

Canadian Physics Counts:

An exploration of the diverse identities of physics students and professionals in Canada

Eden J., Hennessey¹, Anastasia Smolina², Skye Hennessey¹, Adrianna Tassone¹, Alex Jay¹

Shohini Ghose^{1,4}, Kevin Hewitt³

Author Affiliations: ¹Wilfrid Laurier University, ²University of Toronto, ³Dalhousie University,

⁴Quantum Algorithms Institute

Abstract

The lack of diversity in physics remains a persistent worldwide problem. Despite being a quantitative discipline which relies on measurements to construct and validate hypotheses, there remains a paucity of data on both demographics and experiences of marginalized groups. In Canada, there has never been a nationwide assessment of those studying or working in physics. Here, we present findings from Canadian Physics Counts: the first national survey of equity, diversity, and inclusion (EDI) in the Canadian physics community. Our intersectional approach allowed us to gather a wealth of information on gender identity, sexual orientation, race, disability, and more. Analyses revealed key findings, including the first data on physicists who identify as non-binary or gender diverse, as well as the first data on Black and Indigenous scholars. Black physicists (1.2%) and Indigenous physicists (.3%) were found to be the most underrepresented, while White men were overrepresented across all sectors. Among respondents with a disability, only 5% reported receiving full accommodations for their required needs at their place of work or study. One in four respondents from BIPOC gender diverse backgrounds identified as being disabled, and the proportion of sexually diverse students who reported having a disability was more than three times higher than the proportion of heterosexual students with a disability. The data also revealed that students represented more demographic diversity than working professionals, highlighting the importance of acting today in order to retain the diverse physicists of tomorrow. Our analysis identifies areas for intervention and offers recommendations for building a diverse and inclusive physics community in Canada that can be a global exemplar.

Introduction

Previous research has demonstrated the relevance of race and gender in determining who is able to study, work, and succeed in science. For example, the ‘double bind,’ articulates how racism and sexism combine to create significant barriers to the participation women of colour in science (Malcom, Hall, & Brown, 1976; Malcom & Malcom, 2011; Ong, Wright, Espinosa, & Orfield, 2011). Perhaps not surprisingly, Ivie et al., (2014) found that out of approximately 9000 physics and astronomy faculty members in the United States, there were fewer than 75 women who were either African American or Hispanic. Indeed, racialized women are barely represented in physics; in all of history, fewer than ten Black women have graduated with PhDs in theoretical high energy physics (Prescod-Weinstein, 2015). While racialized women are virtually absent at the PhD level in physics, such disparities are well-documented in earlier post-secondary education. A recent report from the United States showed a disturbing decline in the participation of African Americans in physics education over decades; in 1990 about 5% of bachelor’s degrees in physics were awarded to African Americans and less than 4% in 2017 (American Institute of Physics, 2020). Given the lack of representation of women and racialized physicists at all levels, and the ‘double bind’ challenge of experiencing persistent racism and sexism, it is imperative to apply an intersectional lens to subsequent research (i.e., recognition that marginalized identities such as gender, race, ability, interact to create greater oppression; Crenshaw, 1988). While Canadian demographics are similar to the United States in some ways but very different in others (e.g. African American vs African Canadian population), very few studies have focused specifically on the Canadian physics community. Canadian researchers have outlined, however, many barriers to achieving equity in Canada’s higher education system as a whole, including unconscious and implicit bias, affinity bias, white normativity, tokenism, equity tax, and other

factors impacting career progression and lived experiences in academia (Henry et al., 2017, James & Turner, 2017). A national survey of the Canadian physics community to analyze the specific and unique demographics, intersecting identities, and lived experiences of its members is long overdue.

Existing data on physics students and professionals in Canada are sparse and disconnected. In 1967, a report by the Canadian Association of Physicists (CAP) headed by D.C. Rose assessed the physics community through a survey that gauged numbers of faculty and students by department, but this work did not include an analysis of demographic identities, such as gender or race (Science Secretariat, 1967). Three decades later, another analysis was conducted of highly qualified personnel who had obtained physics degrees at 52 Canadian universities and colleges (Robertson & Steinitz, 1997), however, this report included only one question on respondent sex (i.e., response options were ‘male’ and ‘female’). National statistics reported aggregated data, such as faculty in physical sciences, computer science, engineering, and math (Statistics Canada 2009), bachelor’s students in chemistry and physics (National Graduates Survey 2009), or graduate students in math and physics (NSERC 2010), all with a binary sex variable. An independent survey by the Canadian Association of University Teachers in 2010 similarly reported on physics faculty members (CAUT 2010). In 2017, Donna Strickland reported on physics departments in Canada and reported proportions of female students and faculty members, however, this analysis did not include any other aspect of demographic identity, such as race (Strickland, 2017). A 2018 report showed enrolment of women and visible minorities in undergraduate physics programs from 2000 to 2009, but did not disaggregate data beyond binary sex and racialized variables (Perreault et al., 2018). Our understanding of the demographics of the physics community in Canada is largely informed by these few analyses,

along with selected reports from Statistics Canada (Chan, Handler, & Frenette, 2021; Hango, 2013; Wall, 2019), and research focusing on particular identities in physics (e.g., women; Predoi-Cross et al., 2019; Dengate, Farenhorst, Peter, & Franz-Odendaal, 2021).

In Canada, women are not adequately represented in physical and chemical sciences and in post-secondary physics education, despite comprising the largest proportion of post-secondary graduates (Wall, 2019). In response to the lack of gender diversity within Canadian science, including in physics, various initiatives to promote equity have been implemented, such as conferences promoting women in physics (Predoi-Cross et al., 2019), the NSERC Chairs for Women in Science and Engineering Program (2021), NSERC Chairs for Inclusion in Science and Engineering (2023) and the Waterloo Charter for Gender Inclusion and Diversity in Physics (International Union for Pure and Applied Physics, 2021). The transition to college/university represents the largest loss of women from STEM programs - women make up only 34% of Grade 12 physics students in Ontario, which is a required course for post-secondary physics education (Wells 2018). While it is a step in the right direction to understand women's representation in Canadian physics, gender is only one facet of identity that relates to the retention of physics students (Porter & Ivie, 2019). Despite the importance of assessing the multifaceted identities of scientists, there has never been a national survey that collects demographic data (i.e., gender, race, sexual orientation, disability) from physics students (or faculty) in Canada, although such data is sorely needed to understand representation and retention rates of all historically disadvantaged groups.

To this end, the present study conducted the first ever Canada-wide survey to assess representation in physics. We focus here on two questions: 1) what are the demographic identities of post-secondary physics students (compared to working professionals) in Canada? 2)

how do the demographic identities of physics post-secondary students (and working professionals) in Canada intersect? The current research therefore acts as a foundational step towards understanding the intersecting identities of those studying and working in physics across Canada.

In addition to the ‘double bind’, research from social and organizational psychology has proposed various factors that affect participation in science. Such factors range from aspects of individual experience, such as identification with science (Robinson, Perez, Carmel, & Linnenbrink-Garcia, 2019), confidence (Sterling et al., 2020), access to resources (Porter & Ivie, 2019), parental education (British Royal Society, 2013), experiences of harm such as sexism (Aycock et al., 2019; Clancy, Nelson, Rutherford, & Hinde, 2014) and racism (Clark & Hurd, 2020; American Institute of Physics, 2020), to societal factors such as socialization (Tenenbaum & Leaper, 2003), stereotypes about scientists (Banchefsky & Park, 2018; Reuben, Sapienza, & Zingales, 2014), the predominance of Whiteness in the academy (Johnson & Howsam, 2020), and the culture and climate of classrooms and labs (Settles, Cortina, Malley, & Stewart, 2006; Walton et al., 2015). Social justice must also be better integrated into Science, Technology, Engineering and Mathematics (STEM) in order to attract those who have faced social injustice. Gibbs and Griffin (2013) found that among post-doctoral scholars non-URM (under-represented minority) scientists often cited freedom to choose their own research topics as a main reason to pursue a faculty career, whereas URM post-doctoral scholars were more often driven by goals such as mentoring students like themselves and addressing health problems in their communities. Garibay (2015), in a study comprising 6100 undergraduates found that equity, social justice, helping others through their work and working for social change, were more important to URM STEM students than their non-URM peers. Ebony McGee (2020) has concluded from these

studies that “Justice-oriented STEM is the key to getting and keeping BIPOC in STEM.” While it is critical to understand factors affecting participation in science, it is necessary to start with an understanding of who is represented in scientific fields before we can begin to address the experiences of scientists. This paper therefore focuses on the demographics of those studying and working in physics in Canada.

Methods

Survey Design

To participate in the survey, respondents were required to either 1) be pursuing a physics degree at a Canadian institution, or 2) hold a physics degree and be working/residing in Canada, as of November 2020. This approach was chosen in order to include a wide array of respondents and capture the experiences of those who have left the field. The majority of this population can be generally divided into undergraduate students, graduate students, postdoctoral fellows, research staff, faculty, or working professionals in government or the private sector. In order to estimate the population required to achieve a 95% confidence level and 3% confidence interval, the Canadian Association of Physicists contacted the representative heads of all Canadian institutions offering a physics degree (N=60) requesting group populations as of Oct 19, 2020. Responses were received from 64% of institutions, and used alongside enrolment rates, degree length, and historical data to project estimated total populations for all groups shown in Table 1. With regards to industry and government positions, given approximately 1100 physics undergraduates graduating each year (Strickland, 2017), and approximately 40% beginning a career in industry or government (Robertson & Steinitz, 1997), assuming an average work

lifespan of 25 years yields a total cohort of 11,000 physicists employed in the private sector or government.

Given these data and assumptions, we projected the estimated total populations (weighted by degree enrolment and average degree completion time) and calculated the corresponding survey responses required in order to achieve a 95% confidence level and 3% confidence interval (Table 1).

