Illustrating Meritocracy: (How) Do Canadian Engineers See Social Structure?

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Abstract

Despite roughly four decades of equity, diversity, and inclusivity (EDI) work, stark racial and gender inequities continue to plague the engineering profession [1,2]. Addressing systemic inequities can be challenging in any profession, but particularly so when members are socialized to think of themselves as free agents, unencumbered by social structures [2,3]. Our paper examines the prevalence of agentic and structural explanations of career mobility among 952 Canadian engineers who responded to a national engineering career path survey. We found that 49.3% of racialized men, 71.6% of white women, 75.6% of racialized women and 68.0% of LGBTQ2SI+[1] engineers, compared to only 26.3% of white men, believed their social location had impacted their careers suggesting that individuals who are relatively under-represented in the engineering profession are more inclined to view their social location as a non-neutral feature of their career mobility. When asked to explain their answers, we found that engineers identified either (a) the culture of engineering, or (b) disproportional access to supports within engineering as the factor advantaging or disadvantaging their career mobility dependent on social location. These findings are relevant to engineering education researchers because it exposes patterns of professional buy-in to agentic, meritocratic norms in engineering culture. When we name dominant ideologies without illustrating how they land in the lives of engineering graduates, we risk further disadvantaging those who are negatively impacted by structural inequities.

Introduction

Despite nearly four decades of equity, diversity, and inclusivity (EDI) initiatives, structural inequities continue to be perpetuated within the engineering profession [1,2]. In Canada, this EDI work has historically been decentralized, with individual institutions developing their own agendas [4]. More recently, the Canadian government has indicated an interest in this issue, through the establishment of national funding program changes aiming to uplift under-represented groups within STEM fields [5]. This indicates a national understanding for the need to increase representation and retention within the field. However, despite these efforts, data on practicing engineers within Canada indicate continued inequities. In 2022, for example, while women made up 25.2% of undergraduate engineering students, women accounted for only 14.4% of Canadian professional licensed engineers (P. Eng.) [6]. Additionally, while the under-representation of racialized engineers has been identified, a lack of data on their prevalence in the profession has limited research on their experiences in the Canadian context. Further, by conducting research primarily in undergraduate engineering contexts, Canadian engineering EDI work fails to address the experiences of professional engineers [1].

Why does it remain challenging to tackle structural inequity within engineering? While many possibilities exist, our paper foregrounds the possibility that structural inequities are difficult for

[1] Here LGBTQ2SI+ is used to refer to members of the broad queer community. While the acronym includes explicit reference to specific queer identities-lesbian, gay, bisexual, trans, queer, two-spirit, intersex- the plus-sign is intentionally included to imply breadth to the definition.

many engineers to appreciate partly because they are taught to think of themselves as agentic problem solvers—pushing considerations of social structures external to their success or failure.

Most of the literature on engineers' careers frames these deeply structured occupational trajectories as personal journeys [1]. This framing anchors researchers and engineering educators in dominant ideological beliefs of meritocracy within engineering, thereby suppressing the recognition of social structure within the profession [7]. Recognizing that social structures play a role in reproducing systemic inequities is a pillar for EDI work—especially the E (equity) dimension since it requires that we address structural power imbalances in the profession. According to the National Equity Project, systemic inequities can be categorized as being either institutional or structural in nature, with institutional oppression being the oppression resulting from policies and practices at the organization level and structural oppression illustrating how these effects accumulate historically across institutions [8]. Tackling systemic inequities requires acknowledgement of their structural nature. The emerging body of literature addressing the impact of structural inequity on engineers' career paths has primarily taken place in a U.S. context, leaving a dearth of data about the ways structural supports and constraints impact the career mobility of Canadian engineers [7,9,10].

Our paper is based on the MASc thesis of the first author. It analyzes responses from a national career path survey (n=982) to understand how members of the engineering profession within Canada view social structure or structural inequities, as relevant to their own careers.

Literature Review

Our paper builds on two bodies of literature: engineering career paths and engineering culture. In many ways interconnected, both fields offer possible explanations for the structural durability of inequity within the profession. Literature on engineering career paths reveals how career stratification can inequitably limit – or privilege – engineers' career mobility based on their social location. Literature on engineering culture illustrates the effects of a hegemonic dominant culture on the inclusion of historically under-represented groups, such as gender and race minorities, within engineering.

Engineering Career Paths

Challenging the idea of meritocratic engineering career advancements, literature on engineering career paths indicates streaming and career stratification for under-represented groups within the profession. Historic research on engineering career paths argued for the presence of a dual career track within the profession—allowing an engineer to progress through either managerial or technical roles [11]. Goldner and Ritti describe these dual tracks as distinct, arguing that an engineer's career path is predominantly shaped by an individual's allocation to one of these tracks [11]. This perspective builds on human resource professionals' attempts to retain technically trained engineers who prefer not to ascend a strictly managerial ladder. More recent research on engineering career paths has begun challenging this binary, by beginning to explore the expanding definition of engineering work. In their study of engineering graduates two to three years post-graduation, Sheppard et al. found this expanding definition of engineering work to be a key challenge for undergraduate students envisioning their futures within the profession [12]. Similarly, Rottmann et al. use the empirical reality of diversified career paths to illustrate

engineers' mobility patterns later in their careers [13]. Following career history interviews with 28 senior engineers, they proposed five distinct engineering career paths: company men, technical specialists, boundary spanners, entrepreneurs, and invisible engineers [13].

