

# “Oscillating Between Hope and Despair”: A Narrative Case Study of Culture and Coping for Women in Engineering in Higher Education and Industry

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## Abstract

Women in engineering in all phases (students, faculty, and industry) are traditionally underrepresented, and have been underrepresented in the field for decades (Eaton et al., 2020). The United States government has invested in STEM disciplines to address the low presence of women in STEM fields and the STEM workforce (National Academy of Sciences, 2016). Lower representation can be attributed to numerous factors, including a lack of institutional commitment, lack of representation throughout students' upbringing, inappropriate cultural recruitment/outreach efforts, educational discrepancies throughout PK-12, and social expectations among others (Seymour & Hewitt 1997; Geisinger & Raman, 2013; Camacho et al., 2010; Smith et al., 2012). Not only is there low representation in the field of engineering, but also low retention for students, faculty, and industry due to the same factors that impact representation. The current qualitative study is a narrative case study utilizing relational interviewing. Participants included three women in the engineering field-- an undergraduate student, a professional engineer, and a faculty member and administrator. The key themes we uncovered-- Impact of Dominant Culture; Lack of Belonging/Connection; Justification of Existence; Emotional Turmoil; Coping Strategies—are woven throughout and across the narratives. Actionable change that we hope will come from this narrative study include determining ways we can make the engineering field more inclusive at all levels-- in the classroom, on co-op, at universities, in academia, and on the field in industry.

**Keywords:** women in engineering; engineering education; engineering; narrative case study; coping strategies; improving culture

## 1. Introduction

### 1.1 Undergraduate Women Experiences

Studies have shown that various factors impact women's desire to pursue careers in engineering (Bona et al., 2010). Oftentimes, negative factors discourage students from entering or continuing in engineering majors. Stereotypes have been shown to negatively impact the self-efficacy of many undergraduate women in engineering majors (Cadaret et al., 2017). According to Bandura (1999), Gender-based stereotypes were shown to influence the self-efficacy of the students even more than their engineering capabilities. Women in engineering were shown to succeed in engineering environments where inclusive environments have been procured. Obiomon et al. (2007) found that barriers were intensified and compounded for Black women who repeatedly were held to harsher standards while also being the group who was least likely to receive encouragement and acknowledgement for intellect, skills, and work. Morelock's study (2017) was able to confirm Gee's findings (2001) regarding the marginalization of students attributable to their social identities such as gender, race and class.

### 1.2 Experiences of Women in Faculty

Women have reported high levels of discrimination and dissatisfaction working as engineering faculty (Britton et al., 2012). This is especially true for Black and Latino women (Walkington, 2017). Scholar Ashford-Hanserd (2020) found that Black women predominantly had negative experiences, most of which took place during graduate education. Negative stereotypes and biases played a major role in their experiences while pursuing Masters' and PhD degrees.

Researchers have found that “persistence in the academy was aided by (1) supportive colleagues internal to the

department or institution, (2) supportive colleagues external to the institution, and (3) the intersectional considerations of group-specific nuances shared by Black, Latina, and Asian women engineering faculty members” (McGee et al., 2021, p. 57). McGee et al.’s (2021) study is significant because it shows that Women of Color working as engineering faculty perform their jobs better when they are embedded in departments with supportive faculty and leadership. Unfortunately, this is not a common situation for women, especially women of color in academia (Walkington, 2017).

Investigating the retention and promotion patterns of women and non-white faculty in STEM disciplines from 1992 to 2015 at four institutions, Gumpertz et al. (2017) found that representation had a significant increase from 1992 to 2015. However, the increase was largely due to the increase in white women and Hispanic faculty, leaving Black women with a larger gap. The numbers for both hiring and promotion increased at a significantly lower pace compared to all other groups for all women.

Furthermore, workload for women in academia is disproportionate (McGee, 2022). McGee et al., 2022 found that Black faculty were often overworked and most of the service performed did not count towards the requirements of service for the reappointment, promotion and tenure process. It was found that most Black women focused on their own social equity-related service (McGee et al., 2022).

