

# Do environmental researchers from marginalized groups experience greater interference? Understanding scientists' perceptions

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## Abstract

Researchers in the environmental studies and sciences play a critical role in influencing real-world decision-making and policies. However, interference during research and sharing of results has been documented in Canada and around the world. Further, research has shown that workers from marginalized social identity(s) experience discrimination in the workplace. Whether interference in research is related to social identity has never been examined. Using a mixed-methods design, we surveyed 741 environmental researchers in Canada to understand the relationship between social identity (gender, disability status, 2SLGBTQI+ status, race, and perception of racial identity) and reported experiences of interference. Results found that researchers with marginalized identities experienced worse outcomes across 11 of the 25 quantitative measures. For example, most marginalized groups experienced significantly greater fear of misrepresentation by media and (or) fear of negative career consequences due to public commentary, and racialized and disabled persons reported greater external interference in their work (e.g., from management and workplace policy). Given these findings, we express concern that the experience of interference in research can (1) threaten the personal well-being of marginalized researchers, (2) limit the representativeness of information disseminated, thereby impacting environmental decision-making and policy, and (3) contribute to inequities in representativeness of marginalized researchers in environmental sciences in Canada.

**Key words:** social identity factors, interference in science, marginalized groups, environmental studies and sciences, environmental researchers

## Introduction

Environmental researchers' ability to effectively conduct and communicate their research is essential for society to understand and act on environmental problems such as climate change and other anthropogenic impacts and stressors. However, in Canada and around the world, environmental scientists and researchers have experienced "interference in science" (Robertson et al. 2023; Driscoll et al. 2021), which prevents researchers from properly conducting and disseminating their work. Robertson (2022) defined interference as "deliberate actions that result in both the reduced funding or capacity for research activities to levels insufficient to generate knowledge, and (or) the inability of scientists to communicate their results to the public or engage in effective knowledge transfer to inform decision-making". Examples of interference include muzzling or suppression, undue modification to work, reduced funding, and harassment or threats (Robertson 2022). In addition, it has been well-documented that employees' social identities affect how they experience work and the degree to which they can engage in their work

role. Research on this topic has repeatedly found that those from marginalized identities experience greater workplace discrimination (Bell et al. 2011; McDonald 2012; Santuzzi and Waltz 2016; Gartner et al. 2020; Skinner-Dorkenoo et al. 2021; Ramlakhan 2022; Weinberg and Fine 2022), feel less safe voicing their opinions about work-related issues (Brescoll 2011; Eibl et al. 2020), and experience disadvantages in organizational ascent (Funk and Parker 2018).

In efforts to further understand interference in science and broaden the knowledge regarding identifying potential mechanisms, we investigated whether members of marginalized groups from different social identities reported more severe or more frequent interference in science than their majority counterparts. We define marginalized groups as those that are "excluded from mainstream social, economic, educational, and (or) cultural life" and experience discrimination and exclusion due to unequal power relations in society (Sevelius et al. 2020, p.1; National Collaboration Centre for Determinants of Health, n.d). The social identity factors we included were gender, race, perceptions of racial identity

(perceived race), disability status, and 2SLGBTQI+ (encompassing 2-spirit, lesbian, gay, bisexual, trans\*, queer, intersex, and other sexual and gender minority identities) status.

Ensuring that the voices of researchers from marginalized groups are heard by the public, decision-makers, and policy-makers is important for several reasons. First, the voices of marginalized groups help to establish a just and equitable workplace (i.e., free of barriers and discrimination). Creating barrier and discrimination-free workplaces helps to increase the well-being of all researchers, which is positively related to good workplace attitudes and job performance (Tov and Chan 2012; Fine et al. 2020). Second, diverse perspectives provide higher quality, quantity, and impactful research (Hong and Page 2004; Freeman and Huang 2014), as well as produce higher rates of scientific novelty (Hofstra et al. 2020). Third, researchers' identities can substantially influence their research interests and approaches to research. Researchers from marginalized groups are more likely to study marginalized communities, who are disproportionately impacted by climate change, environmental harms, and ecological losses and changes (McCorkel and Myers 2003; Masuda et al. 2008; Freeman and Huang 2014; Islam and Winkle 2017; Taylor 2018; Apakupakul 2020; Holmes 2020; Parker 2020; Massey et al. 2021). Even though these benefits are well known—and there exist current efforts towards increasing diversity and reducing barriers—marginalized groups in Canada continue to face discrimination in the workplace (Smith and Calasanti 2005; Human Rights Campaign Foundation 2009; CBC 2015; Taylor 2018; Employment and Social Development Canada 2019), meaning they may be particularly vulnerable to experiences of interference.

Instances of interference in science have been documented in Canada and across the world. In Canada, after the Conservative Party was elected in 2006, reports of federal scientists experiencing interference (at the time referred to in the media as muzzling) began appearing in the media (Democracy Watch 2012; Turner 2013). These concerns by federal environmental scientists and researchers culminated in the 2012 protest of government interference. Specifically, federal scientists were protesting against the interfering of their ability to conduct and share their work, and speak to the media (Fitzpatrick 2012; Makuch 2013). During this time, The Professional Institute of Public Services Canada (PIPSC), a union that represents scientific and technical employees at 40 federal departments and agencies, surveyed their membership regarding these concerns (PIPSC 2013). They found that 90% of federal scientists felt they could not speak freely, amongst many other concerns regarding political and managerial interference with their work (PIPSC 2013). After the Liberal Party was elected in 2015, PIPSC conducted a follow-up survey in 2017, in which they found that though accounts of muzzling had reduced, federal scientists were still experiencing interference (Halpern 2015; PIPSC 2018). In Australia, Driscoll et al. (2021) documented widespread experiences of interference in environmental studies and sciences (using the term “science suppression”) across researchers in government, university, and industry settings. More extreme examples of interference have also been documented, for exam-

ple, in Iran, scientists were arrested for their work studying endangered cats (Catanzro 2019; Torres 2021).

The PIPSC surveys are, to our knowledge, the only reported studies in Canada that have considered interference in environmental studies and sciences. Though serving as a breakthrough report that highlighted serious concerns regarding the integrity of science, these studies were limited to federal scientists. As well, the research did not include ethics board review for survey methods, nor did they investigate the relationship between experiences of interference and social identity. As such, Robertson (2022) provided a rigorous, contemporary update on the prevalence of interference in environmental studies and sciences in Canada across disciplines, and career stages. In this study, we analyzed data collected by Robertson (2022) to specifically investigate the relationship between social identity and perceptions of interference. We deem it important to highlight the experiences of marginalized groups in a separate article given the importance of marginalized groups' contributions to science, as well as recent attention from institutions employing scientists to the pursuit of equity, diversity, and inclusion (EDI) (Beck 2022).

This is the first known work connecting interference in environmental studies and sciences with social identity, and given that both interference and discrimination are global phenomena, the implications extend beyond Canada. We contribute to the understanding of interference in science by (1) documenting how experienced interference can vary based on social identities and (2) contributing to knowledge about identity-based discrimination (Triana et al. 2021) by identifying a novel mechanism by which people with marginalized identities are excluded from participating in their work roles. Population demography from the 2016 Canadian census was also used as base line to compare our survey respondent population.

## Methods

### Research design and data collection

Data for this study were collected as part of a larger survey documenting the experience of interference in sciences across Canadian environmental researchers. Complete survey development and methods can be found in Robertson (2022). The study population included individuals living in and employed in Canada, who reported working in and conducting research in the environmental studies or sciences in any sector (government, academia, non-profit, industry, or other). Survey responses were collected through a phased approach, using purposive sampling to specifically target the population of interest (Young et al. 2016; Peters et al. 2018; Anbleyth-Evans and Lacy 2019; Robertson et al. 2023). The study was approved by the Dalhousie Research Ethics Board on 22 July 2021 (REB # 2021-5630).

The survey was available in English and took place in August 2021. The survey consisted of three sets of questions: (1) documenting demographic and social identity factors; (2) assessing researchers' perceived freedom to communicate their scientific works; and (3) assessing their perceptions of

**Table 1.** Table depicting aggregated higher order factors.

16. My public commentary in areas where I am scientifically knowledgeable is constrained by	Higher order factors
16.1: My belief that scientists have no role in making public commentary beyond information provision	–
16.2: My concern about how I may be represented by the media	Fear of media
16.3: My fear of being drawn to comment beyond the boundaries of expertise	
16.6: My stress around discussing contentious issues	
16.4: My uncertainty about the boundaries of my expertise	–
16.5: My belief that my primary obligation is to my organization, rather than to the public	–
16.7: My fear of risking funding opportunities	Fear of negative career consequences due to public commentary
16.8: My fear of being made redundant	
16.9: My fear of reducing opportunities for advancement	
16.10: My workplace colleagues/peer pressure/work culture	Externally imposed sources of interference
16.11: My workplace policy	
16.12: My middle management	
16.13: My senior management	
16.14: The Minister's office	

managerial or political interference in their scientific work and its consequences to the public and (or) environment (see [Appendix A](#) for consent form and the complete list of survey questions).

