

# **Female Engineers of Color in Early Career: Overcoming Challenges through Networking and Other External Supports**

## **Abstract**

The purpose of this study was to explore the challenges that female engineers of color face in their first years of employment, and how their social and professional networks prepared them to face these challenges. The target population was women of color who were one to five years into their engineering careers. We focused on this population because women of color currently account for only 5% of engineers in the workforce (NSF, 2017a).

We collected data through one-on-one interviews of female engineers of color who graduated between 2011 and 2015. In our data analysis, we identified common challenges participants experienced early in their careers and strategies they used to overcome those challenges. Additionally, we highlight ways in which universities and professional associations can support women of color in the early stages of their engineering careers.

## **Purpose**

Though much attention has been paid to improving the diversity of the engineering workforce over the past couple of decades, only 20% of all engineering bachelor's degrees are earned by women (Yoder, 2017). For women of color, this statistic is even more striking: Approximately 3% of bachelor's degrees awarded in engineering go to Black, Hispanic, and Native American women combined (NSF, 2017a). For African American women, degree attainment in engineering is actually declining (Slaughter, Tao, & Pearson, 2015). Asian women, who are typically not considered underrepresented in educational circles, only earn 2.5% of all engineering bachelor's degrees (NSF, 2017a).

The low percentage of women of color earning degrees in engineering impacts our ability to diversify the profession. Currently, fewer than 5% of working engineers are women of color (NSF, 2017b). Considering how few women of color are earning engineering degrees, it is imperative that we attend to the retention of those that enter the profession. Researchers have identified several factors that contribute to the lack of diversity in engineering, particularly among women and people of color; however, little research specifically addresses the unique challenges of women of color in engineering professions.

The purpose of this qualitative study was to explore the challenges that female engineers of color face in their first years of employment, and how their social and professional networks have prepared them to face these challenges. In addition, the researchers sought to understand what gaps exist so universities and professional associations can better support female engineers of color in college and in the workforce.

## **Theoretical framework**

To understand the challenges that women of color face early in their engineering careers, an intersectionality framework was used to analyze the data collected in this study. Intersectionality

refers to the “critical insight that race, class, gender, sexuality, ethnicity, nation, ability, and age operate... [as] reciprocally constructing phenomena that in turn shape complex social inequalities” (Collins, 2015, p. 2). Crenshaw (1989) indicated that it is necessary to analyze issues using an intersectional lens to best address the needs and problems of those who are marginalized and to avoid compartmentalizing experiences that undermine collective action. Given the researchers’ affiliations with organizations that support women and Black engineers, the application of an intersectionality framework allowed for a greater understanding of how various identities interrelate to impact the lives of female engineers of color.

## **Methodology**

The primary focus of this exploratory study was to promote the narratives of early-career women of color in engineering and share their insights. To that end, we focused on the challenges that women of color in engineering faced early in their careers and the supports they received from their networks, universities, and professional organizations to help them overcome those challenges. A qualitative research design utilizing one-on-one interviews allowed for a closer look into their experiences and a more nuanced view than is typically available through quantitative methods.

Data were obtained from interviews with 31 women of color between October 2016 and June 2017. Women were eligible to participate if they had graduated on or after May 2011 and had been employed in the engineering workforce after graduation. We used purposive sampling, with participants recruited through the National Society of Black Engineers (NSBE) and the Society of Women Engineers (SWE) social media outlets. We conducted one-on-one semi-structured interviews, allowing for clarification and follow-up questions. All participants signed IRB-approved consent forms and were informed of the confidentiality and anonymity of the data. Interviews ranged from 15 minutes to one hour in length. Interviews were recorded, and files were transcribed by an outside entity. We uploaded the transcriptions into Dedoose, an online data analysis application; we used open and axial coding to analyze the data, looking for categories and emerging themes.

## **Data Sources**

We interviewed 33 women for this study. Two participants were ineligible to be included due to their graduation dates. Table 1 lists the demographic information of the 31 women that are included in the study.

Most of the women interviewed were African American. Eight women interviewed were Hispanic, two were Asian American, two were Native American or Alaska Native, and one was of mixed race. There was no eligibility criterion placed on age, but most of those interviewed were under 30 years of age. Of those interviewed, 23% were married, and only three had children. As shown in Table 2, the diversity of engineering disciplines was apparent. The majority of those interviewed had earned mechanical engineering degrees, in line with ASEE’s survey that has identified mechanical engineering as the most popular engineering degree earned by both men and women (Yoder, 2017). Most study participants had between two to five years of work experience in

engineering. A couple of participants indicated a little less than two years of experience, and four had over five years of experience because of employment during college.