### *1.3 Experiences of Women in Industry*

Similarly to the challenges faced in academia, women in industry report high levels of dissatisfaction in the workplace (Ayre et al., 2013). Quite often these women eventually depart the academy. While it has generally been accepted that many leave to focus on their personal lives (e.g. raising families), two-thirds of these women report having left the academy to pursue careers outside of academia. (Fouad et al., 2012). While there are a number of reasons that these women identified as the catalyst for their departure, one of the consistent factors was the overall lack of satisfaction with work culture in their institutions (Ayre et al., 2013; Frehill, 2010; Servon & Visser, 2011). Rice (2011) found that engineering workplaces lacked diversity, which made Black women engineers acutely aware of their presence as Black women in white man dominated spaces. This compelled Black women engineers to feel pressure to outperform their white men counterparts. The lack of representation in higher-up administrative positions also acted as a visual reminder of their restricted upward mobility (Rice, 2011). The participants often had constrained choices and constantly were forced to navigate environments that ranged from unwelcoming to hostile. Nevertheless, they found ways to thrive including finding support for themselves through workplace affinity groups and seeking support from outside family and friends. Black women “reauthored their own personalized definition of engineering identity that ‘embodied their whole-selves’ through their agency” (Ross & Godwin, 2016, p. 5). Ross & Godwin (2021) found that engineering identity development was only one piece to Black women engineers’ identities puzzle. Developing Black women's engineering identities alone was not enough to retain Black women engineers in engineering.

For the United States to maintain a competitive position in innovation and technology, the disparity for women and Women of Color in engineering must be reduced.

## **2. Method**

The current qualitative study is a narrative case study utilizing relational interviewing. Participants included three women in the engineering field-- an undergraduate student, a professional engineer, and a faculty member and administrator. The undergraduate student and faculty member are both affiliated with a large, midwestern research institution. The professional engineer holds a leadership position at a large international chemical and cosmetics company. The women were recruited via email through the researchers’ professional network; participants were hand-selected due to previous organic conversations we had with them on the topic and their passion for this work.

The three women each participated in one-hour long relational interviews as outlined by Josselson (2013). Josselson’s (2013) relational approach to qualitative interviewing, which instead of adhering to a predetermined set of questions, allows for the interviewer and interviewee to converse more freely. Relational interviewing allows the interviewee to lead the dialogue and the interviewer follows, asking follow-up questions and clarifying as needed. Relational interviewing is also known as being teller-focused, and the purpose of the method is to allow the participant to guide the conversation as well as focus on narrative development (Hydén, 2014).

Qualitative interview data was analyzed via a thematic analysis process. Researchers individually coded the interview data across the three interviews and wrote reflective notes (Clarke et al., 2015; Vaismoradi et al., 2016). Following the initial coding, interrater reliability was established through group coding and consolidation of codes. Codes were compared and labeled within the group, in an iterative fashion until final themes were determined (Vaismoradi et al., 2016).

Following the thematic analysis process, a composite narrative was created to showcase the findings in a humanistic way (Willis, 2019). The creation of composite narratives is meant to combine qualitative data from individual interviews into a single story that captures the themes across interviews (Willis, 2019). Developing composite narratives

allow researchers to “present complicated, situated accounts from individuals,” as opposed to simply listing and describing themes with representative quotes, as is typical in the presentation of qualitative findings (Willis, 2019, p. 471). Furthermore, composite narratives provide the reader with a story to frame the findings, which allows for the humanization of the data as well as accessibility for the reader (Willis, 2019).

### 3. Findings

Our findings are broken down into two main sections: overall themes and subthemes with representative quotes, and narratives that reflect the experiences of each of the women. The key themes we uncovered are woven throughout and across the narratives. Based on the identified themes, three narratives were created systematically from a student perspective, a faculty perspective, and a professional perspective. As mentioned above, we chose to construct narratives based on our thematic analysis in order to connect the reader to the women, in hopes that an emotional connection will pave the way for sustainable, positive change in engineering pedagogy, academia, and industry.

