



Where's My Code? Engineers Navigating Ethical Issues on an Uneven Terrain

Dr. Cindy Rottmann, University of Toronto

Cindy Rottmann is a Senior Research Associate at the Institute for Leadership Education in Engineering (ILead) at the University of Toronto. Her research interests include engineering leadership and engineering ethics & equity education.

Dr. Doug Reeve, University of Toronto

Dr. Reeve is the founding Director of the Institute for Leadership Education in Engineering (ILead) established in 2010. Development of personal capability has been central to his work with engineering students for twenty-five years. In 2002 he established Leaders of Tomorrow, a student leadership development program that led to the establishment of ILead in 2010. He is also a Professor in the Department of Chemical Engineering and Applied Chemistry

Dr. Robin Sacks, University of Toronto

Robin is an Assistant Professor with the Institute for Leadership Education in Engineering at the University of Toronto where she teaches leadership and positive psychology. She served as Director of the Engineering Leadership Project, which aims to understand how engineers lead in industry.

Mr. Mike Klassen, University of Toronto

Mike Klassen is the Assistant Director, Community of Practice on Engineering Leadership at the Institute for Leadership Education in Engineering (ILead) at the University of Toronto. He designs and facilitates leadership programs for engineering students and professionals - with a range of focus from tangible skill development to organizational leadership to complex social problems. Mike is a PhD student in Higher Education at the Ontario Institute for Studies in Education and has an MA in Higher Education and a BAsC in Engineering Science from the University of Toronto.

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Abstract

Claims to professionalism among engineers are rooted in three key features: a specialized knowledge base, self-regulation, and a commitment to public service— [1-3] elements that have been historically codified into a set of ethical guidelines [1, 4, 5]. While these guidelines— Professional Codes of Ethics—may help engineers appreciate what not to do [4, 5], they are insufficiently specific to guide novice engineers through ethically ambiguous situations. As early 20th century artefacts, they also tend to reproduce structural inequities embedded in the history of the profession, and thus fail to reflect the experiences of historically underrepresented groups of engineers [6-14]. The Canadian Engineering Accreditation Board's (CEAB) pairing of ethics and equity [15] demands that we look beyond the codes to help our students navigate ethically ambiguous situations and patterns of privilege likely to arise in their professional lives. Unfortunately, there are several barriers to this process. Our critical analysis of career history interviews with 15 engineers committed to ethics and equity highlight three such barriers: 1) dominant narratives in engineering that make it difficult for social justice viewpoints to be acknowledged; 2) limited organizational influence on the part of junior engineers trying to challenge inequitable workplace practices; and 3) a fear that raising equity issues will result in personal attacks rather than positive change. Together, these three barriers—raised almost exclusively by female, racially under-represented, and LGBTQ identified engineers—illustrate the uneven terrain on which engineers navigate ethical issues.

Introduction: Why do inequities persist in engineering despite long standing ethical codes?

Examples of discrimination in engineering workplaces and universities abound. James Damore's inflammatory memo about Google's diversity policies, Susan Fowler's blogpost about sexual harassment at Uber, a recent social media attack on a Black engineering student at a Canadian university, and multiple targeted attacks on engineering education researchers studying diversity and inclusion in STEM education [16] are just four of the many discriminatory incidents that have occurred over the last six months. Why do incidents like these take place with such prevalence and intensity despite long standing ethical codes to which professional engineers are held accountable? We contextualize our study using two bodies of literature that provide insightful responses to this question— historical studies tracing the development of engineers' ethical codes and critical social justice-based analyses of engineering education policies, practices and norms.

The literature on engineers' ethical codes includes at least three lines of argument: first, there are those who claim that the very presence of a code means engineers are already ethical professionals [17, 18], second, there are those who use the code as an ethical call to action for the profession [1, 19], and third are those who urge us to pay attention to the historical contexts in which these codes were written [4, 5]. Yarmus [18] and Russell [17] articulate the first line of thinking. While there are differences in the tones of their arguments, both argue that engineers'

professional societies should use their members' technical integrity and exemplary ethics as a means of raising the status and stature of the profession. Unfortunately, by framing engineers' professional integrity as an unwavering platform upon which enhanced occupational status should be advocated, they leave little space for critique or improvement in this realm.

Hill et al. and Andrews adopt the second line of reasoning. In contrast to Yarmus and Russell, these authors accept that engineers have room for improvement when it comes to ethical conduct, but by privileging professional codes as a behavioural standard, they omit any ethical principles not named in the code [1, 19]. For example, Hill and his colleagues analyzed professional engineering codes in the UK and Germany and made the important point that engineers, their professional associations and the government cannot leave ethical decisions to "the invisible hand of the market." Unfortunately, the omission of equity and social justice in their framework leaves the inclusion of these dimensions up to that very same invisible hand [19]. Thus, like Yarmus and Russell, Hill et al. and Andrews implicitly mark the professional code of conduct as a necessary and sufficient framework to guide the moral behaviour of the profession.