Engineering career paths are not only diverse but also differentiated with respect to status, legitimacy, and accessibility. Cardador and her colleagues have shown how career stratification pushes women engineers towards under-resourced and less-respected career paths [7]. Similarly, in a follow up analysis of their earlier study, Rottmann et al. found that women and racialized engineers were penalized for excellence, often being tracked into middle management or entrepreneurial roles while white men in the small, qualitative sample were groomed into well-resourced positions [1]. In 1983, LeBold et al. found that engineers who self-identified as Black were more likely to be either unemployed or employed outside of engineering 10 years post-graduation [14]. LeBold's findings also support claims of gender inequity within engineering career paths, with men expressing on average higher levels of job satisfaction, higher salary, and increased chances of promotion over their Black and/or female counterparts [14].

The gendered nature of engineers' career mobility patterns is visible not only between but also within paths. For instance, Gilmartin et al. have illustrated how stretch assignments, which involve unfamiliar work often completed for promotion assessment, intensifies gender and racial inequities within engineering workplaces [15]. Their analysis of data from a nationwide multi-year study suggests that while women were more likely to be shoulder-tapped for these assignments, men experienced more favourable career advancement upon completing these assignments [15]. Further, racial minorities within engineering workplaces, such as Black and Indigenous engineers, were granted the fewest opportunities to showcase their aptitude through stretch assignments for advancement purposes [15].

Engineering Culture

The culture within engineering has often been described as 'hostile' and 'chilly' to under-represented groups [16]. Cech and Riley, among others, have identified a dominant meritocratic ideology within engineering culture that supresses recognition of structural supports and constraints [2,17]. Previous work on the culture of engineering has highlighted dualities that disconnect 'femininity' from technical work [18], hierarchies that undervalue the skills often relegated to engineers from under-represented groups [7], and an overall 'chilly' and 'hostile' climate that limits authentic self-expression of all members [9,10,19].

Cech's research on engineering culture illustrates how three dominant ideologies—depoliticization, meritocracy, and technical/social dualism—work to keep understanding of social structure separate from the profession [2]. Faulkner's work has been key to exploring how dualisms and hierarchical structures operate as a form of symbolic violence for perpetuating gender inauthenticity within engineering. Her ethnographic research illustrates a deeply gendered technical/social dualism and in/visibility paradox present in engineering culture [9,10,18]. The first of these concepts highlights the "nuts and bolts" assumption about what constitutes "real" engineering identity, while the latter illustrates the challenges women face being recognized as engineers due in part to the hypervisibility of their gender.

Together, these findings support the idea that the normative engineer against which all others are implicitly compared is a man. Lorde, whose work is more intersectional than much of the engineering EDI literature, teaches us that the mythical norm in western society is a white, heterosexual, middle class man [20]. She points out that while the norm is mythical rather than embodied, it has a material impact on any individual who conforms to or diverges from that norm. If the mythical norm in engineering is a man, then it makes sense that there is a hierarchy established between masculinity and femininity within the field. As a result of these gendered dynamics, women in engineering often find themselves relegated to lower-status middle-management roles, where their technical expertise may be undervalued. Returning to Cardador, her work has highlighted that a consequence of women in engineering being pushed to management is experiences of eroded senses of belonging, stemming from self-reported feelings of not being 'real' engineers [7]. Here, Cardador has identified an inverted role hierarchy within engineering, earning those who perform technical work higher status and better working conditions. With technical work not being equally distributed to engineers across genders, this inverted role hierarchy continues to under-recognize the contributions of women [1,7].

In addition to her work on dominant ideologies in engineering, Cech and her colleagues have documented the effects of these dominant ideologies on queer engineering students in the Western United States [19]. By analysing interviews with queer engineering students, Cech et al. have revealed a 'chilly' and 'hostile' engineering culture based on heteronormativity [19]. Cech et al. additionally found that these under-represented students had been pushed to find unique ways to make themselves indispensable to peers and teammates on projects, to proactively combat exclusion [19]. In later work drawing on survey data of U.S. STEM professionals (n=25,324), Cech found that white able-bodied heterosexual men (WAHM) experienced enhanced social inclusion and professional respect compared to members of under-represented groups [21]. Here, the under-represented groups Cech identified were 31 different intersectional gender, race, sexual identity, and disability status groups [21]. These findings reinforce that intersectionality likely plays a role in the mythical norm in engineering. It may not just be a man, it may in fact be a WAHM—similar to the mythical norm in Canadian society more broadly.

Transcending the prevalence of gender-based EDI research in engineering, Kwapisz et al. asked three Navajo, Tohono O'odham participants to reflect on the relationship between engineering culture and their own culture [22]. They found that one of the more powerful overlapping features was the notion of engineering as a "process for community development" [22]. In her essay *"Walking in Beauty on an Ever-Changing Path: A Leadership Perspective from a Native American Woman Engineer"*, Zuni clan member Sandra Begay-Campbell documents her trailblazing journey through engineering and leadership [23]. In particular, she illustrates how Indigenous engineers' perceptions of leadership do not reflect the mythical norm of the engineering leader—thereby highlighting a further instance of colonial exclusion [23].

With the literature on engineering career paths illustrating occupational stratification, and the literature on engineering culture highlighting the prevalence of interlocking systems of oppression, there is strong evidence that engineers' career mobility is not in fact entirely agentic. Structural inequities aside, one may be left wondering, how these patterns of privilege are perceived by members of the engineering profession. Our paper contributes to these two bodies of literature by examining more than 950 responses to two questions on a national career path

study—one asking engineering graduates whether or not their social location has shaped their career advancement and another inviting them to explain their response. This analysis enables us to explore the stories engineers tell themselves about their career success and struggles in relation to their gender, race, class, sexual orientation, or immigrant status.