The survey was constructed on a private organizational account owned by the Canadian Association of Physicists (CAP). All information was routed in Canada and stored on Canadian servers. Privacy and confidentiality were ensured by separating personally identifiable participant information, and an API linking system was designed to connect individual responses for data analysis. The survey was piloted for length and averaged 10.4 minutes to complete (N=24) the 38-51 questions (range due to branching structure), which fell within the expected range of 10-15 minutes.

Group	Estimated Population	Responses required
Undergraduate Students	3000	787
M.Sc. Students	500	341
Ph.D. Students	500	341
Postdoctoral Fellows	450	317
Research Staff	300	234
Faculty	1000	516
Private Sector + Government	11000	973

Table 1: Estimated populations of Canadian physics community sub-groups.

Survey Procedure

Invitations to fill out the survey were sent out via email to all members of the Canadian Association of Physicists (CAP), every post-secondary physics department in the country, institutional partners (e.g. Perimeter Institute, SNOLAB, TRIUMF, CLS, IQC, SBQMI), CAP's network of high school physics teachers, industrial partners, and sister professional associations (e.g. COMP, CASCA). All survey participants were encouraged to share the survey link with any other physics students or physicists in their networks. The survey was available in French and English. French entries (9.8%) were translated into English prior to analysis.

The recruitment email described the survey process and emphasized participant confidentiality and anonymity. Participation was voluntary, lasted approximately 10 to 15 minutes, and the survey was completed entirely online. After providing informed consent, participants completed various qualitative and quantitative measures assessing demographic characteristics. At the end of the survey, participants were thanked for their time and given the option to enter their email into a draw for a chance to win one of five \$100 gift cards, and were informed that this data would be stored separately from their survey responses.

As participation was voluntary and based in part on snowball recruitment, findings should not be interpreted as representative of the full physics community in Canada, but rather as a subset of the community who volunteered. This approach was chosen over a CAP member census in order to mitigate the perception of coercion and reach a larger portion of the physics community, including non-members of the Association.

Materials

Participants were asked to provide information regarding employment, education, and personal demographic characteristics. Some demographic information (e.g., gender, race,

sexuality), was recorded or collapsed into overarching variables; for example, racialized groups were at times combined into a BIPOC (Black, Indigenous, People of Colour) category to obtain the statistical power needed to conduct inferential comparisons. While this practice is not ideal, we did so to preserve respondent anonymity and to allow for statistical analyses with smaller numbers. Data in free-form responses was de-identified where appropriate in order to protect respondent anonymity.

To obtain insights about the demographics of physics students and physicists in Canada, respondents were asked to specify their gender identity, sexual identity, age bracket, race/ethnicity, disability status, first language, and immigration status. Respondents were asked to identify which province or territory they primarily lived in, primary position(s) in academia or the private sector, highest education level, education field and future plans, and research field. The results section that follows only includes analyses pertaining to respondent demographics, with a focus on students as they comprised the largest proportion of respondents. Additional information about career contexts for professionals is included in Supplementary Information.

Results and Discussion

Responses were retained for analysis if participants completed the study in full. Duplicate cases were removed ($n = 9$) prior to analysis, leaving a final sample of $N = 2532$. In the following, we compare the demographics of students and professionals to build a picture of the future of the Canadian physics community and identify strategies to promote diversity and inclusion. We focus on the student population as they constituted the largest proportion of survey respondents (895 undergraduate students, 633 graduate students). Given the estimated total number of physics students in Canada (Table 1), our sample is large enough to provide a

representative snapshot of these communities. Our sample size for working professionals was not as high ($n = 1002$), but nevertheless provides an acceptable comparison group for analysis. Given the scarcity of data on representation of physics students and physicists in Canada, this analysis focuses on demographic variables.

Survey responses were received from every region of Canada, including a small number from Northern Canada. Self-reported locations were Ontario (42.2%), Quebec (17.7%), British Columbia (16.2%), Alberta (9.2%), Nova Scotia (5.6%), Saskatchewan (2.3%), Outside Canada (2.3%), Manitoba (1.5%), New Brunswick (1.5%), Newfoundland (1.1%), Prince Edward Island (.3%), Northwest Territories (.1%), and Did Not Answer (.1%). Responses were received from over 75 physics departments, research institutes, and from those in the private sector and government. When asked about field of education, most respondents selected multiple areas (37.6%), followed by physics (general; 22.7%), reflecting the multidisciplinary nature of participants' education paths. A selection of the main demographics is presented here, with additional data included in Supplementary Information.

This survey provided the first data in Canada pertaining to the participation of Black and Indigenous students and researchers in physics. Just 1.2% of respondents identified as only Black, while 0.3% identified as only Indigenous. Another 1.1% identified as Indigenous and another racial identity, and another 0.4% identified as Black and another racial identity. According to Statistics Canada (2023; 2021 census) 4.3% of the Canadian population is Black, and 5% is Indigenous (Government of Alberta, 2023). Based on current data, we find a severe lack of representation of Black and Indigenous physics students and physicists among respondents in Canada. Figure 1 shows the racial identities of respondents in the total sample, as

well as among students and professionals; respondents in both groups overwhelmingly identified as White.

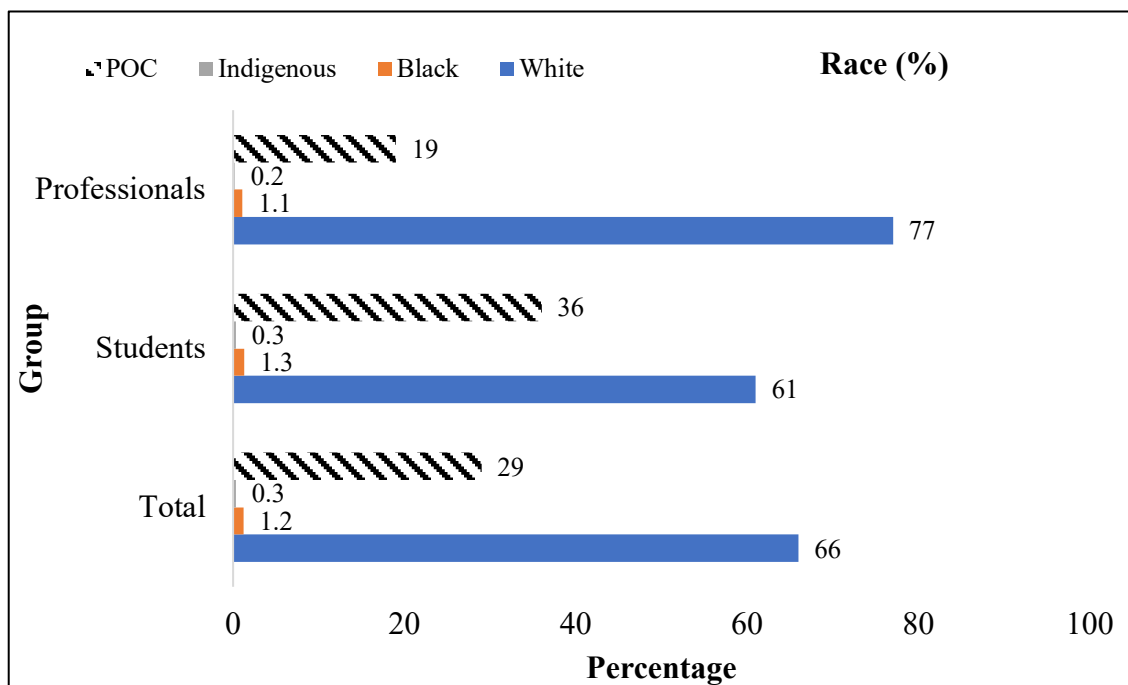


Figure 1. Populations of Indigenous, Black, POC, and White survey respondents, shown in total as well as split between Students and Professionals in this chart. Note: POC = Chinese, Japanese, Korean, West Asian, Southeast Asian, Arab, Latin American, Filipino, South Asian, Multiple selected (multiracial), and those who preferred to self-describe and indicated a racialized identity. Black = those who selected only Black. Indigenous = those who selected only Indigenous.

Our survey also provided the first Canadian data on the representation of gender-diverse students and professionals in the physics community, i.e., non-binary, two-spirit, genderqueer or gender non-conforming, transgender (if gender was not specified), and open-ended self-described gender identities. Figure 2 shows the gender identities of respondents in the total sample, as well as among students and professionals. Gender diverse people are a larger

proportion of our dataset (3.5% of the total sample) compared to the general population in Canada (.33% are transgender and non-binary; 2021 census), particularly among students. While youth in Canada are more likely to be gender diverse, .79% of Canadians aged 15 to 24 identified as nonbinary or transgender; (Statistics Canada, 2022), we find an abundance of gender diverse students in the current sample.