## Measures

### Social identity

Social identity is a term situated within social psychology literature and social identity theory ([Tajfel 1978](#); [Tajfel and Turner 1979](#)). It defines social identity as a person's membership and identification with diverse social groups, including religions, nationalities, sexual orientation, ethnic groups, and gender. These terms are socially constructed and therefore socially experienced, making the term particularly fitting for this research context. Further, social identity does not imply negative or positive connotations but simply refers to categorical groupings upon which individuals may or may not identify with; the consequences of those identities, however, can result in discriminatory or privileged experiences within the workplace and across domains ([Ashforth and Mael 1989](#); [Schmitt and Branscombe 2002](#)). Social identity factor questions we used were derived from the 2016 Canadian census and other nationally obtained social identity information ([Statistics Canada 2015, 2021](#); [Morris et al. 2018](#)). They include questions pertaining to respondents' gender, whether they identified as transgender, their sexual orientation (LGBQ2S+), race, perceived race, disability status, and whether they wore a visible religious signifier. A distinction is made between "race" and "perceived race". The purpose of the distinction is to acknowledge that a person's race is not always the race they are perceived as ([Cosmides et al. 2000](#); [Ho et al. 2017](#)). This is particularly common among biracial or multiracial people ([University of Minnesota 2016](#); [Ho et al.](#)

[2017](#)). Perception of race matter as, for example, "white privilege", a form of societal privilege, is not only experienced by those who are white, but also those perceived to be white ([Concerly et al. 2023](#)). All questions had a "prefer not to disclose" option; however, those responses were later omitted during data analysis. No greater than 7% of respondents chose to "prefer not to disclose" for any survey questions related to social identity. Demographic data pertaining to respondents' province, career stage, and area of study were analyzed separately in [Robertson et al. \(2023\)](#).

### Sources of interference

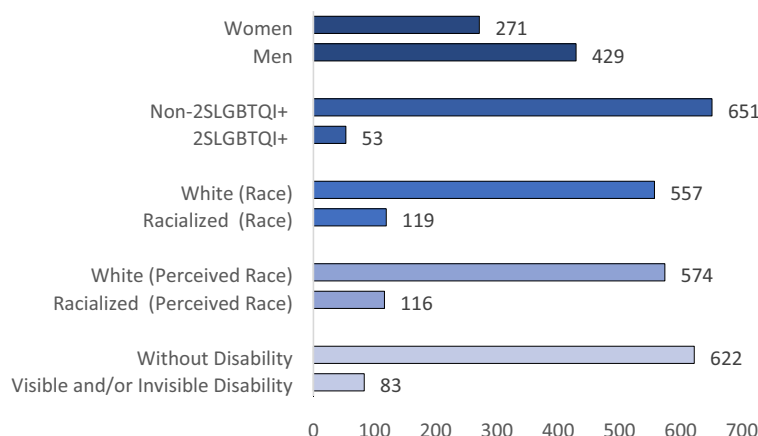
Using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), participants indicated in Question 16 the degree to which they experienced interference from 14 sources. Of these sources, nine were considered internalized factors (e.g., concern about how they may be represented by the media and uncertainty of their expertise) and five considered external sources (e.g., workplace policy and middle management).

We used Cronbach's Alpha ([Holcomb and Cox 2017](#)) to aggregate some of the sources of interference into higher order factors representing shared experiences ([Robertson et al. 2023](#)). Specifically, (1) fear of the media (Q16.2, Q16.3, and Q16.6;  $\alpha = 0.78$ ), (2) fear of negative career consequences for engaging in public commentary (Q16.7, Q16.8, and Q16.9;  $\alpha = 0.83$ ), and (3) externally imposed sources of interference (Q16.10–Q16.14;  $\alpha = 0.91$ ) (see [Table 1](#)).

### Experience of interference

Experiences of interference were assessed through two categorical questions and one open-ended question. The two categorical questions were (1) whether they had ever

**Fig. 1.** Summarized demographics of total survey respondents (741). It should be noted that respondents who identified as gender non-binary are not reported due to insufficient sample size (<10).



experienced “undue modification” to their work (Q10) and (2) whether they believed their identity and (or) demographics have influenced their experiences with interference in their research (Q29). The open-ended question, Q30, “please explain why or why not (optional)”, was a follow up to Q29. The categorical questions were assessed by participant selecting one of the following categorical options (yes, no, or unsure).

## Participants

The survey initially yielded 1291 responses. We removed respondents who did not pass the screening questions or who failed to complete the entire survey (Robertson 2022). A total of 741 responses were retained for analysis, with demographics of respondents summarized in Fig. 1. The breakdown of the demographics are as follows: women  $n = 271$ , men  $n = 429$ , 2SLGBTQI+  $n = 52$ , non-2SLGBTQI+  $n = 651$ , without disability  $n = 622$ , with visible and (or) invisible disability  $n = 83$ , racialized (race)  $n = 119$ , white (race)  $n = 557$ , racialized (perceived race)  $n = 116$ , and white (perceived race)  $n = 574$ . In accordance with Public Services and Procurement Canada’s standardized guidelines for reporting survey results (Government of Canada 2020), any groups with 10 or fewer individual respondents were not reported.

## Data analysis

Questions with only two response options were converted to binomial variables (Yes = 1 and No = 2). Questions with three responses (Yes, No, or Unsure) were also converted into binomials by excluding unsure responses from the analysis (Yes = 1 and No = 2). Questions that used continuous variables (five-point Likert scale) “Not applicable” and “Unsure” responses were also excluded.

Groups with 10 or less respondents were amalgamated with others where possible. Respondents who identified as transgender were amalgamated with respondents who identified as LGBTQ2S+, becoming “2SLGBTQI+” (Government of Canada 2022); race and perceived race groups were amalgamated from individual racial identity categories into

“white”<sup>1</sup> and “racialized” (Nicol and Osazuwa 2022); and respondents who identified having a visible disability and those with an invisible disability were grouped together (Statistics Canada 2017) (Table 2). Data regarding religious signifiers and those who identified as non-binary were omitted due to insufficient numbers of respondents. Across all variables, we computed basic descriptive statistics (mean and standard deviation) in R program.

All statistical analyses were completed in R version 1.4.1717 (RStudio 2021). For binomial outcomes (Q10 and Q29),  $\chi^2$  tests of independence were conducted against each social identity to test for any significant differences. For continuous outcome variable (five-point Likert scale) questions (Q16),  $t$  tests were used to identify statistical significance. Significance threshold was set at  $p < 0.05$ .

A posteriori qualitative coding was conducted on open text question, Q30 (“Please explain why or why not (optional)”), which was a follow-up question to Q29 regarding perceived influence of social identity on their experience of interference. The coding method used was Provisional Coding, which allowed for flexibility as codes could be edited, modified, or removed to better represent the data (Hedlund 2013; Saldana 2016). The purpose of the coding was to identify and analyze major themes in the responses. The responses were manually coded by the first author. The responses were first coded to identify whether the respondent had, had not, or were unsure if they had experienced interference in their work. The responses were then coded for the attributed reason the respondents believed they had (or potentially had) experienced interference, or not. Code categories were generated based on the entire sample and amalgamated thematically (see Appendix A for code book).

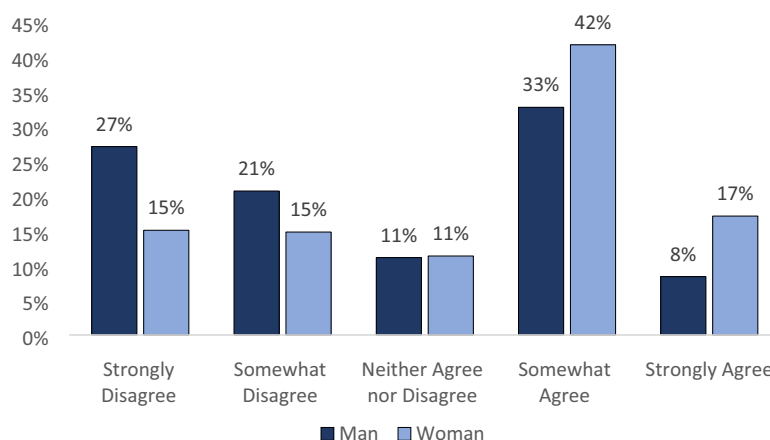
<sup>1</sup> The authors recognize that there is currently a significant debate around the capitalization of ‘w’ in ‘white’ (Daniszewski, 2020; Nicol and Osazuwa, 2022). Copying the decision by the Associated Press, the authors of this article have also decided to lowercase the ‘w’ in ‘white’ (Daniszewski, 2020).