The third line of thinking situates ethical codes in historical context [4, 5]. According to Vesilind's archival research, the ASCE's professional code was used primarily to enhance the image of civil engineers in the United States between 1914 and 1977 [5]. It was not until an engineering firm became embroiled in public scandal—the Spiro Agnew Affair—that the promotion of public good was added to the code. Similarly Tang and Nieuwma's historical examination of the IEEE code suggests that the professional society lacked a code of ethics until three engineers were fired from their public transportation employer (BART) in the mid 1970s for reporting commuter safety issues up the chain of command [4]. In contrast to the ASCE case, the BART engineers were behaving in an ethical manner, but as Tang and Nieuwma's article points out, their society was not immediately supportive of the whistleblowers' plight. Rather, it took the advocacy of two, short-lived, dissident committees—the Committee for Social Responsibility in Engineering (CSRE) and the Committee on Social Implications of Technology (CSIT)—with membership overlap in IEEE to codify ethical principles in 1977. The archival research conducted for these two articles demonstrates that the inclusion of ethical principles in at least two professional codes was a fairly recent addition driven by the need to protect engineers and their professional societies from damaging public relations events. Given their origins, it is important that engineering ethics educators view professional codes of conduct as historically contextualized, negotiated settlements, rather than uncontested statements of moral good.

One of the ways that equity-minded engineering educators have addressed this problem is by revealing the omission of social justice issues in engineering education. Riley and her colleagues have written extensively on this topic [7, 9, 12, 20, 21]. Related to the accreditation process, for example, Riley highlights the incompatibility of diversity initiatives with outcomes-based education [20]. Beyond accreditation, Riley, Slaton and Herkert trace the uphill battle faced by engineering educators trying to infuse specific equity issues into their professional code of conduct [21], Riley and Lambrinidou note the omission of social justice in the public paramountcy clause [22], Herkert reveals the absence of both ethics and equity in the somewhat technocratic framing of the National Academy of Engineering "Grand Challenges for

Engineering” document [12], Riley draws attention to the segregation of diversity booths in the American Society for Engineering Education’s exhibit hall [7], Riley, Slaton and Pawley note the paucity of engineering education research focusing on equity, diversity or social justice [9], and Pawley calls out the “diversity as exception” rather than “diversity as default” practice driving editorial decisions made by the *Journal of Engineering Education* [23]. This community of critical engineering education researchers makes a valuable contribution to the discussion of equity and ethics in their respective fields by making the otherwise invisible omission of equity, diversity and social justice visible in a range of engineering education contexts.

Another group of scholars contributes to this conversation through empirical research attempting to explain this omission. Cech, for instance, attributes engineering students’ decreasing interest in public welfare over the course of their four year degrees to a culture of disengagement in social issues underpinned by three ideological barriers—depoliticization, a technical/social dualism, and meritocratic ideology [24, 25]. Faulkner similarly taps into the problematic nature of dualistic thinking in her ethnographic study of five engineering workplaces in the UK and US [10, 11, 26]. Overall, she found engineers to be respectful in their actions, but also noted subtle dynamics and informal social networks that made it easier for male than female engineers to shape the organizational culture of their respective workplaces, with similar patterns of discrimination experienced by racially underrepresented and gender non-conforming men [10, 11, 26]. This was as true in the American software company with an employment equity policy as it was in the Scottish oilfields. Returning to the higher education context, Dryburgh [27], Tonso [14, 28-31], and Seron [13], explain the persistence of gender inequity in engineering education by examining professional identity-based barriers to belonging. Tonso’s ethnographic study of engineering design teams reveals the limited range of engineering identities available to female engineering students [10], Dryburgh’s study of professional socialization highlights the difficult trade off faced by female engineering students adapting to a sexist “work hard/play hard” culture [27], and Seron et al.’s document analysis of female engineering students’ journal entries points to four ideologies—gender essentialism, meritocracy, individualism and exceptionalism—all of which constrained participants’ capacity to engage in a feminist analysis of the normative, masculine engineering culture [13].

While this final group of studies is limited by authors’ overwhelming focus on gender as the sole dimension of privilege, it does provide us with four plausible explanations for the omission of social justice and equity in engineering ethics education. First, dualistic thinking privileges technical over social aspects of the profession, leaving both ethics and equity issues on the periphery of the curriculum [25, 32], second, informal networks made up of male-dominated social groups leave under-represented populations few avenues for organizational influence in both university and workplace settings [11, 14, 27], third, the dominant cultural narratives available to engineering students and professionals restricts their ability to secure belonging while productively engaging in conversations about diversity, equity or social justice [13, 24, 27], and fourth, engineers’ ideological commitment to meritocracy and political neutrality can make it difficult to for them to accept the validity of corrective initiatives like equity-based hiring and admission policies [33]. The presence of these four robust barriers to equity, diversity and social justice in engineering education suggests that it is irresponsible to teach engineering ethics without explicitly taking equity and diversity into account. As such, we have chosen to frame our study using a critical social justice perspective. After defining what we mean by

critical social justice and describing our methodological approach, we flesh out three thematic responses to the following research question: Why is it so challenging to pursue social justice in engineering education and workplace contexts?

Theoretical perspective: Critical social justice

The concept of social justice is often attributed to John Rawls—an American political philosopher who theorized the term in his seminal text, *A Theory of Justice* [34]. In this 1971 publication, Rawls argued that fair and just societies ought to distribute goods according to the following two principles: 1) all citizens have the right to an extensive set of human liberties and 2) social and economic inequalities must be: i) arranged in ways that are to everyone's advantage; and ii) attached to positions that are open to all. Implicit in Rawls' theory of social justice is the paramouncy of individual rights and freedoms, as well as the notion that social inequality is *compatible* with a just society so long as all citizens have an opportunity to compete for differently compensated positions. Critical theorists including Marx, Habermas, Freire and hooks, in contrast, argue that the social and economic inequalities imbedded in our education, economic and governance systems are always *incompatible* with social justice [35-38]. From a critical social justice perspective, systemic inequities must be challenged and removed before justice can be realized.