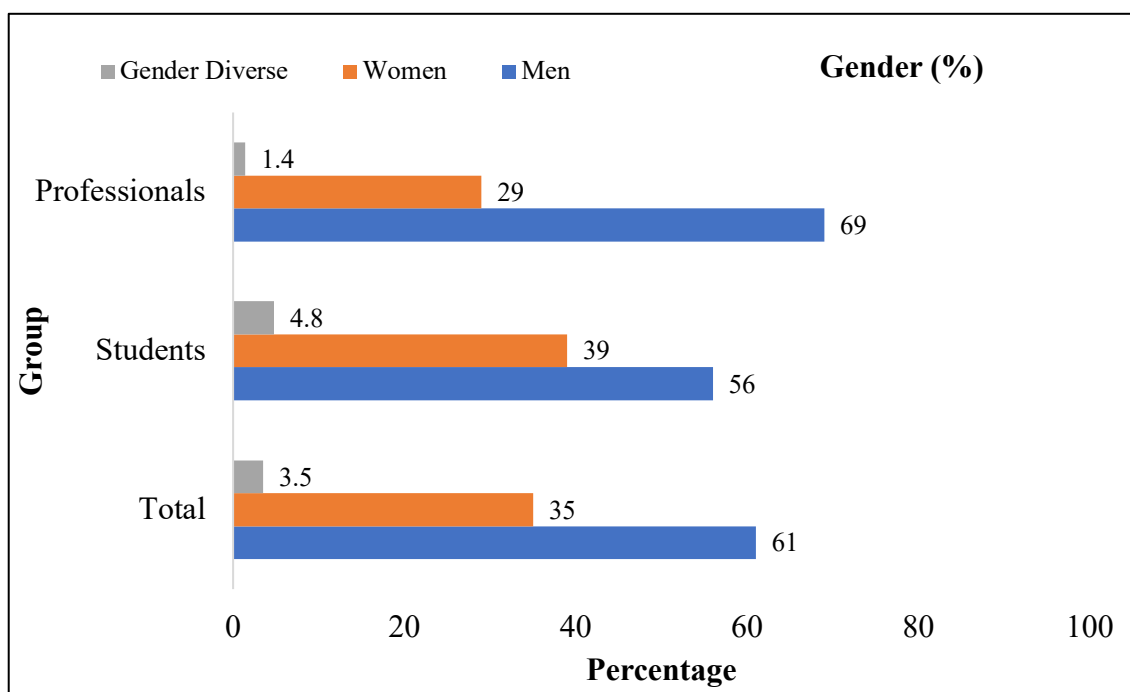


Figure 2: Distributions of survey respondents who are Students and Professionals, split based on gender identity.

Notes. Gender diverse = those who selected two-spirit, non-binary, transgender (only if gender was not specified), genderqueer, gender non-conforming, and multiple gender identities.

While women comprised a moderate proportion of participants, men constituted the largest proportions of student and professional respondents, despite being just under half of the entire Canadian general population. According to data from Statistics Canada, in 2021, cisgender

men comprised about 49% of the general Canadian population, and cisgender women comprised about 51% (Statistics Canada, 2021). Our data are therefore consistent with international statistics showing the overrepresentation of men in physics (Institute of Physics, 2022; American Institute of Physics, 2022). Among students, close to 5% identified as gender diverse, compared to just 1.4% among working professionals.

Looking more closely at intersectional identities, we analysed the proportion of White and BIPOC respondents (i.e., Black, Indigenous, People of Colour) along dimensions of gender identity. While categorizing respondents broadly into BIPOC and White groups does not acknowledge the nuanced and varied experiences within the BIPOC community, we make this simplification at times in this report for three central reasons; 1) to provide enough statistical power to compare White and BIPOC participants in a predominantly White sample, 2) to further research that has evidenced the prevalence of race-based discrimination in physics (e.g., American Institute of Physics, 2020; Malcom & Malcom, 2011; Ong, et al., 2011), and 3) to provide foundational results to the physics community that can serve as the basis for pursuing identity-specific research (i.e., focusing on Black physicists).

We also draw out specific statistics for Black and Indigenous respondents, in particular because these groups are the least represented overall, and have unique experiences and barriers to pursuing physics in the current landscape (AIP 2020, Herkimer 2021). Post-secondary education is a part of an interconnected system that reproduces and amplifies social, historical, and racial inequities that continue to impact the schooling and careers of Black and Indigenous Canadians. Black students are disproportionately streamed into Applied and Essentials programs of study as early as Grade 10, which significantly impacts their ability to pursue post-secondary education, particularly within STEM fields (James & Turner, 2017). Further, Black and

Indigenous physics students rarely see themselves represented among their teachers and faculty, a factor which significantly decreases their likelihood to pass their courses and pursue a university degree (CAUT 2018, Gershenson et al., 2017, Odle et al. 2022). Indigenous students in particular are more likely to leave their post-secondary education early, with one U.S. study finding that only 8% of these cases are due to academic failure, indicating how our education systems fail to adequately support Indigenous students in these environments (Bernardo et al. 2016., Martinez 2014). More research is required on the unique challenges that Black and Indigenous physics students face, and how these impact their education and career pathways.

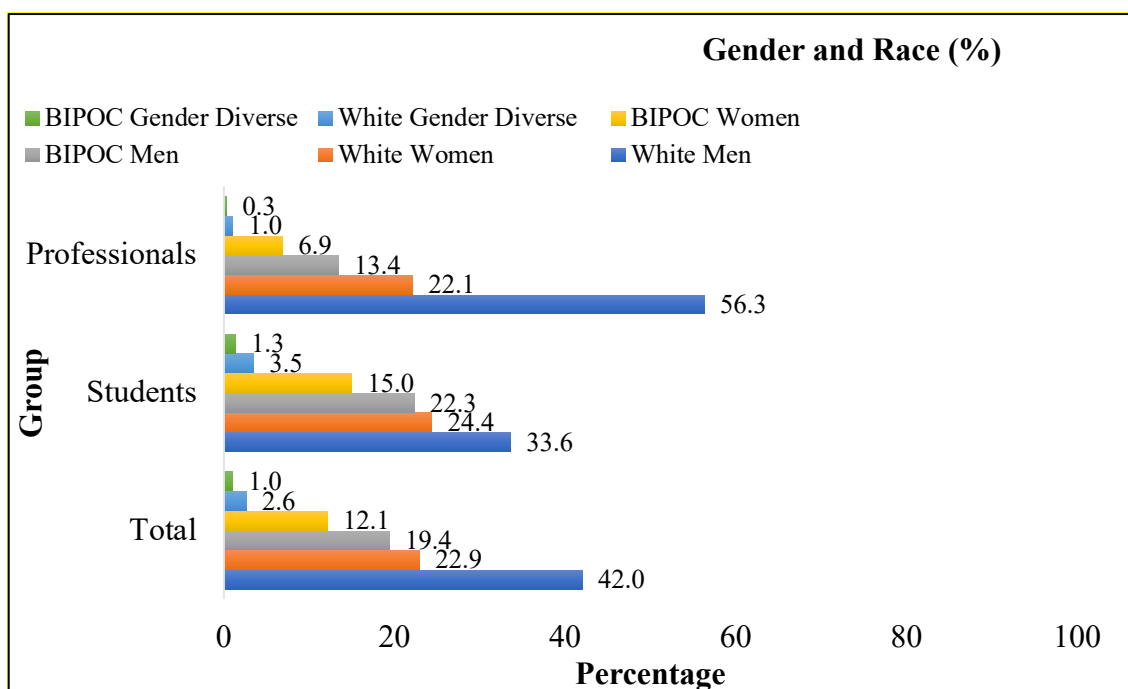


Figure 3: Professionals, Students, and the total survey respondent population shown grouped by gender and race.

Notes: BIPOC = Black, Indigenous, and People of Colour. Gender diverse = those who selected two-spirit, non-binary, transgender, (only if gender was not specified), genderqueer, gender non-conforming, and multiple gender identities.

As illustrated in Figure 3, White men were the majority of respondents among students as well as professionals. However, among student respondents, there was greater representation of diverse and intersecting identities compared to more senior or professional positions. For example, compared to students, among physics faculty (not all working professionals), 64% of survey respondents identified as White men. According to Statistics Canada, close to 70% of the Canadian population is White, split almost equally between men and women (Statistics Canada, 2022). The proportion of White women was roughly consistent across students and working professionals (24% vs. 22% respectively), whereas the proportions of BIPOC men, BIPOC women, and gender-diverse physicists was notably lower among working professionals than students. For example, among students, 22% identified as BIPOC men compared to 13% among working professionals, and 15% identified as BIPOC women compared to 7% of working professionals, representing close to a 2:1 ratio. Given the current demographics of students who could reach the senior ranks of physics faculty in two decades, while there will be more demographic diversity overall, there will likely not be proportional representation even twenty years from now. Indeed, projections from Statistics Canada estimate that by 2041, the racialized population could account for 38% to 43% of the Canadian population (Statistics Canada, 2022). In 2021, this proportion was approximately 30%.

Another important first for this project was the collection of data about the sexual orientation of physics students and physicists in Canada. As shown in Figure 4, most respondents identified as heterosexual (80%), both among students (74%) and professionals (89%). However, we find notable differences in the proportions of those who identify as sexually diverse (i.e., asexual, bisexual, gay, lesbian, pansexual, questioning, queer, and prefer to self-describe) between students and professionals. Among students, there are more than twice as many sexually

diverse respondents (26% vs. 11% respectively). This finding is somewhat expected, given that nationally, almost one-third of self-identified 2SLGBTQIA+ Canadians are under 25 years old (Statistics Canada, 2021). Among professionals, the current survey also shows a larger representation of sexually diverse people compared to the general Canadian population, in which 4% identify as part of the 2SLGBTQIA+ community (Statistics Canada, 2022).