## Results

Responses to interview questions were coded to uncover emerging themes associated with the challenges, networks, and external supports that women of color utilized during their search for an engineering job after college graduation and in their first years in the engineering workforce.

Among the challenges that many women expressed during the interviews, we focus on three: bias in the workplace, negotiating salary and benefits, and performance evaluations.

Bias in the workplace. Numerous participants shared their experiences of realizing that they were a minority in the engineering workplace, and the difficulty of fitting in. Many of those interviewed explained feeling uncomfortable or isolated in their workplace, while others focused on specific biases that they experienced – both gender- and race-based.

*“When I was in Baltimore, it was all white male. And that actually was something I was very uncomfortable with because I was the only female in the room and sometimes the only person of any type of minority status.” – Latina Engineer*

*“I was the only female and the only person of color who was an engineer in our entire company... They weren’t very accepting of having a woman of color coming in and telling them kind of what needs to be done and how things should be done. So I got a lot of push back.” – African American Engineer*

*“...There hasn’t been a lot of women in my particular job for a couple years. There are joking comments. I think people usually apologize. Now that I’ve been there for almost two years, I feel like I’m part of the team. I wasn’t expecting the transition to be as...it was a little more gradual than I expected. I guess I didn’t expect some of those mentality jokes to still be there.” – Latina Engineer*

Negotiating salary and benefits. The gender pay gap that exists in the U.S. is seen even at the new hire stage, as many women hesitate to negotiate their salary and benefits. More than 60 percent of those interviewed indicated that they did not negotiate their starting salaries or benefits, and almost half indicated that they wished that they had negotiated.

*“No, I’ve never [negotiated]. I don’t know how to do that. I’m going to go with whatever they say.” – African American Engineer*

*“At the time, [I was satisfied with my salary] because I didn’t know any better.... After realizing how much work I was actually doing and hearing that everybody else that I worked with made a lot more money than I did, I realized that it was unfair that they were paying me such a low amount of money.” – Latina Engineer*

Performance evaluations. Satisfaction with performance evaluations was an issue, with over 35% of women in this study indicating dissatisfaction with recent evaluations. For some, it was due to a lack of honest feedback, while others felt that they were unfairly treated.

*“I’ve asked for the feedback. But sometimes... all I’ve gotten is ‘oh, you’re doing great’ sort of thing. And it doesn’t help. I’m just like, okay. I’ll just continue doing what I’m doing.” – Latina Engineer*

*“My manager gave me the highest performance rating at the beginning of this year. I had basically asked for a promotion because I got the highest rating. I should probably get a promotion. And she said no but didn’t give me any constructive feedback as to how I can get there or do anything like that.” – Asian American Engineer*

*“... If you’re not telling me what I’m doing wrong or whatever, but you just say I’m doing fine, then it’s kind of hard for me to improve on whatever I need to be doing to help you out more and be a better employee.” – African American Engineer*

Networks and external supports. We also analyzed responses to ascertain the value of social and professional networks, universities, and professional associations in helping women address the challenges they faced in early career. Networks and external supports were commonly relied upon to assist women during their job search and in their first years of employment. The women in this study that were most successful in their career pursuits were those that indicated that they had a strong support system in place. Some were fortunate to have support from a variety of sources, while most indicated receiving guidance, coaching, or mentoring from one or two different sources.

For many women in this study, the university career centers and alumni network were a key factor in getting exposure to hiring companies and prepared for professional interviews.

*“My university had an amazing career center where you got resume support.... We definitely had a career fair every semester of the fall and spring.” – African American Engineer*

*“[Alumni members] have been very actively helping us. They look at your resume for you, [conduct] mock interviews.” – Asian American Engineer*

A number of participants stated that the support that they received from their colleagues and mentors helped them be more comfortable in their workplace and cope with difficult situations that sometimes arose.

*“I think I have a lot of career guidance with my manager and some mentors I found at work. People support what I want to do and help me find the steps to do that.” – Latina Engineer*

*“I have another mentor who is also assigned to a companywide program.... And we talk all the time.... And we are as opposite as can be. She’s not black – but definitely very different backgrounds and upbringings. And we talk about all things: gender, race, you name it.” – African American Engineer*

Most participants were involved with professional associations during college, and all but two study participants indicated that they were currently members of at least one professional association. Many valued the support offered by the organizations, particularly services involving networking and job search assistance.