**Table 2.** Groups that were re-allocated to allow for sufficient sample size for analysis.

Social identity factors	Original grouping	New grouping
Transgender identity and sexual orientation	Transgender LGBTQ2S+	2SLGBTQI+
Race and ethnicity and perceived race	Black, African-Canadian, person of African descent	Racialized
	Indigenous (First Nations, Inuit, and Metis)	
	East Asian (including Chinese, Japanese, Korean, etc.)	
	South Asian (including East Indian, Indian from India, Pakistani, Sri Lankan, Bangladesh, East Indian from Guyana, East Africa, Trinidad, etc.)	
	South East Asian (including Burmese, Cambodian, Filipino, Laotian, Thai, Vietnamese, etc.)	
	Non-white West Asian ("Afghan", "Iranian", etc.)	
	North African or Arab (including Armenian, Algerian, Egyptian, Israeli, Lebanese, Libyan, Palestinian, Syrian, etc.)	
	Non-white Latin American (including indigenous persons from Central and South America, etc.)	
	Pacific Islander	
	White Canadian or of white European descent	White
Visible and (or) invisible disability	Invisible disability	Visible and (or) invisible disability
	Visible disability	
	Visible and invisible disability	

**Fig. 2.** Normalized responses comparing respondents who identified as a man and those as a woman to questions regarding the higher order variable "fear of media" (Q16.2, Q16.3, and Q16.6).



## Results

We considered researchers' perceptions of interference as based on amalgamated identity groups (gender, 2SLGBTQI+ status, disability status, race, and perceived race) grouped by type of question. Statistically significant results are reported here (see [Appendix A](#) for complete results).

### Gender

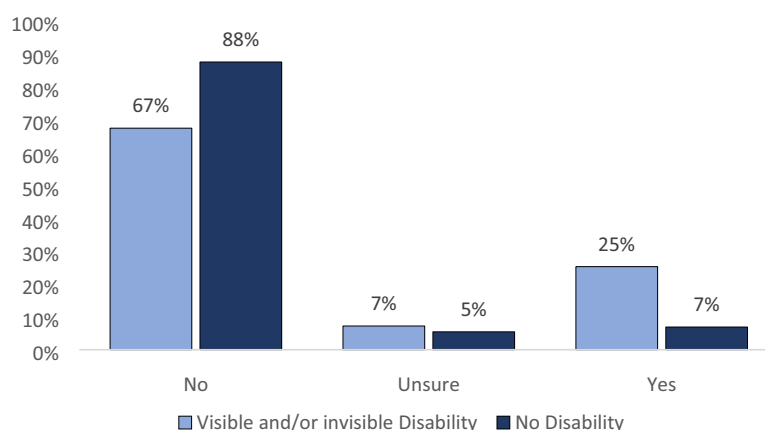
We examined whether women and men differed in their experiences of interference, and found that women, compared to men, reported experiencing significantly greater fear of media (women ( $m = 3.30$ ,  $SD = 1.21$ ) versus men ( $m = 2.79$ ,  $SD = 1.19$ );  $t(538.92) = -5.80$ ,  $p = <0.01$ ; [Fig. 2](#)). Significantly greater fear of negative career consequences due to public commentary were also observed by women (women

( $m = 2.21$ ,  $SD = 1.22$ ) versus men ( $m = 2.02$ ,  $SD = 1.14$ );  $t(496.48) = -2.02$ ,  $p = 0.04$ ). Women also reported that they perceived their social identity to influence their experience of interference significantly more ( $\chi^2(1, N = 659) = 12.36$ ,  $p = <0.01$ ) as compared to men. Women and men did not significantly differ, however, on their reported experiences of undue modification and externally imposed sources of interference.

### 2SLGBTQI+ status

Results showed that respondents who identified as 2SLGBTQI+ reported experiencing significantly greater fear of negative career consequences due to public commentary than did respondents who had not identified as 2SLGBTQI+ (2SLGBTQI+ ( $m = 2.69$ ,  $SD = 1.20$ ) versus non-2SLGBTQI+

**Fig. 3.** Normalized responses comparing respondents who identified as having a visible and (or) invisible disability and those without a disability to question Q10: “Have you ever experienced “undue modification” to your work by your organization, such as substantive changes to a text or story that downplays, masks, or includes misleading information about environmental impacts?”.



( $m = 2.04$ ,  $SD = 1.15$ );  $t(58) = 3.81$ ,  $p = <0.01$ ). No significant differences in responses were found for undue modification, externally imposed sources of interference, fear of media, and perceived influence of social identity to experienced interference.

### Disability status

Results showed that respondents with a disability reported experiencing significantly greater fear of negative career consequences due to public commentary compared to respondents without a disability (with disability ( $m = 2.35$ ,  $SD = 1.27$ ) versus without disability ( $m = 2.06$ ,  $SD = 1.15$ );  $t(94.01) = -1.96$ ,  $p = 0.03$ ). They reported significantly greater perceptions of externally imposed sources of interference than respondents without a disability (with disability ( $m = 2.43$ ,  $SD = 1.32$ ) versus without disability ( $m = 2.07$ ,  $SD = 1.19$ );  $t(84.70) = -2.18$ ,  $p = 0.03$ ). Respondents with a disability also reported experiencing more undue modification to work ( $\chi^2(1, N = 665) = 28.93$ ,  $p = <0.01$ ; Fig. 3). No significant differences were found regarding fear of media and perceived influence of social identity to experienced interference.

### Race and perceived race

Results showed that racialized (race) respondents reported experiencing significantly more fear of negative career consequences due to public commentary compared to white (race) respondents (racialized ( $m = 2.47$ ,  $SD = 1.38$ ) versus white ( $m = 2.02$ ,  $SD = 1.10$ );  $t(136.5) = 3.43$ ,  $p = <0.01$ ). Racialized respondents also experienced significantly greater externally imposed sources of interference as compared to white respondents (racialized ( $m = 2.37$ ,  $SD = 1.31$ ) versus white ( $m = 2.04$ ,  $SD = 1.17$ );  $t(143.33) = 2.50$ ,  $p = 0.01$ ). No significant differences were found regarding fear of media, undue modification to work, and perceived influence of social identity to experienced interference.

When considering perceived race, respondents who believed they were perceived as racialized also showed significantly higher fears of negative career consequences for participating in public commentary (perceived racialized ( $m = 2.51$ ,  $SD = 1.40$ ) versus perceived white ( $m = 2.01$ ,  $SD = 1.09$ );  $t(119) = 3.62$ ,  $p = <0.01$ ). This group also had significantly different perceptions of externally imposed sources of interference (perceived racialized ( $m = 2.36$ ,  $SD = 1.31$ ) versus perceived white ( $m = 2.00$ ,  $SD = 1.17$ );  $t(124.52) = 2.17$ ,  $p = 0.03$ ; Fig. 4).

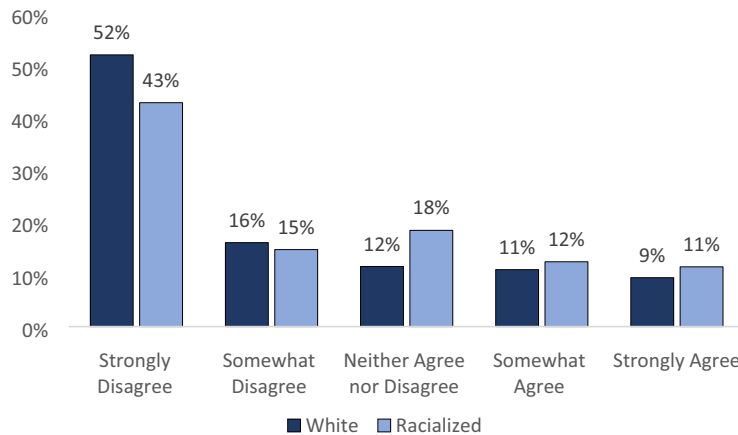
### Understanding respondents' beliefs about the influence of their social identities

When asked whether they felt their identity impacted their experiences of interference (Q29), 48% of respondents said yes, 36% said no, and 17% said they were unsure. Respondents then had an opportunity to expand on this response in a short answer response (Q30) and explain why or why not, they felt their social identities influenced their experience of interference. As gender was the only variable that showed significant differences in Q29, we further analyzed this variable to compare the responses between men and women.

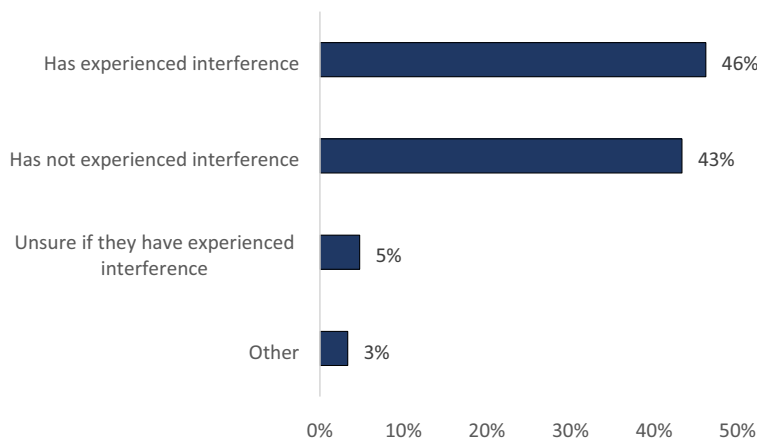
Two hundred-and-forty-two responses to the open text question (Q30) were analyzed, and of these 44% of responses attested to experiencing interference, 46% had not, 5% were unsure, and 3% gave a response that did not fit in the previous three categories (Fig. 5). Comparing the open text responses against gender, results showed that 52% of men had not experienced interference, 26% had experienced interference, 2% were unsure, and 4% had responded “other”. Comparatively, 20% of women had not experienced interference, 66% had experienced interference, 8% were unsure, and 1% responded “other”.