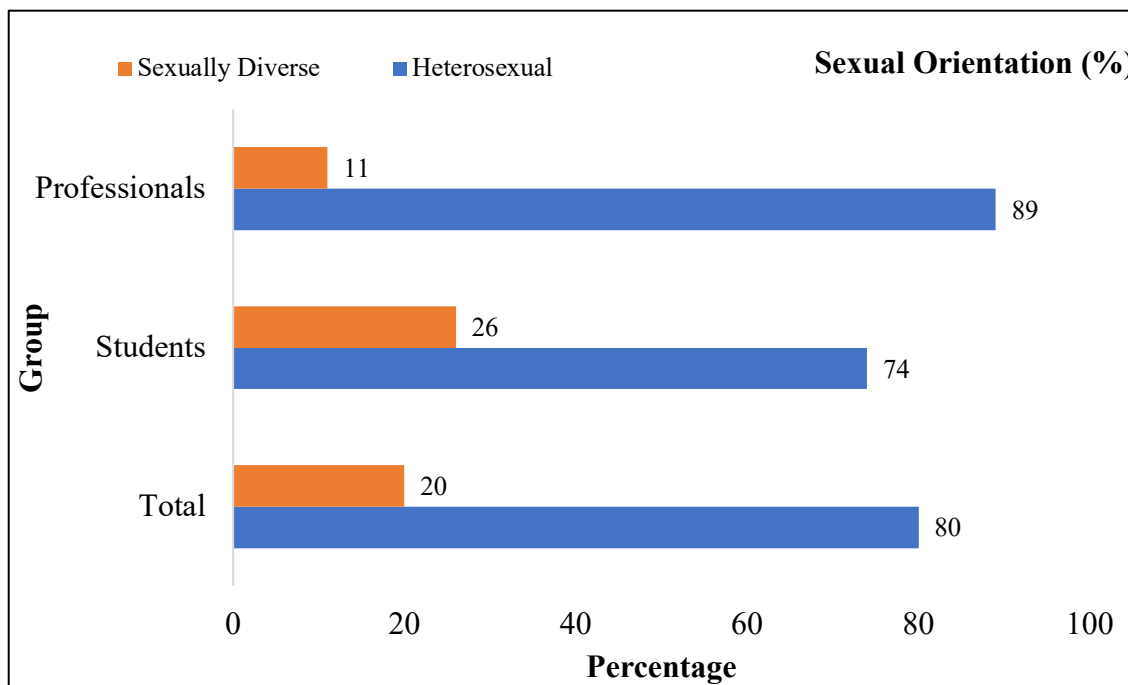


Figure 4: Survey respondents split by Student and Professional status, grouped here by sexual orientation. Notes. Sexually diverse = those who selected asexual, bisexual, gay, lesbian, pansexual, queer, questioning, prefer to self-describe, and multiple sexual orientations.

At the intersections of sexual orientation, gender identity, and race, our data show that women in physics comprise the majority of sexually diverse respondents, and that this is consistent across racial groups. Among both White women and BIPOC women, sexually diverse respondents were more than three times the proportion found in the general Canadian population.

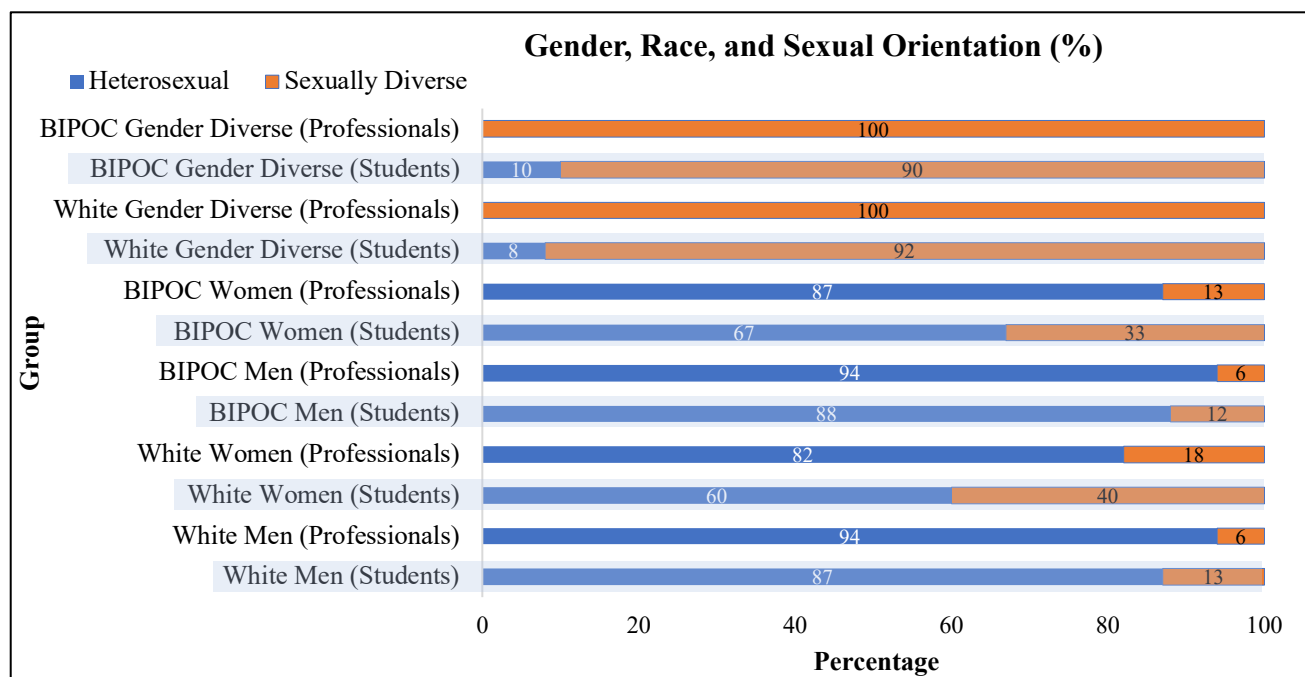


Figure 5: Survey respondents split by Student/Professional status, gender, race and sexual orientation. Notes: Sexually diverse = those who selected asexual, bisexual, gay, lesbian, pansexual, queer, questioning, prefer to self-describe, and multiple sexual orientations. BIPOC = Black, Indigenous, and People of Colour. Gender diverse = those who selected two-spirit, non-binary, transgender (only if gender was not specified), genderqueer, gender non-conforming, and multiple gender identities.

When sexually diverse respondents are further disaggregated, we find that the majority identified as bisexual, and this finding held for BIPOC and White women (12% in both groups). We also find that among students, bisexual women (15%) far outnumbered bisexual men (4%); a finding in line with, and even more pronounced, than recent Statistics Canada data showing that bisexual women (332, 000) outnumbered bisexual men (161, 200) approximately 2 to 1 (Statistics Canada, 2021) in the general population. The strong representation of bisexuality among physicists has also been shown in data collected via the Institute of Physics Member

Diversity Survey, such that in 2019, 11% of respondents identified as 2SLGBTQIA+, with bisexuality having the largest representation (6%; Institute of Physics, 2022).

Finally, we also collected the first data on disability within the Canadian physics community. When asked about disability, 7% of respondents identified as disabled¹. Among students the proportion of disabled respondents was 8%, while among professionals it was 5%. According to the Canadian Survey on Disability (2017), approximately 22% of working-age Canadians (25-64) reported having a disability (Statistics Canada, 2022), suggesting that the current data reflects a low level of representation of disabled people in the Canadian physics community. Figure 6 shows the proportion of participants who reported being disabled across gender and racial identities. Overall, we find that the proportions of disabled people are largest among those with diverse gender identities, particularly among White gender diverse students and professionals. Notably, a quarter of respondents from BIPOC gender diverse backgrounds identified as being disabled, underscoring the importance of disaggregating data along multiple dimensions of identity. Women were more likely than men to identify as disabled among both students and working professionals, a finding in agreement with the Canadian Survey of Disability (2017). Across all but one group of respondents (i.e., White gender diverse), students were more likely to identify as disabled than professionals, which could reflect a greater willingness to identify as disabled among younger cohorts, but could also be a result of those with a disability leaving physics, or having fewer opportunities to pursue physics in the past due to inaccessibility; additional data is required to tease apart these hypotheses.

¹We recognize the ongoing discourse about using identity-first versus person-first language in relation to disability. Guided by findings from a recent study showing that identity-first language was preferred by 49% of disabled people across 23 countries (<https://dl.acm.org/doi/pdf/10.1145/3517428.3544813>) we use the words 'disabled people' in this report.

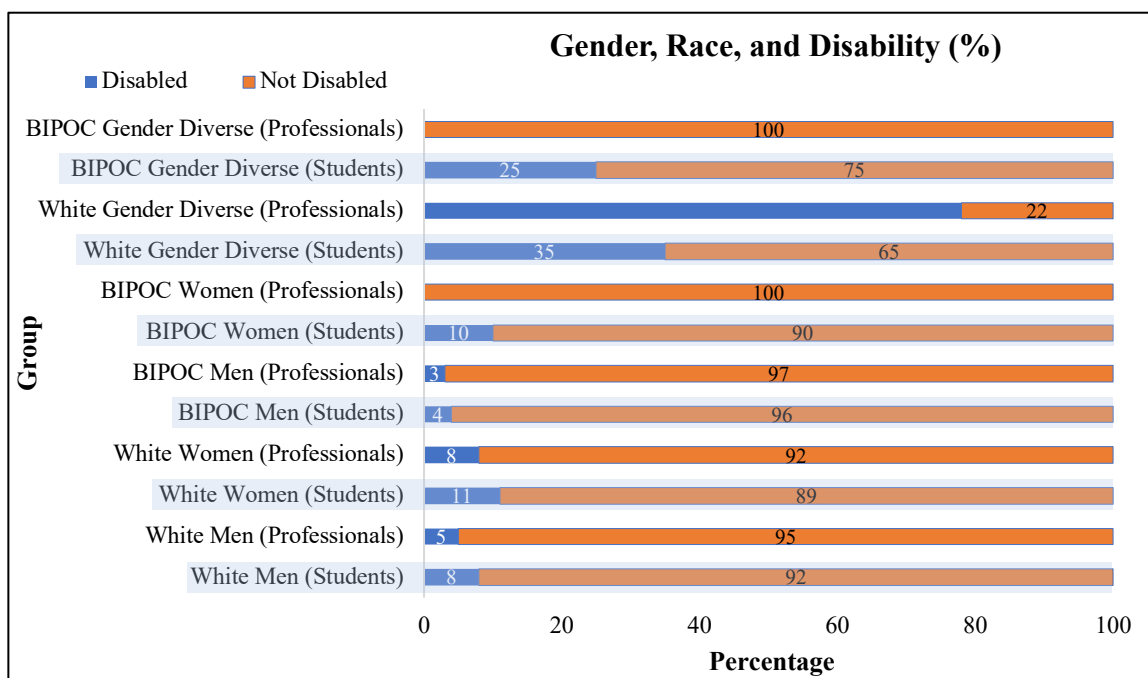


Figure 6: Survey respondents split by Student/Professional status, gender, race, and disability. Notes. BIPOC = Black, Indigenous, and People of Colour. Gender diverse = those who selected two-spirit, non-binary, transgender (only if gender was not specified), genderqueer, gender non-conforming, and multiple gender identities.

