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Less of a Minority in University Education in Engineering? An Intersectional Analysis of Female and Male Students in Canada

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ABSTRACT
While engineering remains a male dominated university program in the industrialized world, in Canada the proportion of women enrolled in undergraduate engineering education has risen in some universities. Furthermore, the percentage of undergraduate female students varies considerably among engineering sub-disciplines. Considering three selected Canadian universities, each with a relatively high proportion of women in undergraduate engineering programs, this interdisciplinary mixed methods study first explains the rationale for its methodology, namely, an intersectional gendered research design drawing on the perspectives of female and male students and faculty members in various engineering sub-disciplines, and of administrators in the engineering programs. We then provide a feminist intersectional overview of the students' personal backgrounds and of student life. The article concludes by highlighting the contributions made by our feminist intersectional analysis toward gaining a deeper understanding of the complex relationship between gender and contextual variables such as university and type of program with various indicators of the background and experiences of students in selected Canadian undergraduate engineering programs. Questions for further research about women as a minority among university students are also identified.

KEYWORDS
Engineering; education; intersectionality; gender equity; Canada

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INTRODUCTION

The persistent underrepresentation of women in engineering, and in engineering education more specifically, continues to garner interest in Canada as it does in the rest of the industrialized world. This issue has attracted the attention of the current federal government, which has recently launched a national multifaceted campaign to increase the number of women in engineering and in the other science, technology, and mathematics (STEM) fields. The need to expand the pool of highly skilled workers in the context of a global knowledge-based economy underpins this initiative, which is also driven by the government's declared commitment to achieve gender equity and diversity in the paid workforce ("Government of Canada launches campaign to encourage young women to choose science," 2017).

This high-profile intervention must be added to an impressive number of efforts undertaken during the preceding decades by a wide range of Canadian stakeholders and policy makers within government, higher education, industry, professional associations, and women's organizations, intended to address the continuing minority status of girls in engineering. An examination of historical trends in female enrollments in undergraduate engineering programs sheds light on why this is. While the proportion of female students increased for a full 10 years between 1991 and 2001 peaking at 20.7%, it then dropped to 17% before once again rising and flattening out at around 20% up to 2015. It should be noted that the total number of admissions of both men and women to Canadian undergraduate engineering programmes increased by around 60% over the same period (Ontario Network of Women in Engineering [ONWiE], 2018). Since 2000, Canadian female undergraduate enrollments in engineering have thus displayed a mixed pattern of growth, decline, and stabilization—fluctuations that have been detrimental to efforts to achieve parity with men.

LITERATURE REVIEW

Unsurprisingly, the "problem" of women in engineering and in the other STEM fields has spurred the growth of a large body of literature that seeks, not only to identify the root causes of female underrepresentation, but also to suggest strategies and measures to break down barriers to their full participation in engineering. While it has roots in Western Europe and Australia, this scholarship's stronghold is in the United States, where a significant number of researchers have tackled these issues from the perspectives of the humanities and social sciences, as well as the interdisciplinary field of women's and gender studies. The increasing involvement of researchers from the natural, physical, and applied sciences has fostered the development of new interdisciplinary fields such as feminist science studies and feminist technology studies, leading to the growth of a more multifaceted and complex form of scholarship (Rosser, 2000; Wyer, Barbercheck, Cookmeyer, Ozturk, & Wayne, 2009).

For its part, Canada has not witnessed a similar pattern of growth in research. Canadian scholarship on women in STEM, especially on women in engineering, for a long time remained scant, scattered, and fragmented (Heap, 2003). This is partly explained by the language boundaries, which have led to the emergence and development of two fairly distinct bodies of knowledge: one mainly produced in French Québec, but with important contributions from Francophone scholars in other provinces such as Ontario and New Brunswick; and the other linked to the much larger community of Anglophone scholars spread throughout the country. Furthermore, limited provincial and federal funding has acted as a major deterrent, inhibiting large-scale, cross-provincial, and interdisciplinary projects. However, important additions to Canadian literature have been published recently based on nation-wide data and analyses about women at various stages of their education and careers in STEM (Council of Canadian Academies, 2012; Natural Sciences and Engineering Research Council of Canada [NSERC], 2017). Two dedicated research initiatives have also addressed this problem: the NSERC-funded National Network of Chairs for Women in Science and Engineering, which supports the Engendering Success in STEM consortium (successinstem.ca); and the 2017 North American Gender Summit, also co-organized by NSERC (Holmes, 2017). Another key contribution is Monique Frize's (2009) landmark study, which situates the underrepresentation of women in Canadian science and engineering in a historical context and provides important insights from her own experiences as a celebrated engineer and activist.