The two most common reasons respondents attributed to having (or possibly having) experienced interference were their gender ( $n = 58$ ) and race ( $n = 9$ ) (Fig. 6). Further analysis showed that 7% of men and 95% of women reported that their

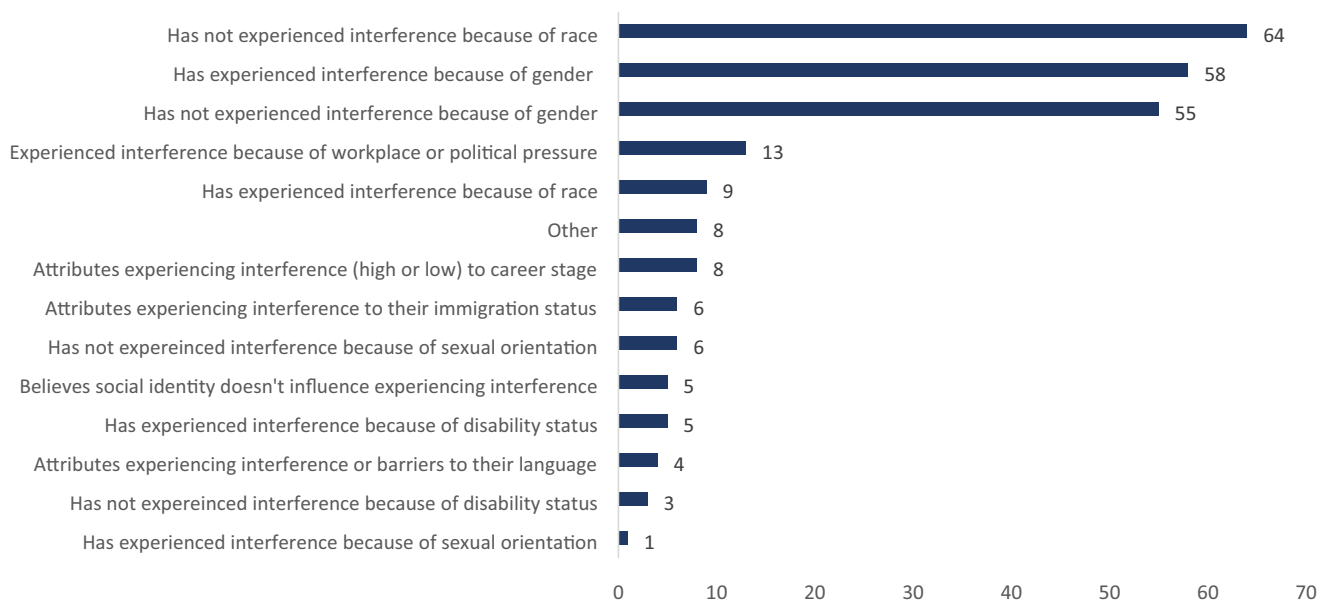
**Fig. 4.** Normalized responses comparing white and racialized (perceived race) respondents to data analysis regarding experiencing interference from the higher order variable “externally imposed sources” (Q16.10–Q16.14).



**Fig. 5.** Coded responses—respondent indicates whether they have experienced interference or not experienced.



**Fig. 6.** Count of frequency of codes describing the attributed reason(s) that respondents described their identity as influencing (or not) their experienced interference with their research work. Codes are abridged for readability.



gender had (or possibly had) contributed to their experiences of interference (e.g., “As a woman in a male-dominant field, I do not benefit from the presumption of competence that is given freely to my male colleagues. Much less competent men receive much greater support and many more opportunities”. Q30, PARID 194). Comparatively, the two most common reasons attributed to not (or possibly not) having experienced interference were also gender ( $n = 55$ ), and race ( $n = 64$ ) (Fig. 6). Further analysis of this showed that 93% of men and 5% of women responded to Q30 indicating that their gender had not (or possibly not) contributed to them experiencing interference.

The most frequent factor reported by respondents for not having experienced interference was their race ( $n = 64$ ). All 64 of the respondents who identified this factor for non-interference identified as white. Throughout the coding process, a reoccurring theme in men’s responses was “white male privilege”. For example, “My identity and demographics [man and white] have likely helped me to get where I am, and they certainly were not in the way”. (Q30, PARID 195) and “As an established white male scientist, I believe I have benefitted from innumerable biases in my favor throughout my education and career”. (Q30, PARID 597).

To understand the prevalence of this sentiment, both groups of codes (race and gender) were analyzed together. Of the 52% of man-identifying respondents who had not experienced interference, 57% attributed it to their gender (man) and race (white) (i.e., “white male privilege”), 32% did not give a reason, and the last 11% gave other reasons such as career stage, or only their gender or race.

## Discussion

This study examined the extent to which social identity factors played a role in the interference experienced by environmental researchers within their research in Canada. Ensuring diverse identities are both represented in research communities and able to conduct their work without interference are critical to the goals of scientific inquiry. Indeed, diverse perspectives enable higher quality research (Hong and Page 2004; Freeman and Huang 2014), increase scientific novelty (Hofstra et al. 2020), facilitates safer and more equitable workplaces (Fine et al. 2020), and give voice to marginalized groups who are disproportionately impacted by climate change and ecological losses and changes (Masuda et al. 2008; Islam and Winkle 2017; Apakupakul 2020; Massey et al. 2021, p.2). We found that social identity factors played a role in the prevalence of interference experienced by respondents and, depending on the social identity factor and question, marginalized groups generally reported experiencing higher rates of interference than the majority counterpart. When looking at all the tests that measured for statistical significance, marginalized groups experienced statistically significant worse outcomes than their majority counterparts across 11 of the 25 tests. We will now discuss the salient differences, their potential impacts, and steps that can be taken to improve workplace experiences and outcomes for researchers in the environmental studies and sciences from marginalized groups.

## Social identity factors and experienced interference

### Gender

Fear of media and fear of negative career consequences due to public commentary were found to be more significant sources of interference for women compared to men. These fears are concerning as they can manifest themselves as self-censorship, thus preventing sharing of information to the public and policy-makers (Bar-Tal 2017; Driscoll et al. 2021; Robertson et al. 2023). Our finding of women-identifying researchers reporting more fear of media is consistent with previous research (Brescoll 2011; Funk and Parker 2018; Donegan 2022; Wright et al. 2022), which has found that women are less likely to speak to the media due to fears of backlash and more likely to be at the receiving end of discriminatory behaviours and action. One respondent in our study further supported this theory in their open text response: “Seeing how women are treated on social media, I am not interested in receiving that type of trolling so [I] stay away from politics or adding commentary on social media” (participant ID 346, Q30).

This is in direct contrast to the experience of men, who identified their gender identity as an asset: “[a]s a white male, I hold more privilege than minority groups, and therefore [am] less likely to experience interference” (participant ID 71, Q30). Men’s awareness of how their identity can positively influence their experience in the workplace and reduce their experience of interference contradicts research by Dancy et al. (2020), who suggested that white men senior students in science, technology, engineering, and math (STEM) often fail to recognize their own privilege. However, it should be noted that this sentiment cannot be quantified as being representative of all man-identifying respondents, as only 32% ( $n = 138$ ) of men-identifying respondents answered Q30.

In their open text responses, many women in our study identified encountering interference in the form of sexism, ideas being ignored or dismissed, or being unable to obtain senior research position, “My field of study is male dominated and the opinion of women is still not viewed on par with male colleagues” (participant ID 732, Q30). These results corroborate with other research that suggests that even with the major strides that have been made in creating more equitable workplaces, women continue to experience increased barriers in the workplace (Schwanke 2013; Stamarski and Son Hing 2015; Employment and Social Development Canada 2019). However, similar to men, it should be noted that these sentiments cannot be quantified as being representative of all woman respondents, as only 34% ( $n = 93$ ) of woman-identifying respondents answered Q30.

It is important to note that the effects of social identity on various experiences of interference were not static but rather varied depending on the respondent’s circumstances. For example, in the open text responses, respondents noted that their experiences of interference were often context specific, “I am a [woman] in science, and a young mother. I also work in [region redacted] Canada, in a field dominated by male scientists, and male partners within partner organizations. I have seen



where my identity has been a help, and a hindrance, depending on the project and context” (participant ID 358, Q30). This highlights the complexity of understanding social identity factors and that their influence is not bound to one experience or factor.