Figure 7 shows the proportion of respondents who reported having a disability across sexual orientations among students and professionals. Here we find that the proportion of disabled respondents is largest among sexually diverse students, and this proportion is somewhat consistent with sexually diverse professionals. Similarly, the proportion of disabled respondents is comparable among heterosexual respondents, both students and professionals. The current data therefore point towards an important intersection of sexual diversity and disability that should be further researched in the Canadian physics community. Indeed, we find that the proportion of sexually diverse students who reported having a disability was more than three times higher than the proportion of heterosexual students with a disability.

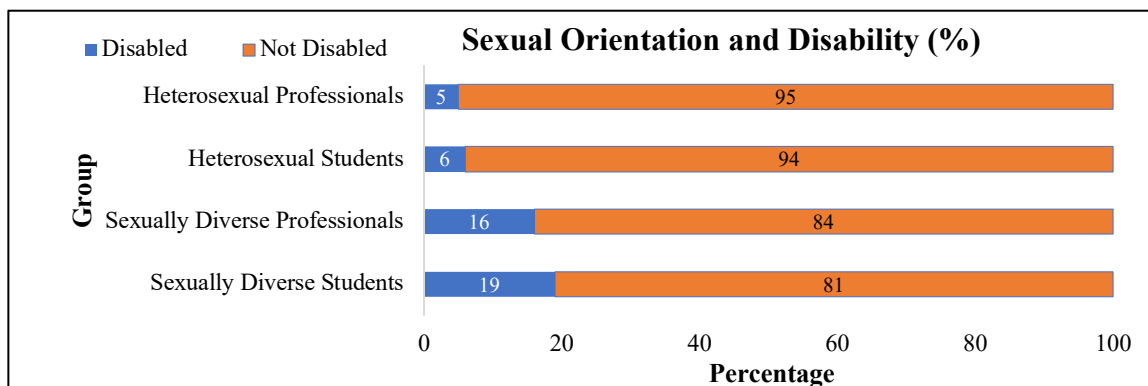


Figure 7: Survey respondents split by Student/Professional status, sexual orientation, and disability. Notes. Sexually diverse = those who selected asexual, bisexual, gay, lesbian, pansexual, queer, questioning, prefer to self-describe, and multiple sexual orientations. Disabled = self-identified as such.

Many disabled Canadians require some level of accommodations at their place of work or study in order for it to function better for them in consideration of their needs. Among those who identified as having a disability, 5% reported receiving full accommodations at their place of work or study, whereas 25% reported receiving adequate accommodations, 14% reported having received partial, inadequate accommodations, 3% chose to enter a free-form text response with additional detail, and 53% reported they had not sought any accommodations. Among students, the proportion of those who reported receiving full accommodations was larger than that among professionals (5.5% vs. 4.5% respectively). The Canadian Survey on Disability reported that almost 60% of working-age disabled people require a workplace accommodation, the most common of which was modified or reduced work hours, which 41% of potential workers needed (Statistics Canada, 2012). The majority (80%) of disabled workers who requested accommodations had their needs at least partially met. Our results show lower rates of accommodation requests, which may reflect underrepresentation of more severe disabilities which are more likely to require workplace accommodations, a lack of systems to make such

requests, or a low belief in their likelihood of being granted, likely a combination of all three factors. The rate of partially-or-fully-met accommodations among both students and professionals was approximately in line with CSD data (Statistics Canada, 2012). It must be considered, however, that many disabled people (45%) do not ask for workplace accommodations despite potentially benefiting from them; the most commonly cited reasons are that they feel uncomfortable asking (33%) or they fear a negative outcome (33%). In addition, despite modified/reduced hours being the most common accommodation needed, it is also the reason most frequently cited for difficulty advancing in employment (Statistics Canada, 2012). While buildings and workplaces are becoming more accessible in general, it is clear that there are many barriers that disabled students and working professionals encounter, particularly when requesting accommodations at their place of work or study – and physics environments are no exception.

Conclusions, Limitations, and Future Research

The present research has provided a wealth of new information about the physics community in Canada that was not previously known. With responses from every region in the country and a robust sample of respondents, this work revealed several key findings. It is notable that the majority of respondents were students, which suggests that students in physics demonstrated a higher degree of buy-in when it came to thinking about their identities, as well as being able to devote the time and effort required to participate. Indeed, the physics students of today are the physicists of tomorrow, so the fact that student respondents were motivated to participate in a voluntary equity, diversity, and inclusion survey indicates an openness to inclusion work that we hope persists into their professional and academic trajectories. Given that

physics students value empathy and identity (Stiles-Clarke & MacLeod; American Institute of Physics, 2020), that Canadian post-secondary institutions are working to improve inclusion (Universities Canada, 2023), and funding agencies are embedding EDI into their programs (Government of Canada, 2023), it is incumbent upon researchers to embrace EDI principles in their scientific practice.

In addition to a high level of responsiveness among students, our research also showed greater demographic diversity among students versus professionals. This difference could be due to a multitude of factors. For example, it could be that the efforts to make the physics environment more inclusive have been successful, or, this could be a reflection of the growing demographic diversity of students in post-secondary education in Canada in general, such as through the increase in international students (Choi, Crossman, & Hou, 2021). Regardless of why we found more demographic diversity among students than professionals, our findings serve as a call to action in the physics community in Canada to enact strategies that can retain these diverse students.

Our research shows a serious lack of Black and Indigenous people among respondents, underscoring the importance of specific recommendations put forth in the Scarborough Charter to support the recruitment, retention, and flourishing of Black scholars (University of Toronto, 2022). In the present work, when we disaggregated the BIPOC data to consider Black and Indigenous respondents specifically (i.e., BI), we found stark differences in their representation compared to POC, challenging the notions of racialized homogeneity that assume all racialized people have similar experiences. Indeed, there is evidence that not all racialized people are represented or rewarded equally in science; for example, research shows that Asian men are overrepresented in science jobs and tend to earn higher salaries than other racial groups (Fry,

Kennedy, & Funk, 2021). We therefore recommend that future researchers adopt a similar disaggregating approach when analysing data about the physics community in Canada, so that the most notable disparities are evident.

The present research also revealed gender diversity among respondents in physics, particularly among students. Despite this diversity, White men still comprised the largest proportion of respondents, which is not unique to the Canadian physics context (see American Physical Society and the Integrated Postsecondary Education Data System, 2022; Bruun, Willoughby, & Smith, 2018). White men can play an important role in work striving to make science more inclusive as they comprise the majority of the physics community (including most senior leadership roles), and are therefore well-positioned to advocate for institutional change. White men who are more senior and established in their physics careers also have an opportunity to leverage power and may face fewer consequences for doing so; men who confront sexism are evaluated more positively (vs. women), and their confrontations are seen as more legitimate (Drury & Kaiser, 2008). We invite White men in physics to be active in EDI work, so that efforts to build a more inclusive physics community in Canada include all stakeholder groups, including allies (or accomplices). If all stakeholders focus efforts on how they can contribute to meaningful, systemic change, it is possible for the physics community to transform into a more just, accessible, and equitable environment.

An interesting finding in the current research was the relatively consistent representation of White women among students and professionals. On the one hand, it is possible that such representation is a result of successful employment equity interventions, in line with the assertion that White women have benefited more than other demographic groups from employment equity and/or affirmative action programs and policies in North America (Wise, 1998). This finding

highlights the importance of rethinking current initiatives and developing more intersectional strategies that will also benefit racialized women or women with intersecting identities in science. Most importantly, it spurs us to ask what can be done to improve and maintain demographic diversity in the physics community in Canada.

Another noteworthy contribution of the current study is data about sexual orientation in the physics community in Canada. Interestingly, we found that among respondents, sexually diverse people were far more represented compared to the national average, especially among students. When further parsing apart this result, the data revealed that the largest proportion of sexually diverse respondents were bisexual women. In general, research shows that people have more positive attitudes towards bisexual women than bisexual men (Friedman et al., 2014), so this result could be attributed to women feeling safer to disclose their sexual identities than men, however, this is merely speculative. Further research is needed to truly understand if and why the physics community has a larger proportion of sexually diverse people than the national average. Our research also draws attention to the need for intersectional analyses of physics identities. For example, those at the intersections of disability, gender diversity, and sexual orientation report unique and overlapping experiences of oppression (Alimi & Abbas, 2019). If we are to strive for the inclusion of diverse voices in physics in Canada, our efforts must not only include, but prioritize the safety and participation of the most marginalized.

While our results have provided valuable new insights, the present study has some limitations. For example, the data included in this report was collected using a snowballing recruitment method, which limits the generalizability of findings as responses reflect the identities of a subset of volunteers who chose to respond. Thus, it is imperative that more systemic data be collected in Canada to ensure that information accurately reflects the

demographics of the physics community. Another limitation of the present work is that at times in our analyses, women and demographically diverse physicists were combined to preserve anonymity and provide enough statistical power for inferential group comparisons. While these decisions are justifiable methodologically and ethically, by combining women and other demographically diverse people, we risk upholding the narrative that these groups have homogenous identities or experiences. To gain a complete picture of the barriers and bridges for participation it would be instructive to investigate participation in high school physics, including the early crucial Grade 10 year when decisions are made with respect to pursuing physics. While representation is an important starting place, it is essential to move beyond the numbers to dig deeper into experiences that influence attraction and retention in the Canadian physics community. Despite these limitations, we are confident that the present findings can be useful and informative for educators, researchers, and policy makers, as well as physics students and physicists in Canada.