An important portion of the literature on women in STEM pertains to engineering and, more specifically, to engineering education. The Society of Women Engineers' (SWE) annual review of the most significant social science literature on women engineers and women in STEM disciplines published in the United States and other countries provides very useful assessments of the main topics and issues addressed by this scholarship. Overall, this growing body of research aims to unravel the complex set of factors that either encourage or discourage women from pursuing an engineering degree. Much attention has been paid to the socialization that girls and boys receive throughout their formal and informal education prior to university, and the extent to which it can lead to the perception that engineering is a male field and therefore not appropriate or attractive for girls. There is also continuing interest in determining if the perception that girls have less mathematics and science ability than boys still persists; if girls lack early educational experiences in engineering; and if they experience lower self-confidence in STEM fields than boys. Other scholars argue that the lack of sufficient knowledge about what engineering actually *is* constitutes another key deterrent to the entry of girls into the field, and recommend that efforts be made to present engineering as a socially relevant profession, since this approach is more likely to respond to the interests and goals of female students. Finally, the role played by parents in encouraging girls to study engineering remains an important research topic, as well as the impact of outreach programs and female role models on the choices made by girls.

Other important topics found in this literature concern the recruitment practices and messages used to attract women to engineering education and the kinds of support programs and activities offered to female students to keep them from falling out of

the so-called "leaky pipeline." The importance of female role models is discussed extensively here, especially in relation to the lower levels of confidence expressed by many female students—a factor that is largely reported. The structural features of the engineering curriculum have also been widely critiqued, especially with respect to its narrow, rigid, decontextualized, and abstract features, and to teaching and pedagogical practices that promote competition and individual achievement.

Overall, two questions persist in the literature devoted to women in engineering: firstly, how has the interaction between gender and engineering shaped the latter into a highly masculine profession; and secondly, how can we transform the masculine culture of engineering to make engineering a place in which women can also feel they belong? Indeed, in their most recent assessments of the literature on women in engineering, SWE reviewers call for more research on the evolving relations between gender and engineering, concluding that "a better understanding of the gendered culture of contemporary engineering is an obvious need" (SWE, 2018, p. 337). They have also encouraged the development of a truly interdisciplinary approach to the study of women in engineering (SWE, 2016, p. 281), as well as more "intersectional gender research—that is research exploring multiple, intersecting facets of identities, such as gender, sexuality, race, and class" (SWE, 2018, p. 355).

Our own project, the subject of this article, constitutes a more focussed, but also more complex research contribution towards the analysis of women's engineering education in Canada. Contrary to many studies, which tend not to differentiate between data on engineering and data on other STEM fields, our study deals exclusively with engineering—a decision based on the understanding that the experiences of women in this field differ from those of women in the natural sciences. Additionally, we have differentiated between the engineering sub-disciplines, since women's representation and experiences can vary considerably among them. Furthermore, instead of focusing our study entirely on a single location, we have chosen three institutions—an approach that allows for useful comparisons to be made. Finally, and more fundamentally, early in the new millennium, our interdisciplinary research team began addressing the question of why engineering remains one of the few undergraduate programs in Canadian universities in which women continue to be a minority.[1]

CONCEPTUAL FRAMEWORK

Our analysis is informed by feminist intersectionality. Intersectionality is both a theoretical and methodological orientation to research; an analytic tool that "gives people better access to the complexity of the world and of themselves" (Collins & Bilge, 2016, p. 2). Intersectionality is a metaphor that was proposed by the legal scholar Kimberlé Crenshaw (1989), and is an approach that has now been widely adopted. Here, it should be noted that what were effectively intersectional analyses had been previously conducted, particularly by feminist scholars (Denis, 2008). Intersectionality involves *concurrently* examining multiple sources of subordination that cut across each other, and is "based on the premise that the impact of a particular source of subordination may vary, depending on its combination with other potential sources of subordination (or of relative privilege)" (Denis, 2008, p.