## Racialized groups

Racialized respondents overall reported experiencing more interference than white respondents regarding fear of consequences due to public commentary and being subject to external sources of interference in their work. It is possible that racialized respondents reported higher rates of interference from external sources, such as from workplace policy and senior management, because these sources can perpetuate racism and systemic discrimination (Walter et al. 2017; Watson-Thompson et al. 2022). Discriminatory policies can disadvantage racialized groups by interfering with their ability to conduct and disseminate their work, practice public commentary, impact social well-being, researcher retention, and, as suggested by the data, make them more fearful of negative career consequences due to public commentary (Miller and Garrañ 2007; Miriti 2020; Watson-Thompson et al. 2022). This was exemplified by PARID 164: “I am a member of a cultural minority. I am excluded from many departmental social events. I do not feel that I will have the support of my colleagues if any of the work that I do becomes controversial” (Q30). These results echo current literature that demonstrates that systemic racism/discrimination is present even in the face of “race-neutral” policies and pro-diversity statements, as racism is typically caused by learned unconscious biases (Barber et al. 2020; Livingston 2020; Mezu-Ndubuisi 2021).

## Disability

Respondents who identified as living with a visible and (or) invisible disability reported experiencing greater fear of negative career consequences due to public commentary, higher rates of external sources of interference, and undue modification to work. A possible explanation for the increased undue modification to work can be found in theoretical frameworks and research regarding ability and differing expectations for people with a disability(ies) (Wolbring and Lillywhite 2021). Specifically, individuals who disclose their disabilities in the workplace are often held to a lower expectation of performance standards. This may be due to preconceived and discriminatory notions that people with disabilities are less competent (Baumgärtner et al. 2015; Santuzzi and Waltz 2016; Wolbring and Lillywhite 2021).

These results strengthen calls for additional EDI policies directed towards people with disability(ies), given that they experience higher rates of discrimination and barriers in the workplace, yet receive less public attention (Baumgärtner et al. 2015; Santuzzi and Waltz 2016; Casey 2020; Meeks et al. 2020). Indeed, despite the emergence of many EDI and diversity initiatives and policies, disability considerations are often minimal or only superficially mentioned (Casey 2020; Meeks et al. 2020). Maintaining the stance that continued con-

crete action for the inclusion and support for people with a disability(ies) in the workplace is needed.

## 2SLGBTQI+

Respondents that identified as 2SLGBTQI+ were found to experience greater fear of negative career consequences due to public commentary. This is consistent with research by Cech and Waidzunus (2021) who found that that 2SLGBTQI+ STEM professionals were less confident that they could whistleblow without fear of retaliation. Beyond the ethical and legal issues this raises, Cech and Waidzunus (2021) also highlighted how these issues can have further health-related consequences (i.e., insomnia, stress, and depressive symptoms) and lead to lower retention rates. Cech and Waidzunus’ research also found that 2SLGBTQI+ professionals in STEM were experiencing reduced career opportunities for advancement and resources (e.g., administrative support and managerial guidance), along with feelings of social marginalization and professional devaluation of their STEM expertise (Cech and Waidzunus 2021). Our study, however, did not find that 2SLGBTQI+ respondents experienced significantly greater experiences of externally imposed interference (which included from managers, and colleagues and peers). A possible explanation for the differences in findings could be the survey populations. The Cech and Waidzunus study was conducted in the United States of America, where surveys have shown to have a lower acceptance rate of 2SLGBTQI+ peoples than Canada (Mazzuca 2002; Poushter and Kent 2020; Flores 2021).

## Impacts of interference on research, researchers, and the integrity of science

Significant differences were observed across 11 of the 25 quantitative measures. This is a concern as interference can impact the well-being of researchers themselves, especially for marginalized researchers, many of whom are already dealing with compounding challenges in the workplace due to identity-related discrimination and stress (Baumgärtner et al. 2015; Dyer et al. 2019; Fine et al. 2020; Cech and Waidzunus 2021; Watson-Thompson et al. 2022). These impacts can have serious repercussions on researchers’ mental health, job satisfaction, researcher retention, and cause moral compromise (Hall et al. 2019; Miriti 2020; Driscoll et al. 2021; Robertson et al. 2023).

Interference in research and self-censorship of researchers also have implications within society. For example, leading to ill-informed public and decision/policy-makers regarding current environmental issues, concerns, and solutions (Lester and Foxwell-Norton 2020; Driscoll et al. 2021; Kaiser et al. 2022; Robertson 2022). This can lead to erosion of democratic processes, which are reliant on transparent information (McNie 2007; Douglas 2012; Hahn 2019; Lester and Foxwell-Norton 2020; Kaiser et al. 2022), lack or misinformation about environmental issues (Measham et al. 2011; Treen et al. 2020), and (or) less effective environmental and conservation policies (PIPSC 2013; Driscoll et al. 2021). The increased experience of interference by marginalized groups can also

have broader implications for society as limited representation of marginalized groups may lead to reduced scientific novelty (Hofstra et al. 2020) and lower quality, quantity, and impact of the research (Hong and Page 2004; Freeman and Huang 2014). As well, limited representation could lead to environmental policies that do not reflect marginalized communities' environmental concerns (Masuda et al. 2008; Taylor 2018; Apakupakul 2020; Massey et al. 2021).

## Intersectionality

Intersectionality considers how multiple aspects of someone's identity (e.g., race, gender, and sexual orientation) interact with one another to affect one's social interpersonal experiences, including at work (Crenshaw 2006; Dancy et al. 2020), and could be an important factor in experiences of interference. We were unable to test for differences in experience across intersectional identities of marginalized groups in this study due to low sample sizes across intersections (e.g., racial and 2SLGBTQI+ minority). Though we were unable to do it among different social identity factors, intersectionality was considered with Robertson et al. (2023) results. Robertson et al. (2023) found that early career researchers were more likely to experience interference than established researchers, suggesting that researchers' career stage may influence their experiences of interference. Consolidating this with social identity, early career researchers were found to have increased level of diversity regarding gender and 2SLGBTQI+ respondents but roughly equal levels of diversity regarding race and disability status. These results suggest that intersectionality is important and complex, and that social identity and career stage are both important considerations when trying to understand interference.

## Sample demographics and the Canadian population

The data do not provide insight as to whether factors relating to interference were hindering with the ability of researchers from marginalized identities to participate in the environmental studies and sciences workforce. There is no census or robust sample of the demographics of researchers in the environmental studies or sciences in Canada or elsewhere in the world. Our study provides the closest known approximation in Canada. We compared the survey respondents' social identity demographics to Canadian demographics (as reported in the 2016 Census) (Stats Canada 2021) to compare the proportion of demographic groups in our sample against their proportion in the Canadian population. The 2016 census did have some differences in data collection (e.g., collecting sex rather than gender), and thus these comparisons should be interpreted with caution. However, with this in mind, we found that women and respondents with a visible and (or) invisible disability were considerably underrepresented among our sample compared to their proportion in the broader Canadian demographics: 38% of our sample were women versus 51% according to the census (Stats Canada 2021), and 12% of our sample identified as having a disability versus 22% in Canada (Morris et al. 2018). Interestingly, respondents who identified as 2SLGBTQI+ in our sample were

represented at double the proportion reported by Statistics Canada (8% versus 4%) (Stats Canada 2021). All other groups were observed at similar rates.

Reported demographics in our survey sample may be different compared to Canadian demographics due to survey bias or insufficient sample size. However, there is documentation that marginalized groups are underrepresented in this field. In the US, marginalized racial groups are found to be underrepresented among researchers in the environmental studies and sciences (Haynes et al. 2015; Browner and Cid 2021). Other studies have found that women are underrepresented in top publishing ecology papers globally (Maas et al. 2021), and marginalized groups are underrepresented among university professors in Canada (Canadian Association of University Teachers 2018). We therefore believe that the underrepresentation of marginalized groups in our sample is an indication of a real pattern impacting the environmental studies and sciences in Canada.

## Limitations and future directions

First, due to the nature of the survey and self-selection bias, the number of respondents who have experienced interference could be overrepresented (Bethlehem 2010; Driscoll et al. 2021). Second, as noted in Methods section, some of the groups had insufficient sample sizes and therefore had to be aggregated with other groups. This compromised our ability to understand the unique experiences of those from smaller social identity groups or to understand intersectional experiences. For example, we had to combine all racialized respondents into one group, even though unique racialized identities can experience different barriers in the workplace (Smith and Calasanti 2005).

Third, there was only one coder of the open text responses. Results could have been strengthened by the addition of a second coder to establish intercoder reliability. Intercoder reliability could have been beneficial as the coding process required subjective application of a posteriori codes, which could have been influenced by the coder's positionality and biases (Burla et al. 2008).

Finally, the researchers' reported experiences of interference and their attributed causes are subjective, self-reported, and not externally validated. How researchers experience interference is unique and an act or instance that may be perceived as interference by one researcher may not be perceived that way by another. As well, there are likely instances of legitimate and illegitimate forms of interference reported, but the ability to distinguish between them is limited due to the subjectivity of self-reported experiences (Robertson et al. 2023). However, this does not diminish the findings from this research as researchers, like all people, experience the world subjectively, and therefore understanding their subjective experiences is important (Sikes and Dunn 2020).