Acknowledgements

Hewitt and Smolina conceived the project. Smolina developed the questions and survey instrument. Hewitt is the PI on the project, wrote and obtained Research Ethics board approval from Dalhousie University under REB 2020-5261. Ghose is the PI on the NSERC CWSE grant that supported the research analysis and manuscript preparation. The Canadian Association of Physicists partnered with Hewitt and Smolina to communicate the survey to the community of physicists in Canada – those pursuing or possessing higher degrees in Physics. Hennessey, Hennessey, Tassone, Jay and Ghose (the WinS team), and Smolina conducted the main analysis. Hennessey & Ghose wrote the initial version of the manuscript, with edits from Smolina, and Hewitt. Hennessey and Smolina are joint first authors of this work.

Hewitt acknowledges that his work is done in Kjiptuk (Halifax), which is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People. This territory is covered by the “Treaties of Peace and Friendship” which Mi'kmaq Wəlastəkwiyik (Maliseet), and Passamaquoddy Peoples first signed with the British Crown in 1726. The treaties did not deal with the surrender of lands and resources but in fact, recognized Mi'kmaq and Wəlastəkwiyik (Maliseet) title and established the rules for what was to be an ongoing relationship between nations on Mi'kma'ki.

Smolina acknowledges that her work is done at The University of Toronto, the Hospital for Sick Children, and the Mouse Imaging Centre, which reside on the traditional lands of the Huron-Wendat, the Seneca, and the Mississaugas of the New Credit First Nation. These territories are protected by the “Dish With One Spoon” wampum agreement, which all guests of this land have a responsibility to honour and uphold.

The WinS team acknowledges that their work is done on the shared traditional territory of the Neutral, Anishnaabe and Haudenosaunee peoples. This land is part of the Dish with One Spoon Treaty between the Haudenosaunee and Anishnaabe peoples and symbolizes the agreement to share, protect our resources and not to engage in conflict.

References

- Alimi, S., & Abbas, J. (2019, May). Health Issues for LGBTQ2 People with Disabilities: A Brief Prepared for the Standing Committee on Health (HESO) for their study on LGBTQ2 Health in Canada. DisAbled Women's Network of Canada. Retrieved online from:
<https://www.ourcommons.ca/Content/Committee/421/HESA/Brief/BR10503899/external/DisAbledWomensNetworkOfCanada-e.pdf>.
- American Institute of Physics (2020). *The time is now: Systemic changes to increase African Americans with bachelor's degrees in physics and astronomy*. The AIP National Task Force to Elevate African American Representation in Undergraduate Physics & Astronomy (TEAM-UP). Retrieved from:
<https://www.aip.org/sites/default/files/aipcorp/files/teamup-full-report.pdf>.
- American Institute of Physics (2022). The number of Doctorates earned in Physics, 2014-15 to 2018-19. Retrieved online from: <https://www.aip.org/statistics/resources/number-doctorates-earned-physics-2014-15-2018-19>.
- American Physical Society and the Integrated Postsecondary Education Data System (2022). *Physics degrees by race/ethnicity*. Retrieved online from:
<https://www.aps.org/programs/education/statistics/degreesbyrace.cfm>

- Aycock, L. M., Hazari, Z., Brewes, E., Clancy, K. B., Hodapp, T., & Goertzen, R. M. (2019). Sexual harassment reported by undergraduate female physicists. *Physical Review Physics Education Research*, 15(1), 010121.
- Banchefsky, S., & Park, B. (2018). Negative gender ideologies and gender-science stereotypes are more pervasive in male-dominated academic disciplines. *Social Sciences*, 7(2), 27.
- The British Royal Society. (2013). Exploring the Impact of Socio-Economic Background on Careers in Science. Retrieved online from:
https://royalsociety.org/-/media/Royal_Society_Content/policy/projects/leading-way-diversity/picture-uk-scientific-workforce/070314-tbr-exploring-the-impact-of-socio-economic-background-on-careers-in-science-report-doc.doc
- Bernardo, A., Esteban, M., Fernandez, E., Cervero, A., Tuero, E., & Solano, P. (2016). Comparison of personal, social and academic variables related to university drop-out and persistence. *Frontiers in Psychology*, 7, 1- 9. <http://doi.org/10.3389/fpsyg.2016.01610>
- Bruun, M., Willoughby, S., & Smith, J. L. (2018). Identifying the stereotypical who, what, and why of physics and biology. *Physical Review Physics Education Research*, 14(2), 020125.
- Canadian Association of Physicists (2023). Annual Department Survey Results. Retrieved online from: <https://cap.ca/wp-content/uploads/2023/07/CAP-Departmental-Survey-Report-20231.pdf>.
- Canadian Association of University Teachers (2018). Underrepresented & Underpaid Diversity & Equity Among Canada's Post-Secondary Education Teachers. Retrieved online from: https://www.caut.ca/sites/default/files/caut_equity_report_2018-04final.pdf
- Chan, P.C.W., Handler, T., & Frenette, M. (2021). Gender differences in STEM enrolment and

- graduation: What are the roles of academic performance and preparation? Retrieved online from: <https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021011/article/00004-eng.htm>. DOI: <https://doi.org/10.25318/36280001202101100004-eng>.
- Choi, Y., Crossman, E., & Hou, F. (2021). International students as a source of labour supply: Transition to permanent residency. Retrieved online from: <https://www150.statcan.gc.ca/n1/en/pub/36-28-0001/2021006/article/00002-eng.pdf?st=51FzmWaW>).
- Clancy, K. B. H., Nelson, R.G., Rutherford, J.N., & Hinde, K. (2014). Survey of academic field experiences (SAFE): Trainees report harassment and assault. *PLoS ONE* 9 (7): e102172.
- Clark, U. S., & Hurd, Y. L. (2020). Addressing racism and disparities in the biomedical sciences. *Nature Human Behaviour*, 4(8), 774-777.
- Crenshaw, K. (1988). Race, reform and retrenchment: Transformation and legitimation in anti discrimination law. *Harvard Law Review*. 101: 1331-1387.
- Dengate, J., Farenhorst, A., Peter, T., & Franz-Odendaal, T. (2021). Gender inequality in research and service amongst natural sciences and engineering professors in Canada. *International Journal of Gender, Science and Technology*, 13(1), 23-42.
- Drury, B. J., & Kaiser, C. R. (2014). Allies against sexism: The role of men in confronting sexism. *Journal of Social Issues*, 70(4), 637-652.
- Friedman, M. R., Dodge, B., Schick, V., Herbenick, D., Hubach, R. D., Bowling, J., ... & Reece, M. (2014). From bias to bisexual health disparities: Attitudes toward bisexual men and women in the United States. *LGBT Health*, 1(4), 309-318.

Fry, R., Kennedy, B., & Funk, C. (2021). STEM Jobs See Uneven Progress in Increasing Gender, Racial and Ethnic Diversity. Retrieved online from:

<https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/>.

Garibay, Juan C (2015). STEM students' social agency and views on working for social change:

Are STEM disciplines developing socially and civically responsible students? *Journal of Research in Science Teaching*. 52 (5), 610-632

Gershenson, S., Lindsay, C.A., Hart, C.M.D., & Papageorge, N.W. (2017, March). The Long-Run Impacts of Same-Race Teachers. IZA Institute of Labor Economics: Discussion Paper Series. Retrieved from

http://legacy.iza.org/en/webcontent/publications/papers/viewAbstract?dp_id=10630

Gibbs, K. D., & Griffin, K. a. (2013). What do I want to be with my PhD? The roles of personal values and structural dynamics in shaping the career interests of recent biomedical science PhD graduates. *CBE Life Sciences Education*, 12(4), 711–723.

Government of Alberta (2023). 2021 Census of Canada - Indigenous People. Retrieved online from: [https://open.alberta.ca/dataset/487a7294-06ac-481e-80b7-](https://open.alberta.ca/dataset/487a7294-06ac-481e-80b7-5566692a6b11/resource/257af6d4-902c-4761-8fee-3971a4480678/download/tbf-2021-census-of-canada-indigenous-people.pdf)

[5566692a6b11/resource/257af6d4-902c-4761-8fee-3971a4480678/download/tbf-2021-census-of-canada-indigenous-people.pdf](https://open.alberta.ca/dataset/487a7294-06ac-481e-80b7-5566692a6b11/resource/257af6d4-902c-4761-8fee-3971a4480678/download/tbf-2021-census-of-canada-indigenous-people.pdf).

Government of Canada (2023). Best practices in equity, diversity and inclusion in research practice and design. Retrieved online from: <https://www.sshrc-crsh.gc.ca/funding-financement/nfrf-fnfr/edi-eng.aspx>.

Hango, D. W. (2013). *Gender differences in science, technology, engineering, mathematics and computer science (STEM) programs at university*. Statistics Canada.

Institute of Physics (2022). Written evidence submitted by the Institute of Physics (IOP) (DIV0033). Retrieved online from:

<https://committees.parliament.uk/writtenevidence/42480/pdf/>.

Henry, F., Dua, E., James, C., Kobayashi, A., Li, P., Ramos, H., Smith, M. (2017). *The Equity Myth: Racialization and Indigeneity at Canadian Universities*. UBC Press.

Herkimer, J. (2021). Holding Our Ground: Indigenous Student Post-Secondary Persistence & Early Leaving. Mississaugas of the Credit First Nation. Retrieved online from:

[https://indspire.ca/wp-content/uploads/2021/12/Holding-Our-Ground-Report-EN-Final-
WEB1.pdf](https://indspire.ca/wp-content/uploads/2021/12/Holding-Our-Ground-Report-EN-Final-
WEB1.pdf)

Institute of Physics, Royal Astronomical Society, & Royal Society of Chemistry (2019).