677). Complexity, inequality, social context, and relationality are key dimensions of the concept (Collins & Bilge, 2016; Scott & Siltanen, 2017). "Feminist intersectionality," we argue, suggests that gender is a necessary dimension of any feminist intersectional analysis, rather than being something that is either assumed or simply ignored.

METHODOLOGY

Using a mixed methods study, funding from the Social Sciences and Humanities Research Council of Canada enabled us to develop instruments and collect data between 2004 and 2008 via our interdisciplinary "Society Centred Educational Practices in Engineering" study.[2] Data were collected in the engineering faculties of three central Canadian universities. The institutions were of diverse geographical location, size, and history, but each with a proportion of women among their undergraduate engineering students that was well above the Canadian average for the period of study. For this article the overall size of the university was noted as the key variant, and the universities are referred to as Small University, Medium University, and Large University. Within each university we examined archival material from official university documents and student newspapers, conducted observations of public activities for engineering students during the opening weeks of term, and administered questionnaires (with both open and closed questions) to male and female faculty members (N=74) and undergraduate students (N= 525) in engineering.[3] In addition, we interviewed administrators and others with administrative responsibilities in engineering and engineering society student governance (N=21), and conducted focus groups (N=14) with young women who were currently engineering students or recent graduates. We sampled students in their second and fourth years in compulsory courses for the year. Of these, approximately 60% of the women and approximately 70% of the men who responded were in their second year.[4] The sample included students both in sub-disciplines with a relatively high proportion of women (approximately 30% of those in the sub-discipline), and in ones with a low proportion of women (about 10%).[5] The percentage of respondents of each sex from the sub-disciplines with high female representation, at each university, is shown in Figure 1.

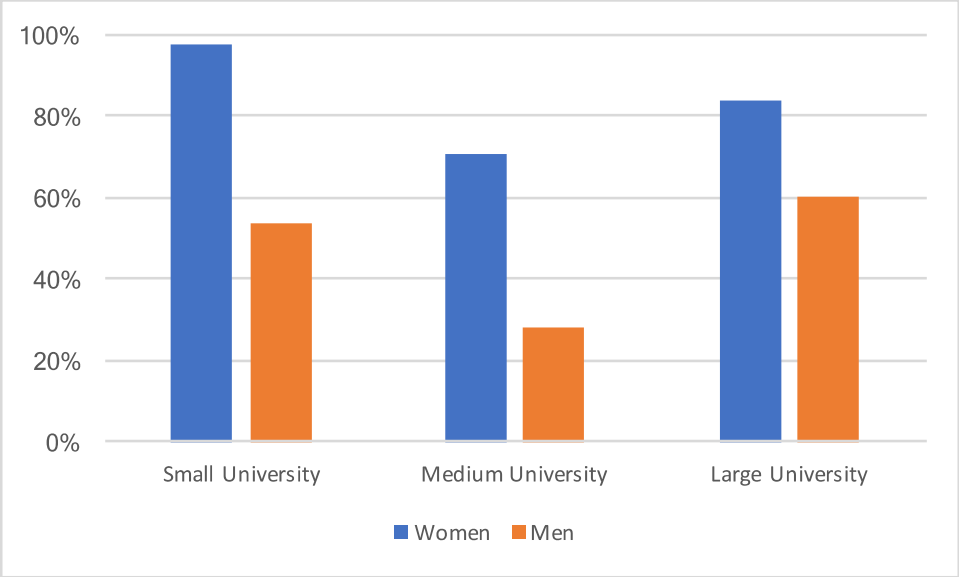

Figure 1. Proportion of respondents of each sex and from each university in sub-disciplines with high female representation.