To use a practical example, a CEO adopting a Rawlsian, or liberal, approach to social justice might institute a merit based pay scheme, while ensuring that all posted positions are open to all qualified engineers. In contrast, a CEO adopting a critical approach to social justice might ensure that demographically under-represented groups of engineers do not disproportionately occupy low paying positions on a transparent pay grid. A common way of distinguishing between liberal and critical approaches to social justice is to contrast the liberal goal of “equal opportunity” with the critical goal of “equitable outcomes.” The first goal builds on the assumption of a pre-existing meritocracy while the second builds on the assumption of pre-existing systemic inequity. In this paper, we adopt a critical approach to social justice. What this means for us analytically is that we: 1) examine who is advantaged and disadvantaged by various policies, practices and norms, 2) foreground the voices of engineers swimming against the current of mainstream engineering culture, and 3) acknowledge the presence of systemic inequities in engineering workplaces and society from the start.

Methodology

The Canadian Engineering Accreditation Board (CEAB) requires degree granting engineering institutions in Canada to incorporate graduate attribute 3.1.10 “ethics and equity” into their formal curriculum. Unfortunately, despite the explicit pairing of ethics and equity in this graduate attribute, many engineering educators decouple the two concepts. The three-year project on which this paper is based set out to fill this pedagogical gap by developing and testing 15 anonymous case studies based on the experiences of Canadian engineers grappling with ethical and equity-based dilemmas in their professional lives. Shortly after receiving a modest, three year pedagogical innovation grant from the Faculty of Applied Science and Engineering at the University of Toronto, and gaining approval from our institutional Research Ethics Board, we began recruiting professional engineers and engineering interns to participate in career history interviews. We deliberately diversified our sample by discipline, career stage, and other

demographic markers. By the end of the second year, we had conducted 15 semi-structured career history interviews lasting between one and two hours with 14 engineers and one engineering educator. All 15 participants had at least one year of relevant work experience. They ranged in age from 18 to 75, were trained in eight different engineering disciplines, and worked in a diverse range of organizational contexts. 50% of the sample was female, 30% were members of underrepresented racial groups, and 14% were LGBTQ identified. We transcribed the interviews verbatim, thematically coded them using a critical social justice lens, and developed anonymous case studies based on ethical dilemmas shared by each participant. While our workshops and professional development sessions foreground the case studies we produced, this paper highlights our critical analysis of the fifteen semi-structured interview transcripts. In particular, it identifies three responses to the following question: Why is it so difficult for engineers to challenge inequities in their education and workplace contexts?

Findings: Swimming against the current of engineering culture

The fifteen interviewees who chose to participate in our study did so because they were committed to ethics and/or equity in engineering education. Two worked for an international development organization, one had taught engineers about environmental sustainability for decades, three were active in LGBTQ (Lesbian, Gay, Bisexual, Transgender, Queer) organizations, one was active in NSBE (National Society of Black Engineers), three had ethics as part of their workplace leadership portfolios, and five struggled to navigate chilly workplace or educational climates as relatively junior, female engineers. Two demographic trends emerged from our findings. First, despite a 60-year age gap between the youngest and oldest participant, nearly all participants chose to discuss an ethical dilemma that occurred early in their careers. Second, interviewees were more likely to infuse equity issues into their ethical narratives when those issues aligned with a dimension of privilege along which they were historically marginalized. To expand on the second point: gender figured prominently in the experiences of five of the seven women, but only one of the seven men; race figured prominently in the experiences of two of the four racially under-represented engineers, but none of the ten white engineers; and the only three engineers to mention sexuality were LGBTQ-identified. These two trends suggest that junior and demographically underrepresented engineers carry disproportionately heavier loads when it comes to supporting social justice, inclusion and equity in their respective workplaces. Because the voices of engineers swimming against the current of mainstream engineering culture can be difficult to detect, we have chosen to highlight their struggles in this paper. First, we address the communication disconnect between equity-minded engineers and their colleagues; second, we identify structural barriers faced by junior engineers attempting to interrupt social inequities from positions of limited organizational influence; and third, we share the concern expressed by many participants that raising equity issues would result in personal attacks rather than positive social change. All of the names we use to identify people and organizations are pseudonyms.

Theme 1: Dominant narratives in engineering made it difficult for social justice perspectives to be heard

“People just don’t know what they don’t know.”

Kathryn

I think it was a big awakening point that there's so much I hadn't experienced and that in many ways I did not acknowledge exists. I knew it existed, but I didn't really acknowledge its existence at the same level until it happened to me.

Marie

Kathryn's explanation for the persistence of discrimination in the first quote suggests that engineers who are unaware of systemic inequities in their midst might not realize that this limited awareness constitutes a gap in their knowledge, while Marie's insight in the second quote suggests that first hand experience with discrimination is one of many ways engineers become aware of these gaps. We are not claiming that there is a direct relationship between engineers' demographic backgrounds and their awareness of equity issues, but we are suggesting that those who have been targeted by racist jokes, heterosexist assumptions, and sexual harassment might have a harder time than others denying the existence of discrimination in engineering workplaces. Those who have not personally faced discrimination, on the other hand, may lack the experiential understanding necessary to hear their colleagues' stories—particularly when these stories either diverge from or cannot be easily expressed using dominant engineering narratives [24]. For example, when Tanya, an intern working at a large mining company, was informed that her request to organize a gay-straight alliance at work was discriminatory, she found herself bumping up against the myth of political neutrality held by an HR representative:

We tried to start an LGBTQ group at work but HR said no because ... exact words, they said "it would be discriminatory." We just wanted to organize a monthly gathering where we could just talk about equality and equity issues, but they said it was discriminatory because you can't have clubs for people with only certain sexual orientations, but that didn't make sense because the club was open to everybody, and then they also said it could be discriminatory because if somebody got your mailing list of all the people that you're inviting to these events, they could use them to discriminate against you. Which was very interesting, especially since straight allies would also be on the mailing list, but just the fact that they're worried that someone might take this list and use it to be discriminatory, well hey, that's the whole reason we're trying to start a gay-straight alliance, so that we won't have this kind of discrimination going on in the workplace. It just seemed like a really dumb excuse that didn't really have any backup.