Research Questions

Our paper examines how Canadian engineering graduates explain the impact of their identity on their career mobility using three related research questions:

- RQ1 – To what extent do engineering graduates recognize the role of social location on their careers?
  RQ2 – How do the findings to RQ1 break down by dimensions of privilege (specifically, gender and race, and sexual orientation)?
- RQ3 – How do engineering graduates explain the relationship between their social location and career mobility?

Conceptual Framework

The theoretical perspective for this analysis draws on Bourdieu's and Giroux's theories of cultural reproduction [24,25], and Cech's dominant ideologies in engineering culture (rooted in Gramsci's theory of hegemonic dominant ideologies) [2,26-28]. Bourdieu's theory of cultural reproduction explains how cultural norms are reproduced over time through institutions like education, in ways that perpetuate social inequality. Related to our current project, he may say that a professional culture anchored in meritocracy will tacitly reproduce pre-existing power imbalances [25]. Similarly, Giroux's theory of cultural reproduction critiques the ways we reproduce cultural norms in educational settings, reinforcing structural inequities in society [24]. Finally, Cech's identification of three dominant ideologies within engineering—depoliticization, meritocracy, and a technical-social dualism— point to specific norms maintaining cultural hegemony, as theorized by Gramsci [26-28], in the engineering profession [2]. Related to our current project, the dominance of agentic ideologies in the hegemonic engineering culture challenge efforts of confronting cultural reproduction, by limiting considerations of structure.

Bourdieu's theory of cultural reproduction incorporates his conceptualizations of field, cultural capital, and habitus [2,29-31]. From his work, we pull these first two notions, field and cultural capital for this analysis. Bourdieu defines a *field* as a space where individuals 'play' a particular game to fight for, accumulate, and hold on to power, and where their success in doing so is influenced by the cultural capital that they wield [30]. Hence, the Bourdieusian field for our analysis is encompassed by the spaces that engineering graduates find themselves working within. Within these fields, engineering graduates possess varied levels of cultural capital, where cultural capital speaks to the ways in which particular knowledge, values, and skills are legitimized or hegemonic in a particular culture [29]. This notion of cultural capital offers us means to consider how different dimensions of privilege, such as gender and race, may offer engineering graduates disproportionate opportunities to legitimize their knowledge, values, and skills based on their alignment with the hegemonic culture. From Giroux [24], we pull the notions of accommodation and resistance to challenge the notion that "backlash" is a form of protest. According to Giroux, "backlash" is actually a form of accommodation to hegemonic norms. Since neither Bourdieu nor Giroux were speaking about engineering, we supplement their

powerful reproductive theories with Cech's dominant ideologies in engineering culture, specifically that of meritocracy. Engineers who believe their career advancement is based on hard work, individual effort, and smarts have internalized a dominant meritocratic ideology.

These key concepts emerging from three critical theorists help us analyze the stories engineers tell themselves about their own career advancement. Please see Figure 1 for an illustration of our conceptual framework. Briefly, we entered this analysis with the expectation that Canadian engineering graduates may respond to dominant ideologies in one of two ways—1) *accommodating* dominant ideologies (either by expressing meritocratic stories or through backlash to policies that challenge the notion of meritocracy), or 2) *resisting* dominant ideologies in engineering by telling counter-hegemonic stories.