In this article we compare women and men engineering students, using student questionnaires. We situate this analysis of their socioeconomic backgrounds, their reasons for studying engineering, and their reported university experiences—both academic and para-academic—in one or more contexts: the institution where they were studying; whether the students are at an early stage (second year) or towards the end (fourth year) of their program; and whether their engineering sub-discipline is one that is predominantly male or one that attracts a more substantial percentage of women. Of course, in addition to the above, there is the more general context of the overall engineering culture.

A GENDERED OVERVIEW OF THE STUDENTS

In many respects, the female and male students were similar, both in their personal background and in their academic and extracurricular experiences as engineering students. In the following sections, we summarize the similarities, and highlight the differences.

Before University: Personal Background

Privileged backgrounds

Both the young women and young men had relatively privileged backgrounds, in terms of parental education and parental socioeconomic status (SES), which afforded them considerable cultural capital. Whereas about 20% of each of the fathers and mothers had completed a college diploma, 57% of the mothers and 67% of the fathers had completed one or more university degrees and, although differences between young women and men were not statistically significant, there was a higher proportion of the former whose mothers and fathers had university degrees. Over half of the mothers and almost two thirds of the fathers had professional or semi-professional occupations, affording them high SES, again with a higher percentage for young women. The gender differences are only statistically

significant when the SES of both parents are considered together, and then the significance was low; 79% of the women and 70% of the men had at least one parent with high SES, so more of the women than men come from a privileged background.

Knowing about STEM and support for studying engineering
Having a parent in an occupation in STEM is another potential source of cultural capital for engineering students. In fact, about 29% of the students have fathers who are engineers, with a further 36% of the fathers working in other science and mathematics fields. While only about 3% had mothers who are engineers, 46% had mothers in a related field of science or mathematics. The only statistically significant difference found between the backgrounds of the female and male engineering students was that 58% of the women, compared to only 41% of the men, had mothers in a field that was related to science and mathematics (other than engineering).[6] Thus, overall, more of the women than the men came from a STEM background, which may have increased the women's knowledge of these fields.

Family, peers, and teachers were generally supportive of the students' decision to study engineering. Few students of either sex reported having been discouraged from studying engineering by their immediate family, peers, teachers, or others working in the field. Between 40% and 70% reported encouragement, with a higher percentage of young women systematically reporting encouragement, although the differences were only statistically significant in the case of siblings, teachers, and others working in the field. In general, mothers and fathers were the most likely to encourage their children, while guidance counsellors were notable for their neutrality.

In high school, young men were significantly more likely than women to have taken an engineering course (25% compared to 12% respectively) or an advanced technology course in their final high school grades (53% compared to 30%). Conversely, young women were slightly more likely to have had non-credit (including volunteer and paid work) STEM experiences during high school.

At University: Academic Background and Experiences
The engineering students of both sexes were predominantly Canadian-born, had grown up in a metropolitan centre or the suburbs, and had been educated in Canada. About 70% said they were of British, French, or Canadian ethnic origin, or from New Zealand, the United States, or Europe. Most of the others were of Asian origin. In general, they were unmarried, without children or other dependents, and had gone directly to university after completing secondary school. Women were more likely to have scholarships (75% women compared to 63% men), and more likely to have an internship placement as part of the program (30% women compared to 20% men), although funding sources were otherwise very similar for both sexes.

The choice of university and choosing to study engineering

In answer to a question about the three most important factors in their choice of a university, academic reasons were the most frequently mentioned: 72% identified the program's reputation (a particularly important reason in both the Medium and the Large University for both sexes); 36% cited the availability of a particular engineering sub-discipline (a reason two thirds of those at the Small University, especially the women, mentioned); and 24% mentioned the possibility of doing a co-op program (for both women and men a reason that was most important for those attending the Small University, and least important for those at the Medium University). The most frequently mentioned non-academic reasons were student life (29%), which was especially significant for men at the Medium University, and least important at the Large University; and not living at home (24%), which was most frequently mentioned by men at the Medium University. Support programs for women in engineering were claimed to have had no influence by almost 75% of the women, and only a slight influence by a further 15%. There were no significant differences among the universities in this respect.