Both Tanya and her company's HR representative were using the word "discriminatory" to back up their claims, but while Tanya was using the term to decrease the incidence of homophobic bullying in her organization, her colleague in HR was using it to prevent the formation of a club she characterized as exclusionary—open only to LGBTQ identified employees. From Tanya's perspective, it made no sense that HR viewed her club as discriminatory because it was open to all employees. It also puzzled her that the "old boys club" which was actually both exclusionary and discriminatory was perceived by HR to be a non-issue. As she saw it, her employer's imprecise and inaccurate use of the word "discrimination" annulled her efforts to use the word in her own inclusion efforts.

Like Tanya, Anita's awareness of the "old boys" culture in a small aeronautics manufacturing plant was palpable. In contrast to Tanya, however, Anita did not try to set up an explicit equity club. She even refrained from interrupting sexist jokes because she believed her attempts to do so would have no impact:

They would make just really, really awful misogynistic jokes and they would talk about going to the strippers. The old boys' culture was in my face all the time. I was just like, "I don't want to be here." They would talk about politics and sports. Being in a very Republican state and me being the opposite of the Republicans, I just kept my mouth shut. Don't mess with US politics if you're an alien, especially if you have no escape route. I changed the subject so often, I talked about...a lot of sports, or I'd ask them about their kids or, "Are you into football?" I'd just talk about nothing to change the subject. That was probably my main strategy. "Okay. Let's talk about something that's not offensive." I don't know. Maybe they thought I was a little jumpy or something. Not ADHD but hyperactive conversationally. I did try and fit in. That was one key coping mechanism, but that meant I had to listen to a lot of sexist jokes while nursing a beer. I tried to deal with it actually by getting buddy-buddy with them. I don't think confronting them was even an option. They wouldn't have heard me anyway.

Anita and Tanya were two of the many young, female engineers we interviewed who struggled to navigate normalized sexism in their respective workplace contexts. Phil, a senior engineering student who had returned from his international development placement at a small agricultural company in Sub-Saharan Africa a semester before our interview, faced a similar struggle to make himself understood in normative—white, male—engineering culture. In particular, he struggled to answer his friends' leading questions about his internship:

The way we present international development, here in Canada, is very shiny, and feel-good kind of a thing... Definitely, the first few weeks, coming back, were extremely frustrating. The typical questions that people would ask us, like, "How was Africa?" I was like ... "I wasn't in all of Africa." Questions like, "Oh. You're such a good person for having done that." I was like, "You know, I really did it out of a sense of my own development.." It's like, "Oh. Yeah. You went out, changed the world." It's like, "Not really. I only saw one small city, or one small country, in sub-Saharan Africa." Especially, a lot of the stereotypes. It's like, "How's the wildlife?" when I was in an urban setting. It's hard, because, when someone says, "How's Africa?" it's hard to condense that whirlwind of experience into five minutes. When you start talking about some of these more complex things, people don't want to talk about it. They're like, "I don't want to hear about how you feel bad about what you did. Tell me how you feel good about it." A lot of my other friends, engineering students, they have some of the white saviour complex. "You're so good. You're helping the poor black people, out there, in the wild." It takes a lot of self-control not to criticize people like that, because it's really not everyone's fault that they think that. The media is really perpetuating that, and unless you've actually seen it, to understand, that's really easy to believe.

Phil's challenge relating his experience to peers who expected a positive spin on colonialism left him isolated and unsure how to prepare the next group of volunteers interested in joining his organization. Together Phil's, Anita's and Tanya's experiences suggest that transforming engineering culture is not as simple as making sure that a few articulate engineers have a well-developed critical analysis of their experience. It also requires a receptive audience. One factor that may increase the receptivity of an audience is organizational influence. Unfortunately, as we discuss in the next section, many of the engineers we interviewed were located at or near the bottom of their respective organizational hierarchies when experiencing their most salient ethical dilemmas, and as such lacked the organizational status to introduce significant reform.

Theme 2: Participants lacked the organizational influence to challenge workplace norms

One of the most common structural barriers participants faced while trying to work in an equitable way was their relatively junior organizational status. While we interviewed engineers across the career trajectory, nearly all participants, even those in their mid to late 60s, shared ethical dilemmas that occurred while they were students, interns or junior engineers. Their newcomer status made it difficult to challenge workplace norms, particularly when senior colleagues who supervised them were actively reinforcing inequitable practices. For example, Anita noticed a problem in one of her internship placements, but believed she lacked the power to change the situation since it was a product of her employer's hiring decisions:

I noticed that all of the new Canadians, all of the people who have immigrated to Canada all worked in testing. I found it to be almost offensive. It was like they had all been pigeonholed into this sub-genre. The woman that sat next to me throughout my term, she had a PhD in Chemistry. I was like how are we not taking advantage of their skills? I mean that was one thing that I've just thought was ... but I was very low level. I didn't have any power. I didn't know even what to do. It was just like if I ever have power, I'm going to not do this....I didn't say anything to anyone. I just noticed it and was like ... this is awful. The company had a start-up culture that was very straight white male dominated. Outside of the testing group, everyone was a white male from here.