Exploring the workplace of LGBT+ physical scientists. Retrieved online from:

[https://www.aps.org/programs/lgbt/upload/exploring-the-workplace-for-lgbtplus-
physical-scientists_1.pdf](https://www.aps.org/programs/lgbt/upload/exploring-the-workplace-for-lgbtplus-
physical-scientists_1.pdf).

International Union for Pure and Applied Physics. (2021). Waterloo Charter for Gender

Inclusion and Diversity in Physics. Retrieved from: [https://iupap.org/strategic-
plan/diversity-in-physics-2/waterloo-charter-for-women-in-physics/](https://iupap.org/strategic-
plan/diversity-in-physics-2/waterloo-charter-for-women-in-physics/).

Ivie, R., Anderson, G., & White, S. (2014). *African Americans & Hispanics among Physics & Astronomy Faculty: Results from the 2012 Survey of Physics & Astronomy Degree-Granting Departments*. Focus On. Statistical Research Center of the American Institute of Physics.

James, C.E. & Turner, T. (2017). *Towards Race Equity In Education: The Schooling of Black Students in the Greater Toronto Area*. Toronto, Ontario, Canada: York University.

- Johnson, G. F., & Howsam, R. (2020). Whiteness, power and the politics of demographics in the governance of the Canadian academy. *Canadian Journal of Political Science/Revue canadienne de science politique*, 53(3), 676-694.
- Malcom, S. M., Hall, P. Q., & Brown, J. W. (1976). *The double bind: The price of being a minority woman in science*. Washington, DC: American Association for the Advancement of Science.
- Malcom, L., & Malcom, S. (2011). The double bind: The next generation. *Harvard Educational Review*, 81(2), 162-172.
- Martinez, D. (2014). School culture and American Indian educational outcomes. *Procedia Social and Behavioral Sciences*, 116, 199-2015. <https://doi.org/10.1016/j.sbspro.2014.01.194>
- McGee, Ebony O. (2020) Black, Brown, Bruised: How Racialized Stem Education Stifles Innovation. *Harvard Education Press*
- Natural Sciences and Engineering Research Council of Canada (2010). *Women in Science and Engineering in Canada*. Corporate Planning and Policy Directorate. Retrieved from: https://www.nserc-crsng.gc.ca/doc/Reports-Rapports/Women_Science_Engineering_e.pdf
- Natural Sciences and Engineering Research Council of Canada (2021). *Chairs for Women in Science and Engineering*. Retrieved from: https://www.nserc-crsng.gc.ca/Women-Femmes/Index_eng.asp.
- Odle, Taylor, Michael Gottfried, Trey Miller, and Rodney Andrews. (2022). Who's Matched Up? Access to Same-Race Instructors in Higher Education. Retrieved from Annenberg Institute at Brown University: <https://doi.org/10.26300/36xa-p946>

- Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, 81(2), 172-209.
- Perreault, A., Franz-Odenaal, T., Langelier, E., Farenhorst, A., Mavriplis, C., Shannon, L. (2018). Analysis of the distribution of gender in STEM fields in Canada. Retrieved from: <https://ccwestt-ccfsimt.org/analysis-of-the-distribution-of-gender-in-stem-fields-in-canada/>
- Porter, A. M., & Ivie, R. (2019). *Women in Physics and Astronomy, 2019*. Report. AIP Statistical Research Center. Retrieved from: <https://www.aip.org/statistics/reports/women-physics-and-astronomy-2019>.
- Prescod-Weinstein, C. (2015, May 24). The five Black women PhDs of theoretical high energy physics. Retrieved from: <https://medium.com/@chanda/the-five-black-women-phds-of-theoretical-high-energy-physics-7a18ccc18d8a>.
- Predoi-Cross, A., Dasgupta, A., Steinitz, M., Aucoin, E., Khattak, A., Hennessey, E., ... & McKenna, J. (2019, June). Update on the status of women in physics in Canada. In AIP Conference Proceedings (Vol. 2109, No. 1, p. 050010). AIP Publishing LLC.: Retrieved from: <https://aip.scitation.org/doi/pdf/10.1063/1.5110084>.
- Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences*, 111(12), 4403-4408. <https://www.pnas.org/content/pnas/111/12/4403.full.pdf>.
- Robertson, B., & Steinitz, M. (1997). Review of Canadian Academic Physics: Highly Qualified Personnel Study. Retrieved online from: <https://people.stfx.ca/msteinit/review.htm>.

Robinson, K. A., Perez, T., Carmel, J. H., & Linnenbrink-Garcia, L. (2019). Science identity development trajectories in a gateway college chemistry course: Predictors and relations to achievement and STEM pursuit. *Contemporary Educational Psychology*, 56, 180-192.

Science Secretariat. (1967). Physics in Canada: Survey and Outlook. Retrieved online from:

https://www.uottawa.ca/research-innovation/sites/g/files/bhrs kd326/files/2022-08/special_study_no_2_-_physics_in_canada_survey_and_outlook.pdf.

Statistics Canada (2012). Canadian Survey on Disability. Retrieved online from:

<https://www150.statcan.gc.ca/n1/pub/89-654-x/89-654-x2015005-eng.htm>

Statistics Canada (2017). Canadian Survey on Disability. Retrieved online from:

<https://www150.statcan.gc.ca/n1/daily-quotidien/181128/dq181128a-eng.htm>

Statistics Canada (2021). A statistical portrait of Canada's diverse

LGBTQ2+ communities. Retrieved online from: <https://www150.statcan.gc.ca/n1/daily-quotidien/210615/dq210615a-eng.htm>.

Statistics Canada (2021). Understanding who we are: Sex at birth and gender of people in

Canada. Retrieved online from: <https://www150.statcan.gc.ca/n1/en/pub/11-627-m/11-627-m2022049-eng.pdf?st=0rJVyMfh>.

Statistics Canada (2022). The Canadian census: A rich portrait of the country's religious and

ethnocultural diversity. Retrieved online from: <https://www150.statcan.gc.ca/n1/daily-quotidien/221026/dq221026b-eng.htm>.

Statistics Canada (2022). The Daily: Canada is the first country to provide census data on transgender and non-binary people. Retrieved online from:

<https://www150.statcan.gc.ca/n1/daily-quotidien/220427/dq220427b-eng.htm>.

Statistics Canada (2022). Canada at a Glance, 2022 - LGBTQ2+ people. Retrieved online from:

<https://www150.statcan.gc.ca/n1/pub/12-581-x/2022001/sec6-eng.htm>.

Statistics Canada (2022). Measuring disability in Canada. Retrieved online from:

<https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2022062-eng.htm>.

Statistics Canada. (2023). Black History Month 2023... by the numbers. Retrieved online from:

https://www.statcan.gc.ca/en/dai/smr08/2023/smr08_270#.

Sterling, A. D., Thompson, M. E., Wang, S., Kusimo, A., Gilmartin, S., & Sheppard, S. (2020).

The confidence gap predicts the gender pay gap among STEM graduates. *Proceedings of the National Academy of Sciences*, 117(48), 30303-30308.

Strickland, D. (2017). Summary of CAP Physics Department Survey – 2016. Retrieved online

from: <https://pic-pac.cap.ca/index.php/Issues/showpdf/article/v73n4.0-a3999.pdf>.

Stiles-Clarke, L., & MacLeod, K. (2018). Demystifying the scaffolding required for first-year physics student retention: contextualizing content and nurturing physics identity.

Canadian Journal of Physics, 96. Retrieved online from:

<https://cdnsiencepub.com/doi/pdf/10.1139/cjp-2017-0225>;) dx.doi.org/10.1139/cjp-2017-0225.

Tenenbaum, H. R., & Leaper, C. (2003). Parent-child conversations about science: The socialization of gender inequities?. *Developmental Psychology*, 39(1), 34.

Universities Canada (2023). Equity, diversity, and inclusion at Canadian universities. Retrieved

online from: https://www.univcan.ca/wp-content/uploads/2023/10/UC-2023-EDI-Report_EN_FA_Web.pdf.

University of Toronto. (2022). Scarborough Charter on Anti-Black Racism and Black Inclusion in Canadian Higher Education: Principles, Actions, and Accountabilities. Retrieved

online from: https://www.utsc.utoronto.ca/scarborough-charter/sites/utsc.utoronto.ca/scarborough-charter/files/docs/Scarborough_Charter_EN_Nov2022.pdf.

Wall, K. (2019). *Persistence and Representation of Women in STEM Programs*. Insights on Canadian Society. Statistics Canada. Catalogue no. 75-006-X. ISSN 2291-0840.

Walton, G. M., Logel, C., Peach, J. M., Spencer, S. J., & Zanna, M. P. (2015). Two brief interventions to mitigate a “chilly climate” transform women’s experience, relationships, and achievement in engineering. *Journal of Educational Psychology*, 107(2), 468.

Wells, E., Williams, M.A., Corrigan, E., and Davidson, V. Closing the Gender Gap in Engineering and Physics The Role of High School Physics. Retrieved from <http://www.onwie.ca/wp-content/uploads/2019/02/White-Paper-Final-Draft.pdf>. 2018.

Wise, T. (1998). Is sisterhood conditional? White women and the rollback of affirmative action. *NWSA Journal*, 10(3), 1–26. <http://www.jstor.org/stable/4316599>.

Supplementary Information

Demographic Measures Used for Analysis

Gender Identity: Gender identity was assessed by asking participants to ‘Please check one or more options that reflect your gender identity.’ Responses were coded into five broad categories, Man, Woman, Gender Diverse (i.e., Non-Binary, Two-Spirit, Genderqueer or Gender non-conforming, Transgender, or open-ended self-described gender identities), Prefer Not to Answer, and Did Not Answer.