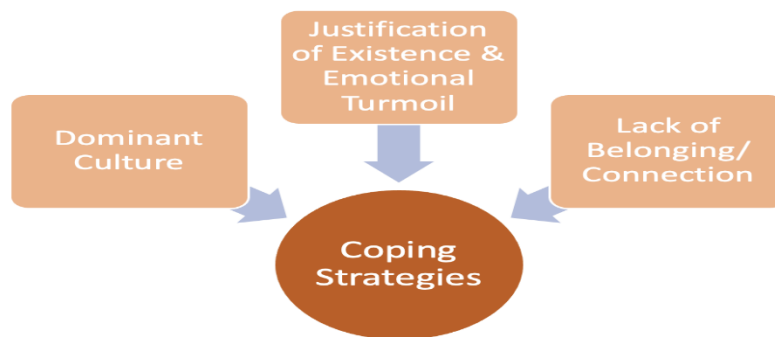


Figure 1. Coping Strategies

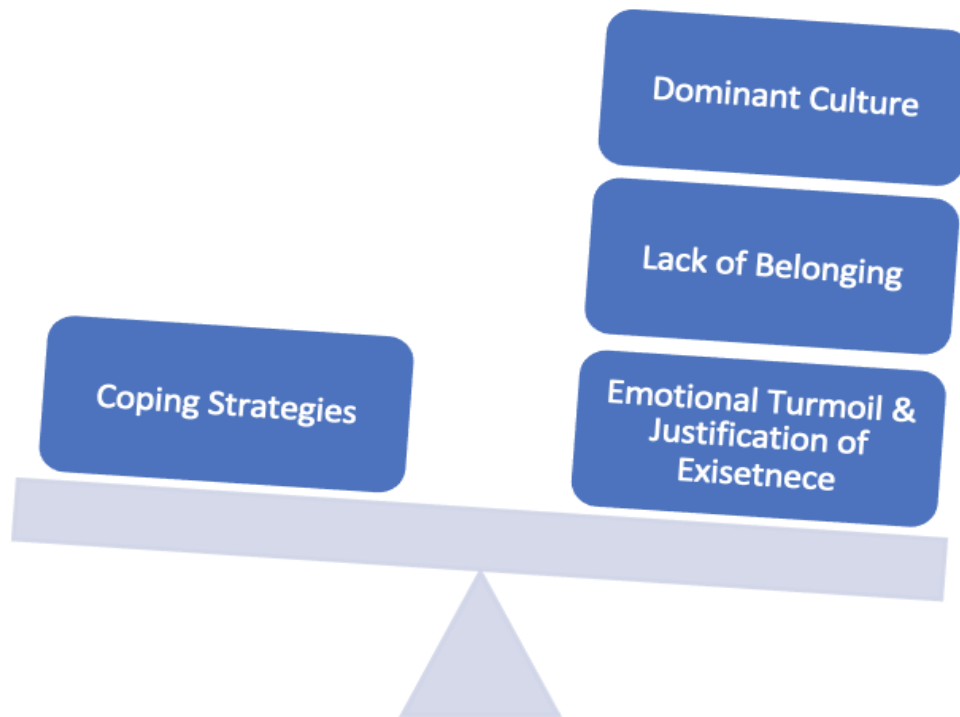


Figure 2. Themes

The overarching themes of the study include:

- Impact of Dominant Culture
- Lack of Belonging/Connection
- Justification of Existence

- Emotional Turmoil
- Coping Strategies

The *dominant culture* of engineering created an environment where women experienced a *lack of belonging* and difficulty connecting with colleagues. The culture created an environment where women had to regularly *justify their existence* in the engineering space. This lack of belonging and necessity to justify their existence created significant *emotional turmoil* for the women, both personally and professionally. Through all of this, the women developed various *coping strategies* to endure within the engineering space.

### 3.1 Impact of Dominant Culture

The women experienced the dominant culture within the engineering space as masculine and competitive. They each discussed having to suppress their personality and their authentic feelings to survive within engineering. One participant mentioned she had to “take off her blackness” at work, while another mentioned they had to “water down” or suppress their personality. The women felt as if the dominant culture within engineering normalized behaviors such as sexism and harassment, one woman referring to it as a “boys club”. Due to the dominant culture, women feel as if they have to work harder than male colleagues to get the same recognition and respect, one woman stated “I couldn’t do enough”. The women told stories of being ignored and being passed over for opportunities because of their sex, one woman mentioning they “didn’t have a seat at the table”. Many of the women felt the dominant engineering culture to be extremely oppressive of women, one woman stated, “people have no understanding of the plight” women experience.