Anita felt she had to wait until she had more institutional power to interrupt the inequitable job assignment practices of her employer. Similarly, Matthew, who at the time of his critical incident had been the most junior technical operator in a food processing plant, had a difficult time navigating an ethical issue with a more senior member of his team because it conflicted with his desire to treat senior mentors and trainers with respect:

They were my co-workers but they were also my trainers. From that end I was raised in an environment to recognize the fact that they were senior to me and to make them feel that they were contributing to me. That's what you learn as an apprentice tradesman. You learn to show that respect, but this wasn't about technical. This was about what are you going to do in a case where somebody has asked you to do something that you simply can't do?

Matthew's experience raises the question—what if a junior engineer's supervisor is the primary source of unethical engineering practice? This was the case for Albert whose supervisor gave him proprietary information developed by their client's competitor. At the time, he was simply happy to have the solution to a challenging technical problem, but years later, he reflected on the limited authority he had had at the time to make a different choice:

Even looking back, I'm not sure what I could have done. We didn't have a well-developed whistleblower policy. I guess I could have contacted the [professional association] but I don't know what they would have done. I don't know if that would have been a good idea or not. I probably could have gotten advice, but I'd also feel like I'm betraying my company by calling the [xxx] on them.

Mid-career specialists with advanced technical training faced a similar issue. Kathryn, for example, who was hired for her specialized technical knowledge in a particular field of risk assessment, was regularly challenged by her older, technically less experienced colleagues. In her case, lacking seniority made it difficult for her to do her job, even when she was the only one with the necessary technical expertise to complete the task at hand:

You know, for me, often one of the issues that I run into is that I'm the specialist, but I'm with very, very senior people. These guys—all guys by the way—were kind of mid-50s, I would say. Sometimes, that can be a barrier too ... Not really for me, but I can imagine for somebody else, it would be quite a barrier. Well, I'm just going to say it, right? I know that younger engineers, especially younger women struggle with that.

For Kathryn, the combination of youth and gender in an organization dominated by older, male colleagues made it difficult for her to gain the necessary credibility to do her job even though she was extremely confident in her technical abilities. Sandra, a junior engineer who was also confident in her risk assessment skills, found it difficult to fulfill her leadership responsibilities at a plant led by managers with significantly more seniority and organizational authority—even when their decisions were putting plant operators at risk:

From observing the way that those two managers were advising the operators, it seemed like some of the decisions being made were being made in more of a hasty way, instead of a safety driven way. Some of the operators, were starting to be exposed to the chemical, with some of the things that they were doing, and were getting minor burns, but being at the bottom of the structural totem pole as a junior engineer put me in a bit of a bind. My technical responsibility, in situations like this, is to help improve solutions to process problems that are occurring from an engineering perspective. I was pushing to have the management slow down and document things properly, go through a risk assessment. This is a situation, where you're definitely outside of your usual process parameters and you're trying to come up with alternatives. Just really flush out the risks associated with what they were trying to do, and make sure that we have the right safe guards in place, and weighing the pro's and con's of what we were doing, but two of the managers were not exactly thrilled because it would slow production. I heard the operators start to say, "we don't feel safe, we don't want to do this job," but the production manager, for some

reason, did not really hear them properly. It can be hard as a junior engineer to raise technical issues to a manager when there are differences of opinions and priorities.

Sandra's experience suggests that even when engineers are confident in their technical skills, it can be difficult for them to lead up the hierarchy—particularly when their leadership results in a delay or otherwise negatively impacts the organization's economic bottom line. Since safety, equity and other ethical concerns are rarely seen by production managers to coincide with increased efficiency, productivity or profit, junior engineers who raise these issues may find themselves swimming against the current of their employer's demands. For interns and even junior engineers, the problem is not simply about occupational influence; it is also often about job security. In our final section, we identify the fears participants shared about raising equity issues in their respective workplace and educational contexts.

Theme 3: Fear that raising equity issues would result in personal attacks rather than positive change

We conclude our findings by discussing the paralyzing impact of fear; in particular, the fear that raising equity issues would result in personal attacks or limited job security rather than positive organizational change. While most participants spoke to us freely about the structural inequities they faced, Krista, an engineering intern working for a government infrastructure organization, spent the first hour and fifty minutes of her two-hour interview denying the impact of sexism on her work. It was only as we were about to turn off the recorder that she shared her fears. She revealed that discussing sexism in the past had resulted in harmful personal attacks to her character, *"I can't talk about being a woman in engineering, because I'm automatically labeled as whiny or a crazy feminist, or just all kinds of things, or I have a chip on my shoulder."*

Concerns about labelling extended beyond participants' fears of character assassination. Many of the engineers we interviewed also worried that being branded the "equity person" would result in their exclusion from informal workplace conversations. For instance, Robin, an intern working for a public utility was concerned that calling out a sexist comment made by a member of his all male project team would prevent him from being taken seriously when it came to collaborative workplace decision-making:

I had this internal battle of should I say something or should I direct the conversation elsewhere. Should I directly speak to this or should I indirectly speak to it ... I have a friend who is also in engineering, who at her workplace became known as the "equity girl." She felt like she couldn't say anything after a while because she was always the joy killer and excluded from conversations. Not just conversations, but people would start to ignore what she was saying because they saw it as completely one-sided. There's always the fear that that could happen.