In open questions (which we subsequently coded), we also asked students to tell us why they had chosen to study engineering, and why they had selected a particular sub-discipline. We also asked them whether they felt that engineers cared about society. Almost all students, regardless of their sex (about 94% of the men and 91% of the women), and with no differences among universities for either sex, or between whether or not the students were in an engineering speciality in which women are concentrated, agreed that professional engineers do care about society. Two of the reasons students chose engineering, or a particular sub-discipline, related to contributions to society: 19% (including significantly more women) mentioned social relevance, and 10% mentioned service to society. Students of both sexes at the Small University were significantly more likely to mention social relevance, while those (especially the men) at the Medium University were least likely to cite this as a reason.

Other reasons, which in fact were more frequently mentioned by the students in relation to their subject choice, concerned either intrinsic qualities of the field, or extrinsic rewards they anticipated from jobs in the future. The most frequently mentioned reason was an intrinsic one—interest in the field—and there were no significant differences in this by gender, university, or the two combined. Problem-solving was mentioned by 42% of the students; a more popular reason expressed amongst the men, but also by the fewest of both sexes at the Large University. When looking across both the male students as a group, and across all the students in our sample, the difference between universities was significant. Significantly, many more women (63%) than men (18%) mentioned being able to do mathematics and science as an attraction of engineering. Differences among the universities were significant for women and for the sample as a whole, with this reason most often mentioned at the Medium University. Turning to extrinsic considerations, getting a job was mentioned by 45% of the women and 34% of the men, but with significantly fewer at the Large University mentioning it. However, earning a good salary was mentioned by 17%, which included significantly more men. Although the highest proportions of both sexes citing financial issues were at

the Large University, there was not a significant difference in the percentage giving this reason among the institutions.

Variations in academic confidence

Some questions asked the students about their confidence in mathematics, science, technical, and academic skills, and about any changes in their level of confidence. Between 40% and 50% of the young people entered university feeling very confident in their mathematics and science skills, and their overall academic performance, with a slightly higher proportion of women than men feeling very confident in each case, and little difference among the universities. In contrast, the men were significantly more likely than the women (41% compared to 18%) to feel very confident in their technical skills. Comparing levels of confidence on entering university with present levels of confidence, there were no significant differences among men or among women, although more men who were either very confident or had little confidence on entry had increased their confidence, and more women reported decreased confidence. Other than for technical skills, the percentage of women reporting initial low levels of confidence was lower than the percentage of men.

Changes in levels of confidence in the four primary skill sets varied systematically and significantly across universities, with the most students reporting increased confidence in the Small University and the fewest in the Large University. These inter-university differences were significant for men, but not for women (although their pattern was the same), and typically, in each case, the proportion of men reporting increased confidence was greater than the proportion of women. Overall, the students' confidence in the four skill sets had increased by the fourth year for both women and men, although most of these differences were not statistically significant.

Self-comparisons with female and male peers

We invited the young people to compare themselves separately with women and with men in their engineering classes in terms of a number of criteria related to engineering: more time and effort spent on classwork; better understanding of engineering concepts; being better at solving engineering problems; greater confidence in their engineering skills; greater commitment to engineering; and better ability to work with other people. It was only in comparing oneself on the time and effort spent on classwork and on working with others that there were significant differences between women's and men's responses—and these differences were significant in comparisons with both women and men. A third of the women, but only a fifth of the men, felt that they spent more time on class work than (other) women. In comparison, half of the women and a third of the men agreed they spent more time on class work than (other) men. Thus, women were much more likely than men to feel they spent more time on class work than others, and both sexes were more likely to feel they spent more time on classwork than (other) men (see Figure 2).