#### *Coping strategies: Impact of Dominant Culture*

The women suggest that the engineering culture they experience is oppressive and dismissive of them. One woman stated, “you have less and you make the most with less”. Although the women highlight their struggles, they also capture their persistence and resiliency within the field. However, the women regularly mentioned that they often worked harder than their male peers, in an attempt to prove their worth. Coping strategies for how women tolerate the dominant culture can also be found in the other themes, due to the interrelated nature of themes.

### 3.2 Lack of Belonging/Connection

The women regularly felt othered in the engineering space, mentioning that they “feel like I don’t fit in” or “I just don’t belong.” One of the women discussed how she longed to be included in the social activities at work that their male colleagues engaged in together, for example poker tournaments or golf outings. She went on to state that she was “envious of the camaraderie”. The lack of inclusion in these social relationships impacted her feeling of belonging and hindered her ability to develop deeper relationships with colleagues, causing her to feel isolated and alienated. These situations created a sense of loneliness for the women, one woman stated “that’s all I had, just myself”. Another woman mentioned that colleagues don’t embrace you as a woman engineer, which leads into a justification of existence.

#### *Coping strategies: Lack of Belonging/Connection*

The most common coping strategy seen in regard to combating the lack of belonging is that we see the women masking or suppressing their true identities. The women exhibit high levels of self-regulation and code switching. One participant even stated that she regularly will internally justify the behavior of the assumed person, highlighting the longing for connection with peers that even when being faced with sexist and oppressive behaviors, the women seek a sense of belonging. Some women even went as far to alter their physical presentation of self at work, again “watering down” their femininity by altering their clothes, makeup, and hair, in an attempt of being accepted by peers. They suggest by doing this they are trying to make themselves one of the guys and minimizing attention being drawn to their sex. Finding allies and advocates also served as a coping strategy for the women, allowing them a space to be seen and a community of support.

### 3.3 Justification of Existence & Emotional Turmoil

Within engineering the women felt as if they were constantly having to “prove” they were an engineer. One woman mentioned “people always want to double check your stats”, suggesting that colleagues did not accept them based on merit. Another woman stated that the field of engineering and their peers made them feel as if they were never “qualified enough”, regardless of their accomplishments and education. This lack of trust and respect caused the women to second guess themselves and their abilities within the field. This justification of existence was something the women felt regularly, creating emotional turmoil for them both personally and professionally.

When sharing their experiences within engineering the women expressed feelings of uncertainty, discouragement, intimidation and anger. They recognized that they had a lot of feelings and emotions about what they were experiencing within engineering, but that engineering doesn’t hold space for emotions. Therefore, the women felt as if they had to stifle their feelings and “lie to myself” to keep moving forward. The women recognized the paradox they were living, knowing

they are regularly experiencing sexism and harassment at work, while also recognizing that it is “easier” to not acknowledge these experiences and merely ignore the comments. This constant feeling of having to be on the defense causes the women to live in a constant state of anticipating negative comments, while also living with pent up anger. One woman stated she felt as if her “soul was dying” due to constantly having to straddle this emotional turmoil. However, they did mention that they did occasionally see “glimmers of hope” they kept them going and ultimately caused them to stay within engineering. One woman so authentically stated that she “oscillated between hope and despair”.

### ***Coping strategies: Justification of Existence & Emotional Turmoil***

To survive in the engineering space the women developed a high level of self regulation. The women suggested that finding their “why” helped them remain resilient and remain within engineering. Some of the women also stated that they “lie” to themselves, wanting to believe that eventually the field will get better, but deep down not actually believing it will. However, the idea of lying to themselves allows them to persist. This expert level of self regulation can be seen when the women state that they choose to “not give power” to sexist comments or harassing behaviors. These experiences have allowed the women to develop emotional agency within their professional field. We also see that the women develop both internal and external coping strategies. All of the women give examples of internal self talk, suggesting they regularly give themselves “pep talks” or reminders to give themselves grace. The women all showed a high level of self reflection and emotional awareness as they navigated situations within engineering.