We make several recommendations for future work that both address the limitations of the current study and could meaningfully improve the circumstances for researchers from marginalized identities. First, we recommend a more thorough report of demographics of environmental researchers in Canada that includes additional social iden-

ties, including income distribution and immigration status. This echoes calls in other literature, which have found that income distribution and immigration status play critical roles in understanding discrimination (Krieger et al. 2006; Halanych et al. 2011; Di Napoli et al. 2021) and can set a baseline for understanding who comprises the workforce in environmental studies and sciences and what their experiences may be in Canada.

Second, further investigations should include an analysis of intersecting identities. Studying intersectionality is important because it looks at multiple social identity factors and how they relate to one another; in other words, how someone experiences the world cannot be reduced to a single quality (UBC 2021). We observed recognition of white male privilege from open text responses but were not able to study intersectional experiences of marginalized groups, which requires a larger and more diverse sample.

Third, even in light of increasing EDI policy and great strides that have been made in creating more equitable workplaces, systemic discrimination of marginalized groups still exists (National Research Council of Canada 2018; Taylor 2018; Employment and Social Development Canada 2019; Lyle 2021; Skinner-Dorkenoo et al. 2021). Hence, continuing to put effort and resources into actions and policies that are shown to be effective is essential. Examples of these include promoting and installing EDI policies in the workplace (Government of Canada 2021); increasing anti-discrimination and anti-racism education in workplaces in a meaningful way that avoids ineffective “check-off-the-box” approaches (Massey et al. 2021); and involving students and trainees in EDI discussions and initiatives so as to promote bilateral learning (Beck 2022).

Finally, as our survey found that over 50% of respondents experienced fear of media and many of these individuals being from marginalized groups, we echo Robertson et al. (2023) in recommending increasing protection of researchers when they interact with both traditional and social media. Drawing from suggestions by Wright et al. (2022), we recommend that institutions who employ researchers in the environmental studies and sciences (1) create training modules for researchers regarding safety and effectiveness in knowledge mobilization activities, with a section or specific focus for researchers from marginalized groups and (2) foster a readily accessible policy and action plan in place to support researchers who are significantly harassed, threatened, or intimidated because of their research, social identity, or public-facing work. In Canada, the federal government might consider collaborating with the Canada Research Coordinating Committee and other relevant agencies to coordinate a nationwide approach to gathering information about online threats and harassment across sectors. To facilitate immediate action towards supporting researchers’ communication, and in the interest of equity and accessibility, we recommend researchers and institutions consult free resources such as recorded trainings, workshops, and cohort programs provided by organizations like Evidence for Democracy (Evidence for Democracy 2013), Science and Policy Exchange (SPE, NA), RCIScience (RCIScience 2017), and the Union of Concerned Scientists (UCS, NA).

## Conclusion

We present the first known report of the role that social identity factors played in the experience of interference in science among researchers in the environmental studies and sciences in Canada, and the first such work globally. Though many respondents did not report experiencing interference, 11 of the 25 quantitative measures showed marginalized groups reporting significantly higher rates of interference than their majority counterpart. Our results showed that women reported experiencing significantly greater fear of media, fear of negative career consequences due to public commentary, and belief that their identity influenced their experience of interference. Respondents who identified as 2SLGBTQI+ responded experiencing significantly more fear of negative career consequences due to public commentary. Respondents who identified as having a visible and (or) invisible disability reported experiencing significantly more fear of negative career consequences due to public commentary, externally imposed sources of interference, and undue modification of their work. Finally, racialized (race and perceived race) respondents reported experiencing significantly greater fear of negative career consequences due to public commentary, and experiencing more externally imposed sources of interference. As well, echoing other research, demographics of environmental researchers may not be representative of Canadian demographics, with women and researchers with a disability(ies) being underrepresented (Haynes et al. 2015; Browser and Cid 2021; Maas et al. 2021). These findings matter because experiencing interference due to one’s social identity can lead to negative impacts on the researchers. For example, reduced mental health, lower retention, and self-censorship (Hall et al. 2019; Miriti 2020; Driscoll et al. 2021; Robertson et al. 2023). Diverse voices, however, are important because they provide higher quality research, more equitable and safe workplaces, and more scientific novelty (Hong and Page 2004; Freeman and Huang 2014; Fine et al. 2020; Hofstra et al. 2020). In conclusion, understanding and preventing interference based on social identity is important in helping environmental studies and sciences become more inclusive, barrier- and discrimination-free, and more protective of environmental researchers who are working to address the global complex challenges of climate change and furthering environmental changes and losses.

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### Data availability

Raw data generated and analyzed during this study are not available due to the privacy and protection considerations of survey respondents. This is in accordance with this research's ethics submission that was approved by the Dalhousie Research Ethics Board on 22 July 2021 (REB # 2021-5630). Aggregated data results are available as seen in Results section and [Appendix A](#).

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### Author notes

The authors also wish to recognize our positionality, which led to our interest in this work. The research team was comprised of women-identifying researchers, some who are also from racialized backgrounds and some who identify as 2SLGBTQI+. We bring perspectives from multiple academic

disciplines (management, communications, biology, ecology, and psychology), different career stages, and have lived and worked in several Canadian provinces in academia, non-profits, and the public sector. Though having different backgrounds, all researchers were born and raised in Canada. This research was carried out in alignment with the value statement of the Westwood Lab Manual ([Westwood Lab 2023](#)).

## Author contributions

Conceptualization: MER, ARW

Data curation: MER

Formal analysis: SMC, AC

Funding acquisition: ARW

Investigation: SMC, MER

Methodology: MER, ARW

Project administration: SMC, MER

Supervision: ARW

Writing – original draft: SMC

Writing – review & editing: MER, AC, SA, ARW

## Competing interests

The authors have declared that no competing interests exist.

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## Appendix A

### Consent form



**DALHOUSIE  
UNIVERSITY**

### Consent form

INTERFERENCE IN CANADIAN SCIENCE: DOCUMENTING SCIENTISTS' PERCEPTIONS OF THEIR ABILITY TO CONDUCT AND COMMUNICATE ENVIRONMENTAL RESEARCH

[Versioning: after receiving ethics approval, add the date of approval and the consent form version number. The first approved version is v1.0. If subsequent amendments to the consent form are requested and approved, the date of approval and version number (e.g., v2.0) must be updated.]

**Who is conducting this study?** This research study is being conducted by MER (MES candidate) and ARW (assistant professor) at the School of Resource and Environment Studies at Dalhousie University. The research is primarily funded by Dalhousie University through the Dean's Collaborative Research Grant.

**What is the study about?** The purpose of this study is to document the ability of researchers in environmental studies and sciences to conduct and communicate their scientific research. The study is funded by Dalhousie University.

**What do I have to do?** If you choose to participate, you will be asked to anonymously answer questions to inform the research team about your perspectives on interference with research on environmental sciences or studies. We will also ask for your demographic information.

All responses are anonymous.

**Is my participation voluntary?** Your participation in this research is entirely your choice. There are no right or wrong answers, our aim is to understand your perspective on the issue of interference. Excerpts from responses to long-form survey questions may be used in the report, only if the information could not possibly reveal the identity of the response author. You may choose "prefer not to answer" where applicable and may stop the survey at any time by closing the browser window. Recorded responses cannot be deleted after submitting the survey as they are anonymous. If you do not submit your responses by clicking "Submit" at the end of the survey, your responses will be deleted from the data set.

The survey should take approximately 25–30 min to complete.

**What will happen to my responses?** The findings of the research will be shared anonymously and in aggregate via theses, peer-reviewed papers, summary graphics for social media, news releases, and presentations. Your demographic data may also be shared with the scientific societies that you indicate membership to, if they disseminated the survey to you and requested the data in exchange. Aggregate findings for particular identity groups will only be shared if there are a minimum of 10 respondents in that category. All data will be kept indefinitely in secure storage (locked hard drives) for the possibility of be re-analyzed in future as part of longitudinal research.

**Are there any risks?** The risks associated with this study include potential emotional distress in recalling and recounting experiences with interference to your scientific work that may have been negative or traumatizing. If you experience this, we recommend reaching out to your organization's Employee Assistance Program if applicable or using the following services to seek counselling and support.

Canadian Mental Health Association (613)-549-7027

Crises Help Line (CAN) 1-800-233-4357

**What are the benefits?** There will be no direct benefit to you for participating in this research. The research, however, might contribute to new knowledge on the prevalence and impacts of interference in science in Canada. Participating in the research study ensures that your perspective is included in the case that the research is successfully mobilized to impact the training, programs, and policy of science advocacy groups and governments. If you interested in receiving direct communication about the results of the research or be involved in future research, you will have the option to confidentially provide your email address to the research team via an external form which will be in no way connected to your survey responses.

**What about compensation?** To thank you for your time, you may choose to enter a draw for a chance to win one of three \$50 gift cards to an online store of your choice or donate to the organization/charity of your choice upon completing and submitting the survey. Your contact information for the draw will not be linked in any way to your survey responses.