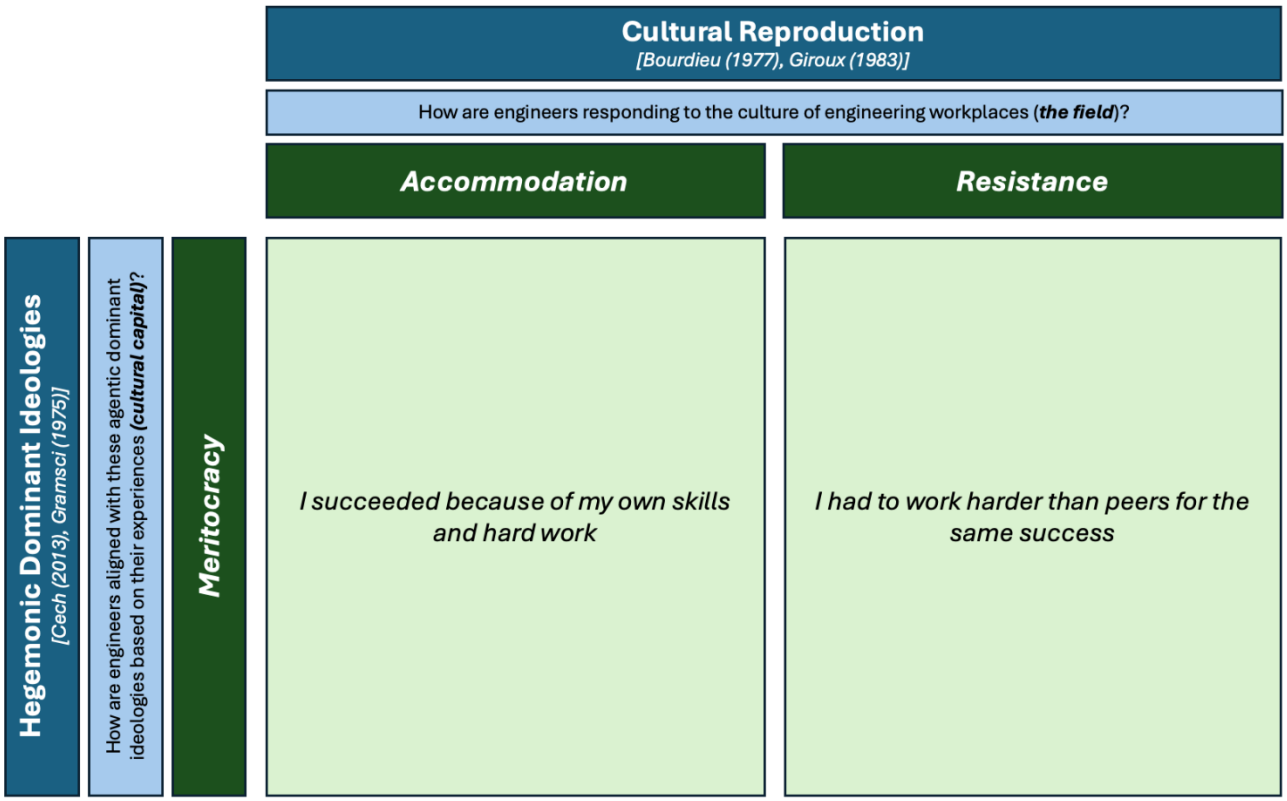

Figure 1: Conceptual Framework: Culturally Reproducing Dominant Ideologies in Engineering

Research Methods

Cross-Canada Survey for Data Collection

The line of analysis presented in our paper is drawn from the MASc thesis of the first author. The second author is her supervisor and Co-PI of the larger project, and the third author is a committee member and PI of the larger project. The initial project "More than Recruitment & Retention: Tracking Inequity in Engineers' Career Paths" was funded through the Social Sciences and Humanities Research Council of Canada (SSHRC). It examined systemic inequities

in the experiences of engineers on five occupational trajectories that emerged from an earlier qualitative study on the leadership development of senior engineers [13].

The national career path survey included 69 forced choice and open-ended questions to engineering graduates in Canada in their mid- to late-careers who met the following inclusion criteria: must have completed their undergraduate studies prior to 2013, and either have worked or studied in Canada. This survey was distributed, in both English and French, in partnership with seven provincial engineering regulators, two territorial regulators, two equity-oriented societies (Women in Science and Engineering, National Society of Black Engineers), Engineering Deans Canada, and the University of Toronto's alumni network. Following one month of survey circulation in November 2022, the survey closed with responses from 982 engineering graduates, of whom 66% were white men, 21% white women, 9% racialized men, and 5% racialized women. Further characteristics of the survey sample are included in Table 1.

Table 1: Survey Sample Characteristics

Variable	% of Sample (n=982)
Licensed P. Eng.	87% licensed
Location of Undergraduate Training	86% domestic, 11% internationally educated
Age Category	34% (30-45 y), 47% (46-65 y), 17% (66+)
Gender	25% cis women, 74% cis men, 0.3% non-binary/trans
Race	82% White, 13% Racially Minoritized[2]: (3.9% East Asian, 2.4% South Asian, 1.8% Black, 1.1% Indigenous)
Race x Gender (Intersectional Variable)	66% white men, 21% white women, 9% racialized men, 5% racialized women
Sexual Orientation	90.4% heterosexual, 2.6% LGBTQ2SI+[3], 7.0% unknown

Note. Percentages may not add up to 100% due to rounding or because 'prefer not to answer' responses have been omitted.

As indicated by Table 1, our sample has an overwhelming over-representation of licensed professional engineers, with 87% of our participants being licensed. We also have an over-representation of white women, who account for 21% of our participants while only accounting for 14.4% of licensed engineers in 2022 [6]. Additionally, our sample has an under-representation of internationally educated engineers, and we cannot comment on the representation of racialized engineers because Engineers Canada does not report race breakdown of professionally licensed Canadian engineers [6,32].

The current line of analysis focuses specifically on the following two survey questions:

- Q52: Do you think your gender/race/sexuality/immigrant status/social class/etc. has influenced your career so far?
- Q53: Please explain your response above.

[2] Only racial groups accounting for more than 1% are listed.

[3] Responses from across the queer community were grouped together to avoid singling out individuals. Representation from specific groups within the queer community were too small to allow for more disaggregation.

Across all demographic groups, 90.2% of participants completed Q52 and 54.9% completed Q53. As per Table 2, the gender by race sample characteristics for Q52 closely mirror those of the whole survey, whereas Q53 response rates decreased most greatly for white men (down to 58% from 66%). Comparatively, the response rate for white women is increased, as well as for racialized engineering graduates.

Table 2: Survey Response Rates for Gender and Race Groups

Race x Gender	% of Sample (n=982)	% of Q52 Sample (n=886)	% of Q53 Sample (n=539)
Racialized Women	5%	5%	6%
Racialized Men	9%	8%	10%
White Women	21%	21%	27%
White Men	66%	66%	58%

Quantitative Analysis

We used frequencies, percentages, and cross-tabulations to respond to our first two research questions, drawing on survey responses to Q52: "Do you think your gender/race/sexuality/immigrant status/social class/etc. has influenced your career so far? In addition to descriptive statistics on the breakdown of these responses (RQ1), we used chi-squared tests of independence to determine if there were significant differences in responses for various race and gender groups (RQ2): racialized women (RW), white women (WW), racialized men (RM), and white men (WM).