### ***3.4 Narratives***

Below you will find the three narratives-- student, faculty, and professional:

#### ***Student Narrative***

Jamie thought she had landed her dream job when she accepted her first co-op with a prominent engineering design firm. In the weeks prior to the start of her co-op, she spent her free time taking supplemental online courses to improve her skills with the company's preferred drafting software. For Jamie's first project, she was assigned to a co-op student team that reported to a central supervisor. She was used to being one of few women in class, but she was the only female member of her engineering project team. Fortunately, two of her team members were fellow classmates from her engineering program.

Even though Jamie had prepared for the co-op term and was excited by her first project, she started to feel as if she were falling behind her other teammates. In design meetings, many of her male counterparts were eager to speak up and seemed confident in their understanding of the project. Jamie was hesitant to talk in team meetings since she didn't fully understand the project materials and started to wonder if she was in over her head.

As the first weeks of co-op progressed, Jamie and Mark, one of the co-ops from her academic program, became closer. Eventually, Jamie felt comfortable enough to tell Mark about her insecurities around the current project and her feeling that she didn't fit in with the rest of the team. Mark reassured her that nobody on the team was truly confident and encouraged her to make more of an effort to engage with the other team members.

Mark's reassurance helped, but even though Jamie became more confident in her engineering abilities, she still felt miles away from some of her male teammates. A clear pecking order emerged within the team with Brian, the second co-op from Jamie's university, at the head of the pack. The other co-ops would regularly gather around Brian's desk and talk about the latest sports game or upcoming weekend plans. Jamie tried to join in but had little in common with most of her fellow teammates.

One morning, Jamie joined the group that gathered around Brian's desk and expressed her anxiousness about some of the difficulties she was facing with the current project.

Brian leaned back in his chair. "Can't flirt your way out of this one, can you?"

The statement felt like a gut punch, and for a moment, Jamie thought she had misheard. "What do you mean?"

Brian smirked. "You know, just like you did in Mechanics. Sit in the front row, smile at the Professor, and get an A. Wish I could do that."

Several in the group snickered.

Jamie's mouth hung slack. *Is he joking?* She wasn't sure whether to laugh or run screaming from the room. *Do my classmates think I'm flirting for grades?*

She met Mark's gaze, and he quickly broke eye contact and stared at the floor. He didn't laugh, but he didn't defend her either.

The comment stuck with Jamie, despite Mark's best efforts to convince her that it was just a bad joke.

*Why didn't he say anything? Am I making something out of nothing?*

### **Faculty Narrative**

Mary marched down the hallway while clutching a piece of crumpled printer paper. She whizzed by the open door to Andrew's office, eager to avoid a confrontation. Andrew had accidentally copied Mary on an email to several other faculty members that referred to her as *the diversity hire*. She had had enough. Typically, Mary tried to give her coworkers the benefit of the doubt when she perceived comments as racist or sexist, but Andrew had repeatedly made his position clear that Mary was only hired because she was black and female.

The Unit Head's office door was ajar, and Mary crossed the office and handed the printed email to him without saying a word. He skimmed the crinkled piece of paper. "Definitely a bad joke. I'm sure it's just a misunderstanding."

Mary's mouth hung ajar. She turned toward the door then stopped herself. As she turned to face the Unit Head once more, she let loose a list of Andrew's offenses. She clenched her fist to keep her hand from trembling.

The Unit Head leaned back in his chair. "I'm sorry. I can tell you're angry. I will talk to him."

Mary took a deep breath. *Angry* was the word she had hoped to avoid. All she needed was to be known as *that woman*, someone who squawked about every perceived injustice. She had seen this label applied elsewhere, and it typically didn't end well for the people involved. "I'm sorry. But this has been a recurring issue, and I think something should be done about it."

The Unit Head scratched his chin. "You're right. You know, we've been tasked with identifying someone to lead the department's DEI initiatives, and I think you'd be great at it. Would you be interested?"

The thought of leading the initiative made her cringe. Not only would she have to relive her personal trauma from encountering racist and sexist treatment in her personal and professional life, but she would have to convince some of the very perpetrators of these acts that DEI initiatives were worth pursuing. Mary's short time at the university had left her surrounded in a cloud of questions. *Do my coworkers see me as a diversity hire? What about my students? Mary had received several racist comments in her student reviews over the years. How do my male coworkers always seem to find secret pots of funding?* But with her reappointment date rapidly approaching, she had little room to say *no*.