*“...being a part of that network is empowering. And when you get to go to conferences or seminars, and you all get together, it’s like one big genius family.” – African American Engineer*

*“I’m grateful to SWE because I was able to meet other women who also had the same aspirations, especially the conference for the career fair.” – Latina Engineer*

*“I could relate to people in NSBE because they were people of color. When I say people of color, I mean they came from the same culture and background as I did.” – African American Engineer*

*“I was part of the Society for Hispanic Professional Engineers. My support came from them. My parents didn’t go to school, so they didn’t have a lot of help for me.” – Latina Engineer*

However, some noted that they were not as active in the organizations after college graduation.

*“I’m supposed to be a member of SWE, but I don’t actually go to any meetings. I’m supposed to be member of ASCE, but I don’t actually go to any meetings.... I’m trying to work and finish school at the same time and balance school life. If I were to take one off my plate and switch it for one of these professional organizations, I think they could be really very beneficial. I could see the benefits of networking.” – Native American Engineer*

*“[I dropped my professional engineering association membership after] I visited a local chapter in my area.... They were really lowly populated, and they didn’t have a lot of events. It kind of just faded out of my mind, really.” – African American Engineer*

The narratives of early-career women of color shared in this study offer a glimpse into the influence of race and gender on their experiences in the engineering workplace. While almost every woman interviewed expressed no regrets about her decision to pursue an engineering career, what many lacked in those first few years of employment was the knowledge of how to advocate for themselves – starting with negotiating their first job

offers. While external supports such as colleagues and mentors were helpful to many, some women noted that they could benefit from more active membership in professional associations that offered more diverse events, better support during employment changes (employers, positions, and locations), and easier access to events that accommodate their busy schedules.

### **Significance**

The purpose of this study was to understand how external supports, particularly social and professional networks, universities, and professional associations, can better assist women of color in their transition into the engineering workforce. The application of an intersectionality framework to analyze the interview responses provided a way to investigate the influence of race and gender in female engineers' lives during the early phase of their careers, allowing for greater understanding of experiences that may be overlooked when solely looking at one aspect of their identity. This work is significant because the need to diversify the engineering profession will happen not just through the recruitment of more women and people of color into engineering degree programs, but also through ensuring that women of color are supported in all stages of their careers. A 2012 study found that 10% of women who earned engineering bachelor's degrees never entered the field, while another 27% left the profession at some point in their career (Fouad, Singh, Fitzpatrick, & Liu, 2012). It is important to note that the majority of those that left did not leave the workforce entirely, so finding out what issues women of color in early career are challenged with can help universities and professional associations better support them and reduce the attrition of women of color from the profession.

## Tables

Table 1: Participant Demographics

Race		Count
	Asian/Pacific Islander	2
	Black or African American	18
	Hispanic or Latina	8
	Native American/Alaska Native	2
	Mixed Race	1
Age (years)		
	< 25	4
	25-29	22
	30+	4
	No Response	1
Marital Status		
	Married	7
	Single	24
Children		
	Yes	3
	No	27
	No Response	1

Table 2: Participant Work Experience

Area of Specialization		
	Aerospace Engineering	3
	Chemical Engineering	4
	Civil Engineering	5
	Computer Science	1
	Electrical Engineering	3
	Industrial Engineering	3
	Manufacturing Engineering	1
	Mechanical Engineering	9
	Software Engineering	1
	Systems Engineering	1
Years of Work Experience		
	< 2 years	2
	2-5 years	25
	5+ years*	4