Figure 2: Proportions of women and men who felt they spent more time on classwork than other male and female students.

In terms of working better with people, the results were also significant; a striking 50% of the women felt that women worked better with people than men did, while only a quarter of the men felt that men worked better with people than women did. The pattern that emerges when only universities are compared or when universities are compared for each sex is complex. There are more likely to be significant differences among men than among women from universities of different sizes, but this may be partly due to the larger number of men in the sample. It seems that students in the Medium University are most likely to give a neutral answer, while those, especially men, at the Large University are most likely to say they are not better than their male counterparts at understanding concepts or have more confidence in their engineering skills. Conversely, compared to other men, our male respondents at the Large University were more likely than those at other universities to say they spent more time and effort on their class work and that they were more committed to engineering.

Academic achievement and support

Young women were significantly more likely to have obtained an A average during the previous year than young men (40% compared to 26% respectively), and less likely to have obtained a C or less (21% women compared to 31% men). Unsurprisingly, for both sexes, and in all universities, there was a significant association between high grades and feeling encouraged on the one hand, and low grades and feeling discouraged on the other. Women with A grades were slightly more likely than men with A grades to have been encouraged by their grades (67% women compared to 64% men), but were also more likely to have been discouraged by grades of C or less (80% compared to 70% respectively).

Once enrolled in engineering, both the women and men students were largely satisfied with, and committed to, their chosen field, although they had no illusions about their heavy workload and the high level of competition among students.

Overall, and based on the responses of both women and men, the Large University could be described as the least welcoming of the universities (especially for women). At the Large University higher percentages reported that they were discouraged by the atmosphere, agreed that the competitive climate favoured male students, disagreed that their faculty was supportive of women students, and agreed that demeaning or stereotypical comments about women were made in their classes. In both the questionnaires and focus groups, women commented on the challenges they faced. For instance, several of the young women mentioned in (women only) focus groups that women needed to have thick skins in order to be successful in engineering, or indeed, even to survive as engineering students.

Also striking in all the institutions was the low percentage of students who commented on having been either encouraged or discouraged by the faculty member who influenced them the most—by their role model or mentor, or by their faculty advisor. For many, these questions were simply not applicable. Conversely, among those who had participated in such interactions, women were significantly more likely than men to report encouragement from the faculty member who had most influenced them during the previous 18 months. There were no significant differences between men and women in terms of encouragement (or otherwise) from a role model, faculty advisor, influential teaching assistant, influential member of the engineering society, or their peers, although in general all were considered to be encouraging. However, those at the Large University were most likely to report having been discouraged by one or more of these categories of people.

At University: Student Life

Significantly more women than men (30% compared to 10% respectively) had held elected positions in an engineering or technical society at university, confirming the administrators' perception of the importance of women students in student associations. Unsurprisingly, the women were significantly more likely than the men to find their participation in student engineering associations encouraging, along with their leadership in student associations and participation in university governance (and there was no significant variations among universities in this area). Women were also significantly more likely than men to find engineering social events and student life encouraging. At the same time, there were significant differences among the universities. At the Large University, the lowest percentages of both men and women found engineering social events and student life encouraging. At the Small University women were most likely to find both encouraging, while at the Medium University it was men who found both most encouraging.

Finally, almost half of the women for whom it was applicable, found belonging to a Women in Science and Engineering (WISE) group encouraging; a similar proportion found other networking opportunities for under-represented groups encouraging, as did about a quarter of the men. However, only a minority reported that such networking opportunities were applicable. In this case, there were no significant differences among the universities.

Although women had been more likely than men to participate in STEM competitions in high school, at university it was the men who were significantly more likely both to participate in engineering competitions and to find such involvement encouraging. We question whether this reflected that the content of the university engineering competitions focussed more on the engineering sub-disciplines that attracted male students.

Concluding Discussion

This article, which presents some of the results produced by our ongoing interdisciplinary project, provides an exploratory examination of a sample of women enrolled in undergraduate engineering programs at three Canadian universities. The women in our sample had chosen to enter a field in which women continue, overall, to be largely underrepresented in Canada.

