called confinement control. Normative control meant that women tended to be relegated to low-level positions and were encouraged to adopt low status behaviours; their work was undervalued and they did not advance. Confinement control meant that women were separated from unsafe men by being secluded to the physical office space, and kept from travelling, staying late, or eating in restaurants. In normative control limitations were framed as originating inside the women; in confinement control limitations were framed as being external to the women.

From Global Circuits of Gender: Women and High-Tech Work in India and the U.S., 2008 WEPAN Conference Proceedings, 2008

Sociologist Winifred Poster interviewed 180 employees at three tech companies in Silicon Valley, Bangalore and Delhi, in 1995 and 1996. Poster found that at the American company, "technical competence is defined as a masculine trait," and "women are treated as second-class personnel, or even non-technical personnel." Women's colleagues would situationally enhance their status along expert/non-expert lines; overemphasize the technical aspects of men's jobs and trivialize the technical aspects of women's jobs; denigrate women's engineering skills; sporadically test women for their technical competence; disappear women's technical work by ignoring them during technical meetings or ignoring their work; and mocking/humiliating them publicly for their technical knowledge. Poster found however that women were encouraged to display leadership skills, and were paid similarly to their male colleagues. (14% less) By contrast in India, women's technical skills were not questioned or denigrated and their competency was assumed. The assumption was that technical work itself had no gender, and that there was no reason women wouldn't be assumed to be able to do it well. However, their work was restricted in a variety of ways. Women were not allowed to work at night after regular business hours. Some offices and floors were designated as male and women were informally discouraged from going there. Women were discouraged from travelling which made it hard for them to make contacts with other engineers and researchers at universities, and to travel for conferences. And, women were paid less than men, to a greater degree than was the case at the American company. (Check for stats.)

From BS At Work: How Benevolent Sexism Undermines Women and Justifies Backlash, Harvard Business School, 2013

Hostile and benevolent sexism don't conflict; "rather, they jointly resolve the tension between dominance and interdependence." "Hostile sexism punishes women when they challenge male dominance, while benevolent sexism rewards women for conforming to stereotypes and roles that serve men's needs. Together, these ideologies act as the carrot and the stick that motivate women to stay in their place." "Benevolent sexists, more often than not, are also hostile sexists." "High BS nations exhibit more hostile sexism and less equality for women, suggesting that whatever

protection BS ostensibly offers, women fare less well in societies that strongly endorse BS." "Women who accept BS come to resent women who, by seeking equality, threaten traditional gender relations in which women cede power in exchange for men's provision and protection." "Benevolent sexism uniquely predicts patronizing discrimination, which masquerades as polite help and sympathy while undermining women."

Glossary of concepts

- stereotype threat / identity threat / imposter syndrome
- implicit bias / unconscious bias
- the competency/likability paradox AKA double bind AKA prove-it-again pattern AKA abrasive trap
- the glass cliff / glass ceiling / glass wall
- over-efforting / effortful coping
- attributional rationalization
- "leading with the cookies" / service burden / service work
- emotional labour
- male-dominated/majority-male (means under 25% female)[129]

[129] "A nontraditional occupation for women is one in which women comprise 25 percent or less of total employment." United States Department of Labor, Women's Bureau

Missing research

These are areas that I'm interested in, for which I haven't yet found relevant research. If you know of useful studies or other sources, please email me at susanpgardner@gmail.com, or add them here by commenting. Thanks :)

- Country-of-origin effects. Anecdotally, North American-originating women have told me they feel like they've experienced sexist treatment particularly in their relationships with men from cultures that are less gender-egalitarian than North America. (Particularly, India and China.) I would love to find research into this.
- Supervisor effects. My understanding is that 1) people in HR have a common saying that "people leave bosses, they don't leave companies," which I think means that a big reason people cite for quitting their job is difficulties with their direct supervisor, 2) the research shows that women generally report more dissatisfaction with direct supervisors than men do, and that 3) that effect is largest in majority-male industries, and perhaps particularly STEM and particularly computer programming, and 4) I hypothesize that quality of management may be unusually low in tech companies and particularly in start-ups. I would love to see research on any of this. Particularly, I'm interested in research that surveys tech industry employee satisfaction with their supervisors/managers, broken down by gender and race.
- The concept of erasure. I've noticed a couple of anecdotes about women having been erased from Silicon Valley history -- most recently, when the Tinder co-founder was stripped of her co-founder title. This doesn't happen only to women, of course. But I wonder if there's been a persistent pattern of erasing women's contributions. Would welcome more research / cites to research, into this. (Note I have not yet read Walter Isaacson's The Innovators.)

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last updated 21 February 2015

(Bolded titles contain tips/tactics/strategies/advice for women in tech, not just data or analysis.)

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