Sexual Identity: Participants were asked to check all options that apply from a list. Responses were coded broadly into four categories, Heterosexual and Sexually Diverse (Bisexual, Lesbian, Gay, Pansexual, Polyamorous, Asexual, Queer, Questioning or Unsure, or open-ended self-described sexual identities), Prefer Not to Answer, and Did Not Answer.

Population Group (Race/Ethnicity): Population group was assessed by asking, ‘Please check all that apply or specify in ‘Other’ if none of the labels are representative of your identity.’ Responses options were White, South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean, Japanese, Aboriginal identity, and Prefer Not to Answer, and Prefer to Self-Describe. Respondents were informed that these categories were taken from Statistics Canada’s 2016 Census to allow for comparison to this population data. Responses were further coded into a five-category variable for ease of interpretation in analyses: White, BIPOC (i.e., Black, Indigenous, and People of Colour), Prefer Not to Answer, Prefer to Self-Describe, and Did Not Answer.

Disability Status: Participants were asked, ‘Do you identify as a disabled person or someone with a disability?’ Responses were coded into five categories, including No, Yes, Unsure, Prefer Not to Answer, and Did Not Answer.

Location: Respondents were asked to identify which province or territory they primarily lived in. They selected from a list of provinces and territories or indicated living outside of Canada.

Current Positions: Participants’ positions in academia or industry were assessed by asking, ‘What best describes your current primary position? (Select one). Positions were coded into eight broad categories, including Undergraduate Student, Graduate Student (i.e., Master’s and Ph.D. students), Post-Doctoral Researcher, Faculty (i.e., Adjunct Professor, Lecturer, Assistant Professor, Associate Professor, Professor, and Professor Emeritus), Industry/Government (i.e., Industry Employee, Government Employee, Non-Profit Employee), Research Institute (i.e., Research Associate, Data Scientist, Research Institute Employee), or Another Position (i.e., General Retiree, Highschool/College Teacher, Academic Administrators, Self-Employed, and Unemployed), and Did Not Answer.

Education Field: Participants could select one or more fields that best described the higher education degrees they had pursued. Responses were coded into 16 categories, Did Not Answer, Physics General, Engineering General, Mathematics and Statistics General, Computer Sciences General, Health Sciences General, Arts and Humanities General, Biophysics and Soft Matter Physics, Atmospheric and Climate Physics, Astronomy and Astrophysics, Medical and Health Physics, Particle and Nuclear Physics, Chemical Physics, Geophysics and Earth Science, Other (specify), and Multiple Selected.

Disability Accommodations. Disability accommodations were assessed by asking, ‘Does your current place of work or study provide accommodations for you?’ Responses were coded into five categories: “I have not sought out accommodations or do not require any,” “I have received partial, inadequate accommodations for my needs,” “I have received adequate accommodations for my needs,” “I have received full accommodations,” and “Other (open text).”

Institution/Location. Institution and location were assessed by asking participants to select the province or territory and institution within if applicable.

Supplementary Data

Students' Demographic Characteristics

Students' self-reported gender identities were Men (55.2%), Women (38.7%), Gender Diverse (4.8%), Prefer Not to Answer (1.1%), and Did Not Answer (.2%).

Self-reported sexual identities were Heterosexual (72.2%), Bisexual (9%), Multiple Selected (8.4%), Gay (2.2%), Prefer Not to Answer (1.6%), Asexual (1.5%), Lesbian (1.4%), Pansexual (1.4%), Questioning/Unsure (1.1%), Queer (.9%), and Did Not Answer (.3%).

Self-reported race/ethnicities were White (60.7%), South Asian (10%), Multiple Selected (9.1%), Chinese (6.6%), Latin American (2.4%), Arab (2.2%), West Asian (2.1%), Black (1.3%), Prefer to Self-Describe (1.2%), Prefer Not to Answer (1 %), Filipino (1%), Southeast Asian (1%), Korean (.7%), Indigenous (.3%), Japanese (.3%), and Did Not Answer (.1%).

Self-reported disability status was No (80.7%), Yes (8%), Did Not Answer (5.5%), Unsure (5.2%), and Prefer Not to Answer (5.6%). Of those who identified as having a disability (or were unsure), disability accommodations were predominantly not sought out or required (46.7%).

Students were primarily located in Ontario (43.5%), Quebec (18.2%), and British Columbia (15.2%).

Professionals' Demographic Characteristics

Professionals' self-reported gender identities were Men (68%), Women (28.6%), Gender Diverse (1.4%), Prefer Not to Answer (1.6%), and Did Not Answer (.4%).

Self-reported sexual identities were Heterosexual (85.9%), Multiple Selected (3.8%), Prefer Not to Answer (3.1%), Bisexual (2.9%), Gay (1.4%), Lesbian (.5%), Pansexual (.5%), Asexual (.3%), Questioning/Unsure (.2%), Queer (.3%), Polyamorous (.3%), and Did Not Answer (.8%).

Self-reported race/ethnicities were White (77%), South Asian (5.8%), Chinese (3.8%), Multiple Selected (2.9%), Prefer Not to Answer (2.1%), West Asian (1.9%), Latin American (1.5%), Black (1.1%), Arab (1.1%), Prefer to Self-Describe (.8%), Japanese (.5%), Korean (.4%), Did Not Answer (.4%), Southeast Asian (.3%), Filipino (.2%), and Indigenous (.2%).

Self-reported disability status was No (85.3%), Did Not Answer (6.8%), Yes (5.3%), Unsure (1.4%), and Prefer Not to Answer (1.2%). Of those who identified as having a disability (or were unsure), disability accommodations were predominantly not sought out or required (71.2%).

Professionals were primarily located in Ontario (40%), British Columbia (17.8%), and Quebec (17%).

Full Sample Demographic Characteristics

Self-reported gender identities were Man (60.2%), Woman (34.7%), Multiple Selected (2.6%), Prefer Not to Answer (1.3%), Non-Binary (.7%), Did Not Answer (.3%), Genderqueer or Gender Non-Conforming (.1%). Self-reported sexual identities were Heterosexual (77.6%), Bisexual (6.6%), Multiple Selected (6.6%), Prefer Not to Answer (2.2%), Gay (1.9%), Did Not Answer (.5%), and Polyamorous (.1%).

Self-reported race/ethnicities were White (67.1 %), South Asian (8.3%), Chinese (5.5%), Multiple Selected (6.6 %), Prefer Not to Answer (1.5 %), West Asian (2%), Latin American

(2.1%), Black (1.2%), Arab (1.8%), Prefer to Self-Describe ²(1%), Japanese (.4%), Korean (.6%), and Did Not Answer (2%), Filipino (.7%), Southeast Asian (.7%), and Indigenous (.3%).

Self-reported disability status was No (82.5%), Did Not Answer (6%), Yes (7%), Unsure (3.7%), and Prefer Not to Answer (.8%). Of those who identified as having a disability (or were unsure), disability accommodations were predominantly not sought out or required (53%).

Respondents were primarily located in Ontario (42.2%), Quebec (17.7%), and British Columbia (16.2%).

Table 1

Gender and Racial Identities Across Positions (7 positions)

Gender and Racial Identities							
Positions	White	White	BIPO	BIPOC	White	BIPOC	(N)
	Men	Women	C Men	Women	Gender Diverse	Gender Diverse	
	N	N	N	N	N	N	
Undergraduate	264	220	207	131	39	18	879
Graduate	239	145	127	93	13	*	619
Post-Doc	47	18	29	14	0	0	108
Faculty	242	76	44	14	*	0	379
Researchers/ Institute	63	25	16	13	*	0	119
Industry/Government	112	44	23	14	*	*	199
Another Position	78	50	17	11	*	0	158

Note. Another position = Self-employed, unemployed, high school, CEGEP, College teacher/professor, medical doctor, medical physicist, laboratory technician or demonstrator, academic administrative staff, retired, sales, not-for-profit, and educators. * = fewer than 5 respondents. (N) = total number of participants. In line with conventions from the Natural Sciences and Engineering Research Council (NSERC), frequencies less than five are not reported or collapsed into larger categories to preserve anonymity (https://www.chairs-chaire.gc.ca/about_us-a_notre_sujet/statistiques-statistiques-eng.aspx).

²*Note.* Prefer to Self-describe responses were Jewish, West Indian, East Asian Taiwanese, Lebanese, Hong Konger, Caribbean/Indo-Guyanese, Ashkenazi Jew, Turkish, North Indian, Armenian, Mixed, White/Indo-Caribbean, North Indian Kashmiri, African South Asian, Diverse, Mixed, Canadian Trinidadian, Canadian, Mixed visible minority, Celtic, and Algonquin.

Table 2*Gender and Racial Identities Across Academic Positions (9 positions)*

Gender and Racial Identities							
Academic Positions	White Men <i>N</i>	White Wome n <i>N</i>	BIPO C Men <i>N</i>	BIPOC Wome n <i>N</i>	White Gender Diverse <i>N</i>	BIPOC Gender Diverse <i>N</i>	<i>(N)</i>
Undergraduate	264	220	207	131	39	18	879
Master's	89	53	44	48	*	*	240
PhD	150	92	83	45	9	0	379
Post-Doc	47	18	29	14	0	0	108
Assistant Professor	44	16	11	*	*	0	76
Associate Professor	54	16	6	5	0	0	81
Professor/Dean	112	34	19	*	*	0	168
Professor Emeritus	20	*	*	0	0	0	23
Instructors/Adjunct	11	7	7	*	0	0	29

Note. * = fewer than 5 respondents. (*N*) = total number of participants. In line with conventions from the Natural Sciences and Engineering Research Council (NSERC), frequencies less than five are not reported or collapsed into larger categories to preserve anonymity (https://www.chairs-chaire.gc.ca/about_us-a_notre_sujet/statistiques-statistiques-eng.aspx).