**Where can I direct my questions?** You should discuss any questions you have about this study with ARW and MER. Please ask as many questions as you like before or after participating by contacting [woodlab@dal.ca](mailto:woodlab@dal.ca). If you have any ethical concerns about your participation in this research, you may contact Research Ethics, Dalhousie University at (902) 494-3423, or email [ethics@dal.ca](mailto:ethics@dal.ca) (and reference REB file # 20XX-XXXX).

If you consent to participate, please click "I consent" below.

**CONSENT TO PARTICIPATE:**

- I consent. (continue to initial survey)
- I do not consent. (exit study)



#### Question response type legend:

- Multiple choice
- Multiple checkbox
- \* Response type indicated with text \*

### Complete survey

1. Do you identify as a researcher in the environmental studies or sciences?
  - Yes
  - No
2. Are you currently working/employed in the field of environmental studies or sciences?
  - Yes
  - No
3. In what Canadian Province or Territory do you predominantly conduct your work?
  - British Columbia
  - Alberta
  - Saskatchewan
  - Manitoba
  - Ontario
  - Quebec
  - New Brunswick
  - Nova Scotia
  - Prince Edward Island
  - Newfoundland and Labrador s
  - Northwest Territories
  - Nunavut
  - Yukon
4. Please indicate your primary areas of research or your discipline(s). You may select up to three of the following.
  - Civil, Industrial and Systems Engineering
  - Chemical, Biomedical and Materials Science Engineering
  - Mechanical Engineering
  - Electrical Engineering
  - Computing Sciences
  - Mathematical Sciences
  - Physics and Astronomy
  - Chemistry
  - Geosciences
  - Evolution and Ecology
  - Cellular and Molecular Biology
  - Plant and Animal Biology
  - Psychology
5. Please indicate the full names of all the scientific societies where you hold membership. If there is more than one, separate the names using semi-colons.
 

\*Open text response\*
6. What career stage are you in?
  - Early career researcher: first employed as a researcher (inclusive of postdocs) after 2015
  - Established researcher: first employed as a researcher before 2015
  - Retired

Please indicate your agreement with the following statements on a scale of 1–5 (1: Strongly disagree, 2: Somewhat disagree, 3: Neither agree nor disagree, 4: Somewhat agree, 5: Strongly agree, 6: not applicable).

7. I am aware of cases where the health and safety of Canadians (or environmental sustainability) has been compromised because of political interference with scientific work at my organization.

8. I am aware of cases where my organization has suppressed or declined to release information, and where this led to incomplete, inaccurate, or misleading impressions by the public, regulated industry, the media and (or) government officials.
9. I am aware of cases where the exchange or transfer of knowledge based on scientific evidence for the purpose of developing policy, law, and (or) programs at my organization has been compromised by political interference.
10. Have you ever experienced “undue modification” to your work by your organization, such as substantive changes to a text or story that downplays, masks, or includes misleading information about environmental impacts?
  - Yes
  - No
  - Unsure
11. If yes, who asked you to make the modifications and for what reason?  
\*Open text response\*

Please indicate your agreement with the following statements on a scale of 1–5 (1: Strongly disagree, 2: Somewhat disagree, 3: Neither agree nor disagree, 4: Somewhat agree, 5: Strongly agree, 6: not applicable).

12. I am allowed by my organization to speak freely and without constraints to the media about my research in the environmental studies or sciences.
13. I have received a question from the public or media that I have the expertise to answer but have been prevented from doing so by my organization.
14. Please indicate which topic areas you have experienced constraints on communication, in mainstream or social media, from your organization/present workplace. (check only those options that are applicable).  
“Constraints on communication” refers to any pressure applied to deter public or political engagement, or provision of information or commentary in areas that you are scientifically knowledgeable.
  - ☐ 1 = Biosecurity
  - ☐ 2 = Climate change
  - ☐ 3 = Native species that some consider pests
  - ☐ 4 = Extinctions
  - ☐ 5 = Feral animals
  - ☐ 6 = Invasive/exotic plants
  - ☐ 7 = Firewood collection
  - ☐ 8 = Fishing, commercial
  - ☐ 9 = Fishing, recreational
  - ☐ 10 = Hunting
  - ☐ 11 = Impacts of agriculture
  - ☐ 12 = Impacts of mining
  - ☐ 13 = Impacts of urban development
  - ☐ 14 = Indigenous land management
  - ☐ 15 = Land use planning
  - ☐ 16 = Logging
  - ☐ 17 = Native vegetation clearing
  - ☐ 18 = Pets
  - ☐ 19 = Pollution
  - ☐ 20 = Sustainable use of native species
  - ☐ 21 = Threatened species
  - ☐ 22 = Changes to legislation or policy
  - ☐ 23 = Other (please list)
  - ☐ 24 = I have not experienced any constraints
15. Please explain the nature of these constraints (optional).  
\*Open text response\*
16. Please indicate your agreement with the following statements on a scale of 1–5 (1: Strongly disagree, 2: Somewhat disagree, 3: Neither agree nor disagree, 4: Somewhat agree, 5: Strongly agree, 6: not applicable).  
My public commentary in areas where I am scientifically knowledgeable is constrained by;  
“Public commentary” refers to any information contributed in interviews with media and media statements or editorials, including social media. By “knowledgeable” we mean having enough knowledge to be able to make a professionally informed contribution to public debate.
  - 1 = My belief that scientists have no role in making public commentary beyond information provision
  - 2 = My concern about how I may be represented by the media
  - 3 = My fear of being drawn to comment beyond the boundaries of my expertise
  - 4 = My uncertainty about the boundaries of my expertise

5 = My belief that my primary obligation is to my organization, rather than to the public

6 = My stress around discussing contentious issues

7 = My fear of risking funding opportunities

8 = My fear of being made redundant

9 = My fear of reducing opportunities for advancement

10 = My workplace colleagues/peer pressure/work culture

11 = My workplace policy

12 = My middle management

13 = My senior management

14 = The Minister's office

17. Has your job satisfaction ever been affected by restraints on public commentary and peer communication?

- ☐ Yes
- ☐ No
- ☐ Unsure

18. If yes, please briefly explain how your job satisfaction was affected.

\*Open text response\*

19. How would you define the term "interference in science"?

\*Open text response\*

20. Are you aware of the Scientific Integrity Policies implemented in Canadian federal government departments by in 2019?

- ☐ Yes
- ☐ No

21. If yes, do you feel that the implementation of these policies has had an impact on the ability of researchers in the environmental sciences and studies in Canada to conduct and communicate research? Please explain.

\*Open text response\*

22. How do you identify your gender?

- ☐ Woman
- ☐ Man
- ☐ Non-binary
- ☐ Prefer not to say
- ☐ \*Text Fill\*

23. Would you describe yourself as transgender?

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

24. Do you identify as a member of any marginalized group in terms of sexual orientation? (LGBQ2S+)

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

25. How do you identify in terms of racial and ethnic identity (select all that apply)?

- ☐ Black, African-Canadian, person of African descent
- ☐ Indigenous (First Nations, Inuit, Metis)
- ☐ East Asian (including Chinese, Japanese, Korean, etc.)
- ☐ South Asian (including East Indian, Indian from India, Pakistani, Sri Lankan, Bangladesh, East Indian from Guyana, East Africa, Trinidad, etc.)
- ☐ South East Asian (including Burmese, Cambodian, Filipino, Laotian, Thai, Vietnamese, etc.)
- ☐ Non-White West Asian
- ☐ North African or Arab (including Afghan, Armenian, Algerian, Egyptian, Iranian, Israeli, Lebanese, Libyan, Palestinian, Syrian, etc.)
- ☐ Non-White Latin American (including indigenous persons from Central and South America, etc.)
- ☐ Pacific Islander
- ☐ White Canadian or of White European descent
- ☐ Prefer not to disclose

26. How are you typically perceived in terms of racial and ethnic identity (select all that apply)?

- ☐ Black, African-Canadian, person of African descent
- ☐ Indigenous (First Nations, Inuit, Metis)
- ☐ East Asian (including Chinese, Japanese, Korean, etc.)
- ☐ South Asian (including East Indian, Indian from India, Pakistani, Sri Lankan, Bangladesh, East Indian from Guyana, East Africa, Trinidad, etc.)
- ☐ South East Asian (including Burmese, Cambodian, Filipino, Laotian, Thai, Vietnamese, etc.)