We found, in general, that both women and men had relatively privileged backgrounds, and had received encouragement from their families and teachers. Many reported having confidence in their mathematics, science, and academic competence, and increasing confidence as their studies continued in their technical and engineering skills. We were somewhat surprised at the extent to which many of these characteristics were shared by both women and men, although they were not necessarily present to the same degree.

Regarding role models and other faculty advisors at university, two findings were particularly notable. Only about half the students, women or men, indicated that a role model or advisor had any influence on them—whether encouragement, discouragement, or being a neutral influence. Of those who reported having been influenced, women were more likely than men to report encouragement, regardless of the size of the university, but few students reported being discouraged.

This last observation is one of the reasons for our conclusion that female students indicated an awareness of the "macho" dimensions permeating engineering culture, but also an awareness of the measures that universities were taking to attenuate these dimensions. Conversely, apart from the long-running university-based group WISE, the measures and initiatives aimed at increasing the inclusion of women do not seem to have been very relevant to the women in our sample.

One question we must ask ourselves is why, in the patriarchal context that currently characterizes Canadian society, gender did not consistently show up as a significant variable in the analyses we performed. Indeed, the rather striking degree of similarity between our female and male respondents on many variables represents one of the unexpected results of our study. As a partial explanation for the lack of differences between men and women students, we suggest that the women participating in this study were a self-selected group, who were already highly motivated to study engineering. This fact should also be considered when evaluating the limited reported relevance to these women of institutional strategies intended to promote women's inclusion in engineering. In fact, we wonder whether this limited relevance is a comment on the strategies themselves or rather, as we would argue, a result of the fact that the women in our sample were already

strongly committed to studying engineering and, prior to attending university, had been informed and supported in this choice. It should also be noted that all of the students who reach their second year are likely to be committed to their program and relatively confident in their skills. An additional factor for our study was the predominance of women respondents taking modules with high female representation (see Figure 1), which may also have affected the results. However, whether or not empirical analysis indicates that gender is a significant variable, there should be consideration of the patriarchal societal context of Canada (and other contemporary industrialized societies) and the possible influence this has on the outcome. At the very least, one can interrogate why, in a patriarchal context, gender, specifically being a woman, remains salient, even if it does not emerge as statistically significant when the data are analyzed.

The results of this study demonstrate the value of conducting an intersectional analysis when studying gender and undergraduate engineering education in Canada. While we found many—and largely unexpected—similarities between women and men, our results revealed, for example, how gender played out in a complex way in our three selected universities, which differed in size (the dimension emphasized here), and other contextual dimensions, including institutional culture and policies promoting women's inclusion in engineering. We anticipate examining these other dimensions in the future. In fact, the results we have presented here indicate the need for more qualitative and quantitative research that will lead to a deeper and more nuanced understanding of the complexity of gender in various disciplinary fields and sub-disciplines and in different university settings.

ENDNOTES

[1] The faculty members and research assistants on the team belong to the disciplines of education, engineering, history, and sociology.

[2] We would like to acknowledge the support that the Social Sciences and Humanities Research Council of Canada awarded to this project through its Standard Research Grant Program (2004–2007).

[3] In 27 instances no sex is indicated, so these instances are treated as "missing" for any analysis involving sex. 31% of the sample are women, which is quite representative of the population studied.

[4] 70% were in their second year and 30% in their fourth year.

[5] Sub-disciplines with relatively high concentrations of women were identified as: biological and biomedical; chemical; civil, environment and water resources; mathematical and industrial; metallurgical, geological and mining. Sub-disciplines with relatively low concentrations of women were identified as: computer; engineering physics; engineering systems, software and communications; electrical; mechanical, materials, aerospace, and aeronautics. Of the students, about 58% are in sub-disciplines we have identified as having a high concentration of women, and 42% are in sub-disciplines with a low concentration of women. The 3% of students who were equally divided between women and men in engineering physics were excluded from statistical analysis due to their even distribution in terms of gender.

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