Later in the interview he raised another potential consequence of speaking out—dampened job prospects with his current employer. As an intern who wished to keep his career options open following graduation, Robin decided not to interrupt his colleagues' sexist comments—a decision about which he expressed deep personal regret during our interview. In addition to career-related worries about employability, job security and organizational influence, a small

number of participants were concerned that speaking out against racist, sexist or homophobic incidents would trigger personal experiences with discrimination, forcing them to bear a heavy emotional load. Awande, for instance, expressed caution at the thought of having to personally interrupt racist tropes in a mandatory process improvement class:

I feel like at least for me I usually do not respond when it's something very emotional. If it holds a lot of meaning to me, if I haven't had time to think and process it...I looked around to see how other people were reacting but I didn't really see much of a reaction from most of the other students in class...I guess slavery didn't have as much of a significant meaning to a lot of the other students. [This invention] was just another example of mechanization for them...I had the sense the professor may not be concerned or interested in a discussion about why this was not just a neutral example of innovation, so I was reluctant to put up my hand. I was sitting there hoping someone would put up their hand and say something...part of it for me may be not knowing what the consequences or results of that might be. Not wanting to become too involved in something that may snowball, or that you don't know where it's going to go. I've seen that kind of thing go very badly.

Because of her past experiences taking on the emotional labour associated with anti-racist work, Awande remained wary about taking the first step. Had another student raised his or her hand, she would have been ready to respond, but she first required confirmation that at least one of her peers believed the mechanization of a slave-driven industry was a topic worth interrupting.

Discussion & implications: Making the invisible visible

The 14 engineers and one engineering educator we interviewed for our case study project defined ethics and equity for themselves, focusing on a salient ethical dilemma they had experienced in their professional lives. While not all fifteen participants viewed equity as an integral aspect of engineering ethics education, we have followed Pawley's recommendation to make diversity and inclusion the default rather than the exception in engineering education research [23] by analyzing all of their narratives through a critical social justice lens. Our analytic decision resulted in the foregrounding of voices that are often left on the periphery of engineering education or rendered unintelligible [39]. What did we learn from this process? Why was it so difficult for the engineers we interviewed to challenge inequities in their respective organizational contexts? How can engineering educators and employers who are committed to equity and social justice support them? In this section of our paper, we respond to these questions by supplementing our three key findings with the literature on diversity and inclusion in engineering.

One potential response to the question: "Why is it so difficult for engineers to challenge inequities in their respective organizational contexts?" is that they are socialized to value objectivity and neutrality, which may lead them to question the systemic nature of societal inequities. Cech, Seron and their colleagues point to dominant narratives in engineering education that mask inequities by grounding the discipline in an unacknowledged positivist paradigm and meritocratic ideology [13, 24, 25, 40]. While we certainly found evidence of this, our key informants were not among those engineers who missed the point. They acknowledged the presence of systemic inequities in their classrooms and workplaces, but were regularly

misunderstood while attempting to relate their experiences to colleagues. Some struggled to answer questions infused with stereotypical assumptions, while others had the words they were about to use taken out from under them and redefined. Most spent so much time and effort dodging conversational minefields that it was difficult for them to redirect the conversation. Thus, while the notions of political neutrality and meritocracy were not convincing to many of our participants, they did make it difficult for engineers who were trying to disrupt discriminatory practices to speak in ways that were intelligible to their colleagues. This finding confirms Seron, Cech, and Franzway's arguments that cultural narratives available to engineering students and professionals can restrict their abilities to productively engage in conversations about diversity, equity or social justice [13, 24, 25, 33, 40]. Beyond engineering, it also reinforces Spivak's point in her influential chapter—*Can the subaltern speak?*—that knowledge is never innocent, and that using dominant western frameworks as though they are universal silences culturally subordinated voices [39]. One way engineering educators can respond to this challenge is to critically examine the “hidden curriculum” [41] of engineering education and workplace norms—the taken for granted assumptions about how things work in the profession. By helping the next generation of engineering students unpack professional claims to political neutrality and meritocracy, we can prime them to actively listen to the perspectives of their colleagues and accept the legitimacy of counter-narratives.

A second barrier to the inclusion of diversity and equity issues in engineering classrooms and workplaces relates to the limited influence enjoyed by social justice advocates. Our study taught us that participants tended to experience their most challenging ethical dilemmas during their school to work transitions. Few of them had the organizational status, resources or power necessary to institute systemic change at this point in their careers. This second finding corresponds with Faulkner and Tonso's point that powerful networks of male-dominated social groups leave young engineers and their senior engineering colleagues from under-represented groups few avenues for organizational influence [10, 11, 14]. One way to erode this barrier is for senior engineering leaders and HR representatives to accept leadership direction from engineers who happen to have well-developed analyses and piercing insights about diversity and inclusion. Instead of dismissing engineers who advocate for equity as “the equity girl,” for instance, it is possible to recognize their expertise in a domain that is otherwise drastically underdeveloped in their organization. We are not suggesting that the board of advisors at a large multinational company call on a handful of female, African American, or LGBTQ-identified employees to do their homework, but we are suggesting that when certain employees take the initiative to express an uncomfortable truth, they should be recognized, not penalized for their positive contributions. To the extent that we, as engineering ethics educators, simultaneously frame their experiences as productive windows into a better future, rather than as problematic, self-promoting biases, we will be playing an important role in enabling professional and institutional progress. Another strategy that can be used by social justice advocates, their instructors and employers is to frame leadership as a process made up of small, incremental changes. Change does not need to be large-scale, revolutionary or driven by the CEO to make a difference.