Qualitative Analysis

We analyzed our third research question by employing qualitative coding methods to the 539 responses to Q53, an open-ended question asking respondents to reflect on the impact of their social location on their career. For this open-ended question, we began with a thematic analysis of 539 responses and used the resulting themes to assign codes to all respondents, employing constant comparison between inductive and deductive approaches [33-35]. For our deductive analysis, we read open-ended findings and themes through the conceptual framework outlined in Figure 1. We then chose to quantify our qualitative codes to see how they broke down by gender and race. While we recognize the limitations of quantifying qualitative data, for purely qualitative studies, the large number of relatively short responses enabled us to view patterns more easily by using this mixed-methods analytic approach. We did not conduct inferential statistics on these results since we recognize the limitations of transforming non-numerical data into numerical values. While counts and frequencies are instructive, chi-square tests would be reductive.

Findings

(1) To what extent do engineering graduates recognize the role of social location on their careers?

Our first analysis revealed that only 40% of participants recognized the role of social location on their careers. In fact, the majority of participants (55%) indicated that they believed their social location had not impacted their career. Figure 2 shows the response breakdown to Q52 in detail.

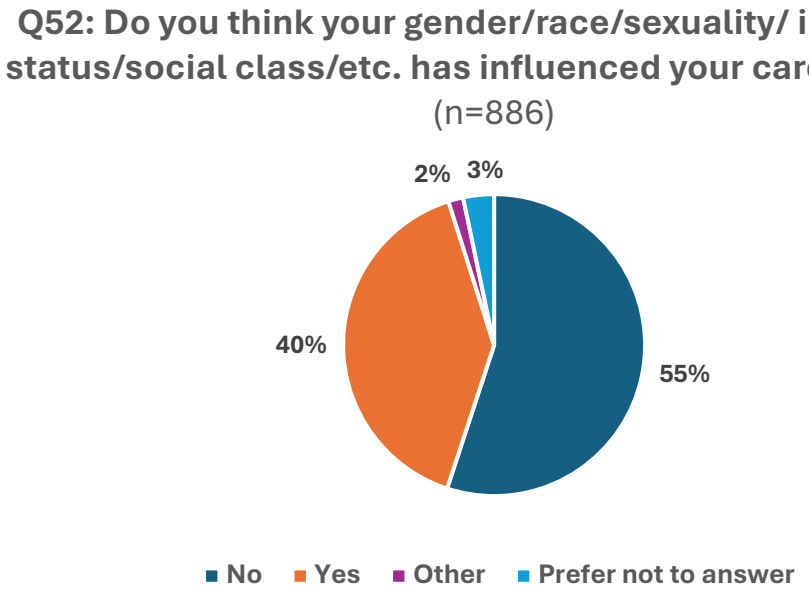

Figure 2: Perception of Social Location Influence on Career, Full Sample

(2) How do graduates' recognition of the role of social location break down across dimensions of privilege (specifically, gender and race, and sexual orientation)?

Our analysis revealed a significant association between recognition of social structure and race by gender of engineering graduates, $\chi 2$ (9, N=886) = 157.83, p<.001. Respondents who had indicated 'other' to Q52, as shown in Figure 2, have been excluded because none were statistically significant (i.e., where adjusted residuals are not <-1.96 or >+1.96). Results from this analysis are summarized below in Table 3.

Table 3: Perception of Social Location Influence on Career, by Race and Gender

Variable	Sample (n=886)	RW (n=45)	RM (n=73)	WW (n=183)	WM (n=585)
% YES	40.1%	**75.6%**	49.3%	**71.6%**	**26.3%**
Adjusted Residual		5.0	--	9.8	-11.6
% NO	55.1%	**15.6%**	47.9%	**25.1%**	**68.4%**
Adjusted Residual		-5.5	--	-9.1	11.1
% Prefer not to Answer	3.3%	**8.9%**	1.4%	2.2%	3.4%
Adjusted Residual		2.2	--	--	--

Note. Percentages in bold represent statistically significant results (p<0.5). Percentages may not sum exactly to 100% due to rounding.

These findings show that racialized women were most over-represented among those who recognized the impact of social structure on their careers, at 75.6%. White women were also over-represented, at 71.6%. These two gender and race groups being most over-represented suggest that gender inequity remains incredibly pervasive within engineering. However, within both gender groupings, racialized participants were more likely to indicate 'YES' than their white peers, reminding us that race also dictates people's experiences within engineering. In fact, when looking at the impact of gender or race separately we found that 72.0% of women indicated 'YES' (compared to 29.4% of men), and 60.2% of racialized participants indicated 'YES' (compared to 37.3% of white participants). It seems understandable that both gender and race impact engineers' perceptions of the impact of social location on their careers, and it is interesting that one factor, gender, was found to be more determinant.

Although our analysis also looked at various other dimensions of privilege, limited response rates from internationally trained engineers or unlicensed engineers led to statistically insignificant results. Interestingly, even with the small 'n' from participants who identified as LGBTQ2SI+, we found a significant association between sexual orientation and those who said 'YES' to recognizing the impact of social structure on their careers, $\chi 2$ (9, N=940) = 22.63, p=.007. For simplicity, only results for certain groups are shared in Table 4.

Table 4: Perception of Social Location Influence on Career, by Sexuality

Variable	**Sample** (n=876)	**Heterosexual** (n=851)	**LGBTQ2S+** (n=25)
% YES Adjusted Residual	39.7%	**38.9%** -1.5	**68.0%** 2.9
% NO Adjusted Residual	55.1%	**50.7%** 2.4	**24.0%** -3.1
% Prefer not to answer Adjusted Residual	34.2%	**3.0%** -2.2	8.0% --

Note. Percentages in bold represent statistically significant results (p<0.5). Percentages may not sum exactly to 100% due to rounding.