\* Due to inclusion of internship experience

## References

1. AAUW. (2013). Engineer took all the right steps but still didn't receive fair pay. Retrieved from <http://www.aauw.org/2013/07/19/engineer-unfair-pay/>.
2. Aronson, J., Quinn, D. M., & Spencer, S. J. (1998). Stereotype threat and the academic underperformance of minorities and women.
3. Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, 38(2), 113-125.
4. Bell, A. E., Spencer, S. J., Iserman, E. and Logel, C. E.R. (2003), Stereotype Threat and Women's Performance in Engineering. *Journal of Engineering Education*, 92: 307–312. doi:10.1002/j.2168-9830.2003.tb00774.x.
5. Bureau of Labor Statistics: U.S. Department of Labor (2015). Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity. Retrieved from <http://www.bls.gov/cps/cpsaat11.htm>.
6. Chubin, D. E., May, G. S. and Babco, E. L. (2005). Diversifying the engineering workforce. *Journal of Engineering Education*, 94: 73–86. doi: 10.1002/j.2168-9830.2005.tb00830.x.
7. Collins, P. H. (2015). Intersectionality's definitional dilemmas. *Annual Review of Sociology*, 41, 1-20.
8. Corbett, C. and Hill, C. (2015). *Solving the equation: The variables for women's success in engineering and computing*. AAUW: Washington, DC.
9. Crenshaw, K. W. (1989). Demarginalizing the intersection of race and sex: A Black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *University of Chicago Legal Forum*, 1989(1), Article 8.
10. DeOrnellas, J. (2015). From curious little girl to household breadwinner. Retrieved from <http://www.aauw.org/2015/03/09/stephanie-engineering-and-cybersecurity/>.
11. DeOrnellas, J. (2015). I am the unicorn: A young woman of color prepares to enter the computer science workforce. Retrieved from <http://www.aauw.org/2015/03/19/i-am-the-unicorn/>.
12. Fleming, L. N., Moore, I. N., Williams, D. G., Bliss, L. B., and Smith, K. C. (2016). Social support: How Hispanic and Black engineering students perceive the support of peers, family, and faculty. 120th ASEE Annual Conference & Exposition, Paper ID #7227.

13. Fouad, N. A. and Santana, M. C. (2016). SCCT and underrepresented populations in STEM fields: Moving the needle. *Journal of Career Assessment*, 25(1). Retrieved from <http://journals.sagepub.com/doi/full/10.1177/1069072716658324>.
14. Fouad, N. A., Singh, R., Fitzpatrick, M. E., and Liu, J. P. (2012). *Stemming the tide: Why women leave engineering*. University of Wisconsin-Milwaukee.
15. Hill, C., Corbett, C., and St. Rose, A. (2010). *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. AAUW: Washington, DC.
16. How diverse is Silicon Valley? (2013). *CNN Money*. Retrieved January 27, 2017, from <http://money.cnn.com/interactive/technology/tech-diversity-data/?iid=EL>
17. Institute for Broadening Participation. (2014). Designing for success: Positive factors that support success in STEM pathways and reduce barriers to participation: What does the research say about what enables students to succeed and persist in STEM fields?
18. Lent R. W., Miller M. J., Smith P. E., Watford B. A., Lim R. H., Hui K...Williams K. (2013). Social cognitive predictors of adjustment to engineering majors across gender and race/ethnicity. *Journal of Vocational Behavior*, 83, 22–30.
19. Lent, R. W., Brown, S. D., Schmidt, J., Brenner, B., Lyons, H., & Treistman, D. ( 2003). Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models. *Journal of Counseling Psychology*, 50, 458–465.
20. Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance [Monograph]. *Journal of Vocational Behavior*, 45, 79-122.
21. Matusovich, H., Streveler, R. & Miller, R. (2010). Why do students choose engineering? A qualitative, longitudinal investigation of students' motivational values. *Journal of Engineering Education*, 99, 289–304.
22. Morning, C. and Fleming, J. (1994). Project Preserve: A program to retain minorities in engineering. *Journal of Engineering Education*, 83: 237–242. doi: 10.1002/j.2168-9830.1994.tb01109.x.
23. National Science Foundation (2017a). Women, minorities, and persons with disabilities in science and engineering. Retrieved from <https://www.nsf.gov/statistics/2017/nsf17310/digest/fod-wmreg/>.
24. National Science Foundation. (2017b). National Center for Science and Engineering Statistics, Scientists and Engineers Statistical Data System (SESTAT). Retrieved from <https://www.nsf.gov/statistics/2017/nsf17310/data.cfm>.

25. Obiomon, P.H., Tickle, V.C., Wowo, A.H., Holland-Hunt, S. (2007). Advancement of Women of Color in Science, Technology, Engineering, and Math (STEM) Disciplines. Faculty Resource Network.
26. Slaughter, J. B., Tao, Y., & Pearson, W. (2015). *Changing the face of engineering: The African American experience*. Baltimore, MD: Johns Hopkins University Press.
27. Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69(5), 797–811. doi:10.1037/0022-3514.69.5.797.
28. Yoder, B.L. (2017). Engineering by the numbers. Washington: American Society for Engineering Education. Retrieved from [http://research.swe.org/wp-content/uploads/2016/08/Engineering\\_by\\_the\\_Numbers\\_2015-16.pdf](http://research.swe.org/wp-content/uploads/2016/08/Engineering_by_the_Numbers_2015-16.pdf).