- ☐ Non-White West Asian
  - ☐ North African or Arab (including Afghan, Armenian, Algerian, Egyptian, Iranian, Israeli, Lebanese, Libyan, Palestinian, Syrian, etc.)
  - ☐ Non-White Latin American (including indigenous persons from Central and South America, etc.)
  - ☐ Pacific Islander
  - ☐ White Canadian or of White European descent
  - ☐ Prefer not to disclose
27. Do you identify as an individual living with a disability (select all that apply)?
- ☐ Yes, visible
  - ☐ Yes, invisible
  - ☐ No
  - ☐ Prefer not to say
28. In your workplace do you wear a visible signifier of a religious affiliation (e.g., hijab, cross, kippah)?
- ☐ Yes
  - ☐ No
  - ☐ Prefer not to answer
29. Do you believe that your identity and (or) demographics have influenced your experiences with interference in your research?
- ☐ Yes
  - ☐ No
  - ☐ Unsure
30. Please explain why or why not (optional).  
\*Open text response\*
31. Is there anything not covered in the survey questions that you would like us to know?  
\*Open text response\*

\*Submit\*

## Data Analysis

### Chi-square tests

#### Q10 Undue modification

Variable Group Comparison	n	Percentage No.	Percentage Yes	X-squares	Degrees of freedom	p value
<b>Gender</b>				1.99	1	0.16
<b>Man</b>	408	92	8			
<b>Women</b>	251	89	11			
<b>2SLGBTQI + status</b>				1.87	1	0.17
<b>2SLGBTQI+</b>	51	84	16			
<b>Non-2SLGBTQI+</b>	612	91	9			
<b>Disability Status</b>				28.93	1	<0.01
<b>No disability</b>	588	92	8			
<b>Visible and (or) invisible disability</b>	77	73	27			
<b>White and racialized (perceived race)</b>				0.61	1	0.43
<b>White</b>	550	90	10			
<b>Racialized</b>	103	93	7			
<b>White and racialized (race)</b>				0.06	1	0.81
<b>White</b>	544	90.5	9.5			
<b>Racialized</b>	109	92	8			



## Q29 Influence of identity on their experience of interference

Variable Group Comparison	n	Percentage No.	Percentage Yes	X-squares	Degrees of freedom	p value
<b>Gender</b>				12.36	1	<b>&lt;0.01</b>
<b>Man</b>	377	78	22			
<b>Women</b>	221	65	35			
<b>2SLGBTQI + status</b>				1.09	1	0.30
<b>2SLGBTQI+</b>	43	65	35			
<b>Non-2SLGBTQI+</b>	552	74	26			
<b>Disability Status</b>				1.45	1	0.23
<b>No disability</b>	536	73	27			
<b>Visible and (or) invisible disability</b>	63	65	35			
<b>White and racialized (perc race)</b>				<0.01	1	1
<b>White</b>	490	72	28			
<b>Racialized</b>	94	72	28			
<b>White and racialized (race)</b>				2.51	1	0.11
<b>White</b>	482	74	26			
<b>Racialized</b>	104	65	35			

## T-tests

### Gender affiliation

Variable Comparison Group	n	Group Means	Standard Deviation	T statistic	Confidence Interval	Degrees of freedom	p value
<b>Media (Q16.2,3,6)</b>				-5.80	-0.68 -0.34	538.92	<b>&lt;0.01</b>
<b>Man</b>	395	2.79	1.19				
<b>Women</b>	257	3.30	1.21				
<b>Consequences of public commentary (Q16.7,8,9)</b>				-2.02	-0.37 -<0.01	496.48	<b>0.04</b>
<b>Man</b>	384	2.02	1.14				
<b>Women</b>	251	2.21	1.22				
<b>External (Q16.10:14)</b>				-0.77	-0.27 0.12	451.52	0.44
<b>Man</b>	369	2.07	1.20				
<b>Women</b>	224	2.15	1.21				

### 2SLGBTQI± status

Variable Comparison Group	n	Group Means	Standard Deviation	T statistic	Confidence Interval	Degrees of freedom	p value
<b>Media (Q16.2,3,6)</b>				0.49	-0.23 0.38	58.9	0.65
<b>2SLGBTQI+</b>	50	3.05	1.02				
<b>Non-2SLGBTQI+</b>	607	2.98	1.24				
<b>Consequences of public commentary (Q16.7,8,9)</b>				3.81	0.31 0.98	58.0	<b>&lt;0.01</b>
<b>2SLGBTQI+</b>	51	2.69	1.20				
<b>Non-2SLGBTQI+</b>	589	2.04	1.15				
<b>External (Q16.10:14)</b>				1.53	-0.09 0.71	46.33	0.13
<b>2SLGBTQI+</b>	42	2.39	1.30				
<b>Non-2SLGBTQI+</b>	554	2.08	1.20				

## Disability status

Variable Comparison Group	<i>n</i>	Group Means	Standard Deviation	<i>T</i> statistic	Confidence Interval	Degrees of freedom	<i>p</i> value
<b>Media (Q16.2,3,6)</b>				−0.32	−0.31 0.22	100	0.74
<i>No Disability</i>	579	2.99	1.24				
<i>Visible and (or) invisible disability</i>	79	3.03	1.18				
<b>Consequences of public commentary (Q16.7,8,9)</b>				−1.96	−0.59 <0.01	94.01	<b>0.03</b>
<i>No Disability</i>	562	2.06	1.15				
<i>Visible and (or) invisible disability</i>	78	2.35	1.27				
<b>External (Q16.10:14)</b>				−2.18	−0.69 −0.03	84.70	<b>0.03</b>
<i>No Disability</i>	527	2.07	1.19				
<i>Visible and (or) invisible disability</i>	71	2.43	1.32				

## White and racialized (race)

Variable Comparison Group	<i>n</i>	Group Means	Standard Deviation	<i>T</i> statistic	Confidence Interval	Degrees of freedom	<i>p</i> value
<b>Media (Q16.2,3,6)</b>				−0.30	−0.026 0.19	158.42	0.76
<i>White</i>	540	3.00	1.20				
<i>Racialized</i>	109	2.96	1.28				
<b>Consequences of public commentary (Q16.7,8,9)</b>				3.43	0.19 0.72	136.5	<b>&lt;0.01</b>
<i>White</i>	525	2.02	1.10				
<i>Racialized</i>	107	2.47	1.38				
<b>External (Q16.10:14)</b>				2.50	0.069 0.59	143.44	<b>0.01</b>
<i>White</i>	483	2.04	1.17				
<i>Racialized</i>	104	2.37	1.31				

## White and racialized (perceived race)

Variable Comparison Group	<i>n</i>	Group Means	Standard Deviation	<i>T</i> statistic	Confidence Interval	Degrees of freedom	<i>p</i> value
<b>Media (Q16.2,3,6)</b>				0.17	−0.22 0.26	135.24	0.86
<i>White</i>	549	2.99	1.19				
<i>Racialized</i>	99	3.01	1.32				
<b>Consequences of public commentary (Q16.7,8,9)</b>				3.62	0.23 0.78	119	<b>&lt;0.01</b>
<i>White</i>	534	2.01	1.09				
<i>Racialized</i>	96	2.51	1.40				
<b>External (Q16.10:14)</b>				2.17	0.03 0.58	124.52	<b>0.03</b>
<i>White</i>	491	2.00	1.17				
<i>Racialized</i>	94	2.36	1.31				

## Code book

### PARID ID

– [fill]

### Gender

- Man
- Woman

Has your identify influenced whether you have experienced interference or not

- Yes
- No
- Unsure

Respondent has experienced interference or not

- Has NOT experienced interference
- HAS experienced interference
- Unsure if they have experienced interference
- Other

### Reason for experiencing interference or not

Code	Definition
Attributes having experienced interference to (or possibly to) their gender	Believes their gender has negatively influenced their experience. Key words for this code include “sexism”, “unfair or unequal treatment”, etc.
Attributes not (or possibly not) having experienced interference to their gender	Believes their gender has positively or had no impact on their experience of interference. Key words include “privilege”, “benefitted”, etc.
Attributes having experienced interference to (or possibly to) their race or ethnicity	Believes their race has negatively influenced their experience. This point also included if a respondent believes their “non white” name has negatively influenced their experience
Attributes not (or possibly not) having experienced interference to their race and ethnicity	Believes their race or ethnicity has positively or had no impact on their experience of interference. Key words include “privilege”, “benefitted”, etc.
Attributes having experienced interference to (or possibly to) their sexual orientation	Believes their sexual orientation or 2SLGBTQI+ status has negatively influenced their experience. Key word is “homophobia”
Attributes not (or possibly not) having experienced interference to their sexual orientation	Believes their sexual orientation or 2SLGBTQI+ status has positively or had no impact on their experience of interference. Key words include “privilege”, “benefitted”, etc.
Attributes having experienced interference to (or possibly to) their disability status	Believes their disability status has negatively influenced their experience. Key word is “ableism”
Attributes not (or possibly not) having experienced interference to their disability status	Believes their disability or ability status has positively or had no impact on their experience of interference. Key words include “privilege”, “benefitted”, etc.
Attributes having experienced interference to (or possibly to) external or internal workplace or political pressure	Cites workplace pressure or political pressure as being the more significant reason as to whether they have experienced interference or not
Attributes experiencing of interference to their immigration status	Believes their immigration status has been a source of interference or discrimination.
Believes social identity should not or does not play a role in the workplace or experiencing interference	Believes social identities should not or do not play a role in the workplace or influencing someone’s experience of interference
Attributes experience of interference (high or low) to career stage	Believes their career stage has influenced whether they have experienced interference or not.
Attributes experiencing interference or barriers to their language	Believes they have experienced interference due to a language barrier.
Other	Use sparingly