Heterosexual engineers were more likely (38.9%) not to see the impact of their social location on their career mobility, while engineers who self-identified as members of the LGBTQ2SI+ community were over-represented (68.0%) in believing this had impacted their career.

Lastly, our analysis revealed a salary difference between the respondents who indicated 'YES' and 'NO': the median salary range of those who indicated 'YES' (n=355) was $100k-$150k while the median salary range of those who indicated 'NO' (n=488) was $150k-$200k. While our previous findings have suggested that engineers belonging to various under-represented groups within the profession were more likely to believe their social location had impacted their career, this finding suggests a correlation between belonging to various under-represented groups and decreased material advantage within the profession.

(3) How do engineering graduates explain the relationship between social location and career mobility?

Our final layer of analysis involved qualitatively analyzing 539 responses to Q53, the open-ended question inviting participants to explain their answer to Q52 [33-35]. Our analysis resulted in six themes: 1) I have been advantaged by engineering culture (yes), 2) I have been advantaged by access to resources and supports (yes), 3) engineering culture has disadvantaged me (yes), 4) compared to my peers, I have had limited access to necessary supports (yes), 5) career mobility in engineering is fair (no), and 6) backlash (yes/no).

First, we present our findings on the engineers who see a connection between their social location and career mobility (those who said yes to Q52), then we share our findings on the engineers who do not think their race, gender, sexual orientation, immigrant status, or social class has influenced their career (those who said no to Q52).

Theme 1 (yes): My social location has helped me fit into engineering culture. This response came up often from engineering graduates who recognized the existence of a dominant culture within engineering and understood how their career mobility had been aided because of their ability to 'fit in'. An example of this type of response is *"I fit the majority description of an engineer and believe that it does make it easier on me than colleagues that do not fit that description."* [WM].

Theme 2 (yes): I was privileged to have access to financial and social supports. While this response also indicates a recognition of one's personal advantage, these respondents associated their advantage to their ability to access supports (of various types, but for the majority either financial or social). An example that highlights the various natures of supports reflected upon is *"I had the privilege to attend university and graduate without much financial hardship. At the same time, a mentor helped me navigate through my early career."* [WM].

Theme 3 (yes): Engineering culture disadvantaged me and others who do not fit into the "old boys club". Some respondents who felt they had been disadvantaged throughout their careers held engineering culture responsible for this, such as *"My last engineering position definitely showed me the impact of not being included in the "old boys club."* [RM].

Theme 4 (yes): I lacked access to the supports enjoyed by others. Other respondents felt that they were disadvantaged specifically because they were not able to access supports available to others. Many responses from this group also highlighted the lack of social supports for working engineers who are also caregivers: *"Being a woman, mother, immigrant is VERY difficult in a career that expects a commitment that goes beyond the 9-5. My career has been slow because I have kids."* [RW]. The impact of lacking the financial or family support to leave jobs and workplaces was also apparent for this group: "*As a first generation Canadian, I have always chosen "safe and secure" job options, due to family expectations*" [RM].

Theme 5a (yes): Backlash. A small percentage of men (both white and racialized) who answered "yes" to Q52 explained their responses in ways that challenged the question. For instance, a white man felt that "*White, heterosexual, Canadian born are always the last. Discrimination is maximum on us* [WM], while a racialized man shared the backlash to gender equity initiatives *"The recent trend is to promote females who are not qualified"* [RM].

Across these themes, racialized women and racialized men were most likely to explain barriers to career advancement as the product of limited supports while white women were most likely to point to engineering culture. White men identified both engineering culture and access to supports as career advantaging factors.

In all four cases (backlash aside), individuals used structural explanations for their "yes" responses—pointing out that they were advantaged or disadvantaged by either engineering culture or inequitable distribution of resources. The directional nature of these responses prompted us to disaggregate findings by gender and race, shown in Table 5. 53.9% of participants in the sample (n=321) shared stories of disadvantage, while 37% shared stories of privilege. Racialized women (100%), white women (82.6%), and racialized men (75.8%) primarily explained their responses to Q52 by sharing experiences of disadvantage, while white men primarily spoke of privilege (74.8%). Notably, some white women (8.3%) shared experiences which simultaneously spoke to privilege and disadvantage—white women were the only race and gender group to do so.

Table 5: Impact of Social Location on Career, by Race and Gender

Impact on Career	Sample (n=321)	RW (n=28)	RM (n=33)	WW (n=121)	WM (n=139)
% Backlash	5.9%	0%	9.1%	0%	11.5%
% Advantaged	37.1%	0%	15.2%	8.3%	**74.8%**
% Disadvantaged	**53.9%**	**100%**	**75.8**	**82.6%**	14.4%
% Both Adv./Disadv.	3.1%	0%	0%	8.3%	0%

Note. Percentages in bold represent majorities.

Next, we present our findings on the engineers who did not see a connection between their social location and career mobility (those who said no to Q52).

Theme 6 (no): Career mobility in engineering is fair. Most engineering graduates who did not think their identity had influenced their career offered explanations that clearly supported agentic beliefs of success, predicated on an assumption that the field of engineering is fair. Participants bought-in to this belief in fairness in two slightly different ways:

> *6a)* Career mobility in engineering is based on merit. This response came up often from engineering graduates who believed that career mobility in engineering is fair, not just for them, but for everyone: *"Advancement based on merit"* [WM] and *"My experience has been that consulting engineering is a meritocracy."* [RM].
>
> *6b)* I have had a good experience with career mobility. This response came from engineering graduates who recognized that the career mobility of others in engineering may have been impacted by social location, but did not make the connection to their own careers. For example, one participant said, *"I am a white heterosexual male so not being in a discriminating position"* [WM] and another *"C'est* [sic] *facteurs non pas influe d'un sans negative (Je ne suis pas un minorite)"* [WM]. These respondents hinted at their privilege without explicitly naming it as a form of unfair advantage.