Finally, our third response to the question, “why is it so difficult for engineers to challenge inequities in their respective organizational contexts?” has been answered in a troubling way by recent attacks on STEM researchers studying diversity and inclusion [16]. Researchers who unsettle the positivist foundations of natural and applied science are often viewed as a threat to

those who have built successful careers on these foundations. Many of the engineers we interviewed were keenly aware of these threats. Some feared that advocating for social justice would result in career-based penalties tied to employability, job security, and access to decision-making networks, while others were concerned about attacks on their character or the incredible emotional burden of raising deeply meaningful issues that others perceived to be non-issues. In short, they feared that raising equity issues in unreceptive, occasionally hostile environments would result in personal attacks rather than positive organizational change. Riley, Tonso, Faulkner, and Franzway [8, 9, 26, 30, 33] add weight to this finding by documenting the symbolic and material repercussions faced by engineers whose behaviour, actions, values, or even presence challenges normative assumptions about engineering work.

The only body of literature we reviewed that did not speak directly to our findings emerged from archival research on engineers' professional codes of conduct [4, 5]. When asked directly about resources that supported their efforts, only one participant mentioned the information-sharing role of his professional society. None raised the importance of their respective ethical codes. This was not about a lack of awareness as all participants had taken at least one course addressing their respective codes of conduct and most had successfully completed a professional practice exam testing their knowledge of the relevant legislation. In fact, much of their formal ethics education had emphasized engineers' need to internalize disciplinary and jurisdictional codes of conduct. Rather, we believe they failed to identify the code as a possible resource because it remains silent on issues of equity, diversity and inclusion. Engineers' ethical codes protect employers, the profession, and a vaguely defined public, but they fail to protect under-represented members of the profession. Who is served by the current code? Whose voices and experiences are left on the sidelines when equity and ethics are decoupled? We need to start asking these questions. Our entering position when we proposed this project was that equity issues were integral to engineering ethics education. We stand by this position. Until ethics and equity are deliberately paired and explicitly named, social justice will continue to live on the periphery of engineering education and practice [25]. In their creative thought experiment, Riley and Lambrinidou asked what might happen if engineers centred social justice in their ethical codes [22]. It is time to implement their suggestion. As Vesilind, Tang and Nieusma revealed, engineers' professional codes have been around for more than a century, with ethics as a somewhat recent edition brought about by short-lived dissident committees dedicated to social responsibility. It is time for engineers' professional societies to ensure that their respective codes reflect the diverse realities of members who have been navigating ethical issues on an uneven terrain for the better part of a century.

Conclusions: Where's my code? Engineers navigating ethical issues on an uneven terrain

Our findings suggest that equity issues—whether or not they are explicitly named—are deeply ingrained in engineers' ethical dilemmas. As such, it behoves us as engineering educators to move beyond simply exposing students to their respective professional codes of conduct. In addition to teaching them important lessons about the legal context regulating engineering practice, we need to help them navigate the complex ethical dilemmas they are likely to encounter in their professional lives, paying close attention to systemic inequities in their classrooms, organizations, profession and society. By doing this, we will be helping professional engineers supplement their technical integrity with a wide-ranging commitment to public good.

References

- [1] G. C. Andrews, *Canadian Professional Engineering and Geoscience: Practice and Ethics*, Fifth ed. Toronto: Nelson, 2014.
- [2] M. S. Larson, *The Rise of Professionalism: A Sociological Analysis*. Berkeley, CA: University of California Press, 1977.
- [3] D. L. Marston, *Law for Professional Engineers: Canadian and Global insights*, Fourth ed. Toronto: McGraw-Hill Ryerson, 2008.
- [4] X. Tang and D. Nieuwsma, "Institutionalizing ethics: Historical debates surrounding IEEE's 1974 Code of Ethics," in *American Society for Engineering Education Annual Conference and Exposition*, Seattle, WA, 2015, p. 18.
- [5] P. A. Vesilind, "Evolution of the American Society of Civil Engineers code of ethics," *Journal of Professional Issues in Engineering Education and Practice*, vol. 121, pp. 4-10, 1995.
- [6] E. M. Jaffee and D. M. Riley, "'It kind of chose me': Agency and influence in women's decision to major in engineering," in *American Society for Engineering Education Annual Conference and Exposition*, Louisville, KY, 2010, p. 18.
- [7] D. M. Riley, "The island of other: Making space for embodiment of difference in engineering," in *American Society for Engineering Education Annual Conference and Exposition*, Atlanta, GA, 2013, p. 19.
- [8] D. M. Riley and A. L. Pawley, "Complicating difference: Exploring and exploding three myths of gender and race in engineering education," in *American Society for Engineering Education Annual Conference and Exposition*, Vancouver, BC, 2011, p. 11.
- [9] D. M. Riley, A. E. Slaton, and A. L. Pawley, "Social justice and inclusion: Women and minorities in engineering," in *Cambridge Handbook of Engineering Education Research*, A. Johri and B. M. Olds, Eds., ed Cambridge: Cambridge University Press, 2015, pp. 335-356.
- [10] W. Faulkner, "Doing gender in engineering workplace cultures. II Gender in/authenticity and the in/visibility paradox," *Engineering Studies*, vol. 1, pp. 169-189, 2009.
- [11] W. Faulkner, "Doing gender in engineering workplace cultures 1: Observations from the field," *Engineering Studies*, vol. 1, pp. 3-18, 2009.
- [12] J. R. Herkert, "Yogi meets Moses: Ethics, progress and the grand challenges for engineering," in *American Society for Engineering Education Annual Conference and Exposition*, Vancouver, BC, 2011, p. 5.
- [13] C. S. Seron, E. A. Cech, S. S. Silbey, and B. Rubineau, "'I am not a feminist, but:' Making meanings of being a woman in engineering," in *American Society for Engineering Education Annual Conference and Exposition*, Vancouver, BC, 2011, p. 19.
- [14] K. L. Tonso, "Student engineers and engineer identity: Campus engineer identities as figured world," *Cultural Studies of Science Education*, vol. 1, pp. 273-307, 2006.
- [15] CEAB, "Accreditation Criteria and Procedures 2008," Engineers Canada, Ottawa, ON2008.
- [16] C. Flaherty, "Engineers declare support for STEM diversity research," in *Inside Higher Ed*, ed, 2018.
- [17] J. S. Russell, "Engineering professional growth and quality and cultivating the next generation," *Leadership and Management in Engineering*, vol. 8, pp. 57-60, 2008.