"I'll consider it. But promise me that you will talk to him."

The Dean reassured her. "I will talk to him."

Later that night, Mary cradled a glass of wine and sat next to her husband on the couch.

"I should have just ignored the email, and now I'm in charge of this whole DEI thing. How did I get myself into this mess?"

### **Professional Narrative**

Alyssa read the name on the placard next to her office door. It had taken years of dedication to work her way into management. She still felt guilty for going above her previous boss's head to bring an idea to upper management, but after several years of being ignored, Alyssa had had enough. The move resulted in a major process improvement at the plant and Alyssa's ultimate promotion. Still, her previous boss hadn't said a word to her since she relocated from her team cubicle to a private office.

Alyssa sat in her office chair and caught her reflection in the monitor. Sometimes, she didn't recognize the woman staring back. Her friends certainly wouldn't recognize her, with her traditional black business suit, plain makeup, and conservative hairstyle. Outside of work, she was bubbly and animated, but it felt as if she left her identity at the office door. The new position was lonely. She had made a few strong connections with previous team members, but now that she was in charge, her new team seemed hesitant to lower their guard. It didn't help that she was replacing a recent retiree who had been universally adored.

She was eager to make connections other managers but had little in common with them. Alyssa had attended several inter-company leadership events as a part of the training for her new role and was surprised by how few women were in leadership roles within the company and that there were no other women of color.

Jerry, another manager in her department, leaned in the doorway and tipped his coffee cup in Alyssa's direction. "Hey, you don't golf, do you? You should join us on Friday."

She thought of the group of managers within her department as the Mutual Admiration Club. They always stood in each other's offices and chatted in the mornings, and they regularly golfed together. Alyssa couldn't golf and had no desire to learn but wondered when she'd have another opportunity to form bonds with the group. "I'm not much of a golfer," she replied.

"Neither is Adams." He smirked. "You'll be in good company."

*It wouldn't hurt to try*, she thought.

Her phone screen flashed from an incoming call. Her sister never called in the middle of the day. "I'm sorry. I have to take this."

Jerry nodded. "I'll stop by later."

Alyssa answered the phone, and her blood ran cold as she listened to her sister's trembling voice on the other end. Her father had had a mild stroke. He was fine, her sister reassured her, but they had taken him to the hospital for further evaluation. She typed a quick email to her boss and the HR coordinator. She looked down the rows of cubicles outside of her office. *Who else is there to tell?*

#### 4. Discussion

Many of the themes uncovered from the interviews align with current literature regarding the experiences of women and women of color in engineering fields—lack of belonging in a male-dominated culture and the emotional turmoil that comes with that is fairly well-known. That said, utilizing narratives is a novel way to humanize the data as well as instigate feelings of empathy and understanding. By engaging audiences in narrative writing that depict personal stories, we can appeal to affect and incite a passion in people to want to make a difference and change the narrative, so to speak. By reading the direct experiences of women in engineering, we are able to resonate deeply with their challenges and will hopefully become inspired to find ways to create actionable change inspired by the unique way the findings of this study were presented.

Actionable change that we hope will come from this narrative study, aside from raising awareness of women in engineering's experiences by unlocking emotion and empathy, include determining ways we can make the engineering field more inclusive at all levels—in the classroom, on co-op, at universities, in academia, and on the field in industry. Coping is another topic that we would like to delve into and exploring more about what that means for women in engineering, including coping techniques and how to propel allyship. Helping women develop ways to cope with their challenges is one aspect but developing allies through Equity and Inclusion training should also be considered. Allies could include students, faculty, advisors, and managers, to name a few.

There are several future directions we are interested in pursuing, particularly in relation to examining other populations within women in engineering and delving deeper into intersectional identities. In the current study, two of the women included were women of color. Exploring the specific experiences of women in engineering with multiple marginalized identities is a clear next step. Interviewing women of color is a natural step for a follow-up study, and specifically interviewing Black women and their unique experiences. Furthermore, looking at men of color in engineering and analyzing the intersecting and differing experiences between White women, Black women, and Black men could also be a potential future direction.

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