Theme 5b (no): Backlash returns. Again, as was the case with those who answered "yes" to Q52, a critical mass of individuals expressed backlash in their explanations. The only difference is that white women joined white- and racialized men among those who expressed backlash following a "no" response.

This second set of findings indicates that all four gender and race intersectional groups included members who embraced meritocratic ideology. However, responses embracing meritocratic ideologies were most common amongst white men and racialized men. This is illustrated below in Figure 3, which summarizes how prevalent these six themes (explanations for both "yes" and "no" responses) were across different race and gender groups. The two themes denoted in grey scale are the themes which align with engineering graduates' buy-in to agentic stories of success.

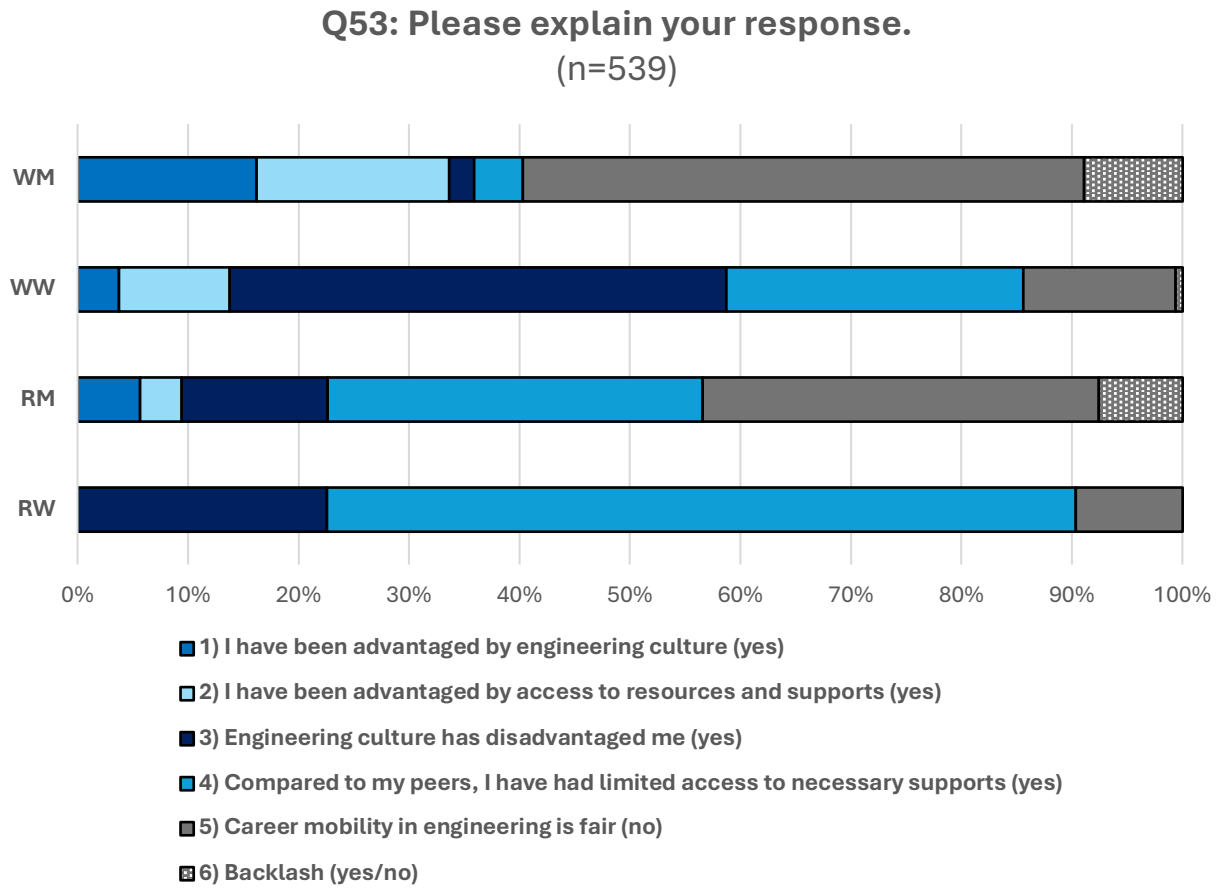

Figure 3: Prevalence of Key Themes in Participants' Responses, by Race and Gender

The four themes denoted by varying shades of blue are the themes found in the responses of engineering graduates who recognized social structure. By intentionally backgrounding (greying out) the responses that reify stories of agency, Figure 3 illustrates that there are numerous ways that some engineering graduates are resisting reifying agentic culture, through naming structure.

Discussion and Conclusions

Returning to our conceptual framework, our findings suggest that meritocracy is alive and well among engineering graduates across demographic groups—with more than half of participants suggesting their social location had not shaped their career trajectories and an additional 5.2% expressing backlash toward our question. This finding of *accommodation* is not uniformly present across demographic groups, with 68% of white men, 48% of racialized men, 25% of white women, and 16% of racialized women answering "no" to our structural proxy question. Stated differently, engineers from under-represented groups were more likely than their white male peers to acknowledge that their social location had impacted their career mobility. While this may be explained as a product of differentiated patterns of privilege in the profession and society, we did not ask participants if their social location had disadvantaged them, only if it had shaped their career trajectory. In other words, the question provided space for participants to name privilege as well as disadvantage. These findings suggest that structural disadvantage is more visible to participants than structural advantage.