- [18] J. J. Yarmus, "Ethics in professional engineering: Leadership through integrity," *Leadership and Management in Engineering*, vol. 10, p. 1, 2010.
- [19] S. Hill, D. Lorenz, P. Dent, and T. Lutzkendorf, "Professionalism and ethics in a changing economy," *Building Research & Information*, vol. 41, pp. 8-27, 2013.
- [20] D. M. Riley, "Aiding and ABETing: The bankruptcy of outcomes-based education as a change strategy," in *American Society of Engineering Education Annual Conference and Exposition*, San Antonio, TX, 2012.
- [21] D. M. Riley, A. E. Slaton, and J. R. Herkert, "What is gained by articulating non-canonical engineering ethics canons?," in *ASEE Annual Conference & Exposition*, Seattle, WA, 2015.
- [22] D. M. Riley and Y. Lambrinidou, "Canons against Cannons? Social justice and the engineering ethics imaginary," in *American Society for Engineering Education Annual Conference and Exposition*, Seattle, WA, 2015, p. 19.
- [23] A. L. Pawley, "Shifting the "default": The case for making diversity the expected condition for engineering education and making whiteness and maleness visible," *Journal of Engineering Education*, vol. 106, pp. 1-3, 2017.
- [24] E. Cech, "The (mis)framing of social justice: Why ideologies of depoliticization and meritocracy hinder engineers' ability to think about social injustices.," in *Engineering for Social Justice: Critical Explorations and Opportunities*. vol. 10, J. C. Lucena, Ed., ed Dordrecht: Springer, 2013, pp. 64-84.
- [25] E. Cech, "Culture of disengagement in engineering education?," *Science, Technology, & Human Values*, vol. 39, pp. 42-72, 2014.
- [26] W. Faulkner, ""Nuts and bolts and people": Gender-troubled engineering identities," *Social Studies of Science*, vol. 37, pp. 331-356, 2007.
- [27] H. Dryburgh, "Work hard, play hard: Women and professionalization in engineering-Adapting to the culture," *Gender & Society*, vol. 13, pp. 664-682, 1999.
- [28] K. L. Tonso, "Advancing women in leadership: Violence(s) and silence(s) in engineering classrooms," *Advancing Women*, vol. 1, pp. 1-16, 1997.
- [29] K. L. Tonso, "Teams that work: Campus culture, engineer identity, and social interactions," *Journal of Engineering Education*, vol. 95, pp. 25-37, 2006.
- [30] K. L. Tonso, "Violent masculinities as tropes for school shooters: The Montreal Massacre, the Columbine Attack, and Rethinking Schools," *American Behavioral Scientist*, vol. 52, pp. 1266-1285, 2009.
- [31] K. L. Tonso, "Engineering Identity," in *Cambridge Handbook of Engineering Education Research*, A. Johri and B. M. Olds, Eds., ed Cambridge: Cambridge University Press, 2014, pp. 267-282.
- [32] W. Faulkner, "Dualisms, hierarchies and gender in engineering," *Social Studies of Science*, vol. 30, pp. 759-792, 2000.
- [33] S. Franzway, R. Sharp, J. E. Mills, and J. Gill, "Engineering ignorance: The problem of gender equity in engineering," *Frontiers: A Journal of Women Studies*, vol. 30, pp. 89-106, 2009.
- [34] J. Rawls, *A Theory of Justice*. Cambridge: Harvard University Press, 1971.
- [35] P. Freire, *Pedagogy of the oppressed*. New York: Herder and Herder, 1970.
- [36] J. Habermas, "The tasks of a critical theory of society," in *Contemporary Sociological Theory*, C. Calhoun, J. Gerteis, J. Moody, S. Pfaff, and I. Virk, Eds., ed Oxford: Blackwell, 1984/2002, pp. 377-400.

- [37] b. hooks, "Essentialism and experience," in *Teaching to transgress: Education as the practice of freedom*, ed New York: Routledge, 1994, pp. 77-92.
- [38] K. Marx, *Capital: A critique of political economy*. New York: The Modern Library, 1906.
- [39] G. C. Spivak, "Can the subaltern speak?," in *Marxism and the Interpretation of Culture*, C. Nelson and L. Grossberg, Eds., ed Chicago: University of Illinois Press, 1988, pp. 271-313.
- [40] C. Seron, S. S. Silbey, E. Cech, and B. Rubineau, "Persistence is cultural: Professional socialization and the reproduction of sex segregation," *Work and Occupations*, vol. 43, pp. 178-214, 2016.
- [41] B. R. Snyder, *The Hidden Curriculum*. New York: Knopf, 1970.