Among the 40% of participants who did acknowledge the impact of their social location on their career mobility, racialized women and men spoke about limited access to supports, white women spoke about the patriarchal nature of engineering culture and white men acknowledged their fit into engineering culture and access to supports. Once again, the percentages of individuals in the "yes" group differed by gender and race—with 76% of racialized women, 72% of white women, 49% of racialized men, and 26% of white men acknowledging the impact of their social location on their career mobility. The impact was characterized as a disadvantage by 100% of racialized women, 83% of white women, 76% of racialized men, and 14% of white men. It was characterized as an advantage by 75% of white men, 15% of racialized men, 8% of white women, and 0% of racialized women. Returning to our conceptual framework, these individuals may be characterized by Giroux as *resisting* dominant meritocratic ideology in the profession.

These findings of differential visibility are not surprising, as it is easier to see inequity when we are personally disadvantaged by it than when we are advantaged by it. What is more interesting is to note the ways in which individuals are advantaged or disadvantaged. The two key features of participants' narratives about career advancement were engineering culture characterized as an "old boys club" and inequitable access to supports. Considering Bourdieu's perspective on cultural reproduction, our findings speak to the cultural capital legitimized within engineering, a cultural capital that appreciates the jokes, language, and values of this "old boys club" and is not accessible to those who deviate from embodying this knowledge.

Overall, while women and racialized engineers were over-represented in seeing the impact of their social location on their careers, many of the explanations that they offered continued to indicate an individualization and internalization of these impacts. This means that while there were references to the exclusionary impacts of engineering culture, these references often described how an *individual* was excluded, or how not fitting in with the culture had caused them to have *internal* doubts about their abilities or belonging. Therefore, while these responses show that some engineers who are part of under-represented groups may be recognizing the faults of the dominant engineering culture, they remain primarily concerned with their own *individual ability to survive engineering culture*. Whereas our pre-existing assumption was that we would find engineering graduates either *accommodating* or *resisting* the dominant engineering culture,

our findings suggest that there may be more than one type of resistance within engineering: with those actively challenging the culture and those trying to survive the culture playing key roles of resistance.

Across the three response types—accommodating meritocracy ("no" response, agentic explanation), resisting meritocracy ("yes" response, structural explanation), and finding ways to survive engineering culture (yes/no response with an agentic explanation), we have illustrated how meritocracy lands in Canadian engineers' stories about their career progression. Given the need to have engineers support equity initiatives, we ought to consider how to help them see structural inequities within the profession. Whether individual engineers recognize it or not, they are all implicated in shaping engineering culture. If they are not empowered to see meritocratic assumptions of progress as a barrier to equity, they remain agents of accommodation and transmission.

Implications

Our analysis contributes baseline narrative data on the stories Canadian engineers are telling themselves about their progress to existent engineering education research identifying meritocracy as dominant in engineering culture. By disaggregating engineering graduates' recognition of social structure by race and gender, we identified that white men, in particular, strongly buy-in to agentic beliefs about their success. If the Canadian field of engineering hopes to make meaningful improvements to EDI work, it is pivotal to consider the role of all members in reifying this hegemonic agentic culture. Our findings suggest that engineering educators have more work to do supporting students in recognizing the social structures that frame society, and the engineering discipline. By beginning with considerations of broader social structures, it may be possible to begin to challenge the agentic socialization of engineers indirectly. Supplementing this approach with direct mentions and challenges of engineering culture, when and where possible, may help engineers see the impact of social structures within profession. Further, engineering educators who speak out against the hegemonic culture may create spaces for those engineers who are *trying to survive engineering culture* to share and access support. Our findings confirm that access to supports remains disproportional for engineering graduates, suggesting that those working in engineering education ought to critically reflect on the types of supports available and how they are shared and promoted. While providing access to supports may not dismantle the dominant engineering culture, it can have a tangible impact on the experiences of engineering graduates who themselves act as agents of resistance.

Limitations, and Future Work

The national survey on which this line of analysis was based depended on regional outreach beyond our local context. We achieved some success reaching out to engineering regulators in the Atlantic and Western provinces, as well as the three Northern Territories, with gaps in two of the three prairie provinces. We achieved this level of regional diversity by partnering with engineers' regulatory bodies. The corresponding methodological limitation was an over-representation of licensed engineers in our sample. Compared to the population of engineering graduates as a whole, we also had an over-representation of white women and an under-representation of racialized men. Beyond these demographic limitations, lengthy national

surveys tend to privilege breadth over depth, leaving open-ended responses shorter than interview-based data generation methods. As is the case in any self-administered survey, our analysis of engineers' perceptions of social structure was limited by their understanding of our question. Interpretive challenges on our end, balancing the need to apply a critical lens while still reflecting the explanations of participants, was the main limitation of this analysis.

Given our interest in understanding how engineering graduates respond to cultural reproduction, foregrounding voices often excluded from engineering is important. Large scale surveys permit us to identify trends in financially feasible ways, but they make it difficult to amplify the voices, stories, and interpretations of under-represented communities. Future qualitative work, involving focus groups and semi-structured interviews with engineering graduates who remain unlicensed, whose careers have followed non-traditional paths, and who are demographically under-represented in the profession, would help us draw out further insights.

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