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## **“Deep Questions for a Saturday Morning”: An Investigation of the Australian and Canadian General Public’s Definitions of Gender**

### **Abstract**

*Objective.* Many studies exist about people’s views of gender in a wide variety of fields. However, participants are not typically asked what they think *gender* means; rather, *gender* is presumed to have a taken-as-shared meaning. *Methods.* As part of a larger study conducted in Australia and Canada about the general public’s views of gender and mathematics, we investigated participants’ definitions of the term *gender*. We considered overall trends and trends by demographic group (country, gender, age, and education level). *Results.* Most commonly, gender was defined as a person’s feelings or self-identification. Participants also frequently solely used the terms *male* and *female* or discussed biological features. However, response patterns varied widely by demographic group. *Conclusion.* Due to these diverse and sometimes contradictory definitions, we argue that researchers cannot assume that participants have common understanding of the term *gender*. We conclude by providing suggestions for how gender-focused research can be done in more transparent ways.

### **Keywords**

definitions of gender; general public; Australia; Canada

### **Introduction**

People’s understandings and definitions of gender remain unclear (Hegarty, 2018; Muehlenhard & Peterson, 2011). There are, however, many studies about people’s views of gender stereotypes (e.g., Carter et al., 2009; Haines et al., 2016; Löckenhoff et al., 2014) and the links between gender and various subject areas, particularly science, technology, engineering, and mathematics (STEM; e.g., Hazari et al., 2013; Ma, 2011). For example, in our field of mathematics education, Forgasz and Leder worked with an international team of researchers to explore the general public’s views of gender and mathematics in Australia, Canada, South Korea, Spain, and the United Kingdom (e.g., Forgasz & Leder, 2011; Forgasz et al., 2014). Despite the large number of studies about people’s views of gender in a wide variety of fields, these studies do not involve participants actually being asked what they mean (or understand) by the term *gender*. Instead, the term *gender* is treated as a taken-as-shared concept, with the presumption that everyone conceptualizes it the same way (and thus is answering the questions in the study from the same viewpoint), which is not the case (Coleman & Hong, 2008; Muehlenhard & Peterson, 2011).

In the recent past, gender diversity has become more mainstream in popular media portrayals (e.g., transgender and non-binary characters on television shows such as *Glee*, *Grey’s Anatomy*, *Orange is the New Black*, and *She-Ra and the Princesses of Power*), as well as more commonplace in the general public’s understandings. We were interested in exploring the general public’s views of gender in this time of societal shifts. To provide varied,

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but comparable, perspectives on this issue, we selected Australia and Canada as our research sites, as these countries are both Commonwealth countries where the majority of the population speaks English. The research questions that guided our study were: 1) How do members of the Australian and Canadian general public define the term *gender*? and 2) How do these definitions vary by demographic group (country, gender, age, or education level)?

### **Theoretical Framework**

In this section, we present the frameworks that guided our study. First, we discuss our epistemological stance, which formed the basis of our reimagining of Forgasz and Leder’s study about the general public’s views of gender and mathematics in a non-binary manner. To further emphasize the complexity of gender as a construct, we provide definitions of key terms and argue that clarity in terminology is lacking in research.

Broadly, we framed the study with a feminist and social constructivist epistemological stance. Consequently, we conceptualize gender as a performative and non-binary social construct (Butler, 1999; Ho & Mussap, 2019; Lindqvist et al., 2020; Lorber, 2018). More specifically, we conceive of gender as the “behavioral, social, and psychological characteristics” (Pryzgodna & Chrisler, 2000, p. 554) of women, men, and non-binary individuals. The umbrella term *non-binary* encapsulates a wide variety of gender identities outside of the man/woman (or boy/girl) gender binary, such as genderqueer, two-spirit, agender, and pangender (Harrison et al., 2012; Ho & Mussap, 2019; Matsuno & Budge, 2017). Gender is “brought into existence as people act in ways accountable in terms of gender norms” (Connell, 2018, p. 342). What is considered appropriate for one’s gender (i.e., gender norms) is not stagnant; rather, such ideas shift over time and differ by culture and geographical location.

Similarly, the terminology that is used to discuss gender, particularly non-binary genders, is also shifting and contextual. It is important to differentiate between the terms *gender* and *sex*. The term *sex* refers to “evolved bodily features including genitals, secondary sex characteristics, genes, hormones, gonads (testes, ovaries), reproductive capacity, and more” (van Anders et al., 2017, p. 194). Like gender, sex is a social construct, one that is used to simplify the complexities of and variations in bodies (Butler, 1999; Fausto-Sterling, 2000). The terms *male*, *female*, and *intersex* are typically used to refer to a person’s sex. Hence, *man*, *woman*, and the terms listed in the previous paragraph (as examples) are appropriate to use when discussing gender (Ho & Mussap, 2019; Lindqvist et al., 2020). In a great deal of “gender” research, including that in the field of mathematics education, operational definitions are not provided for the construct of gender. Additionally, sex and gender terminology are used

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interchangeably, which is problematic due to the conflation of two different, although related, constructs (Damarin & Erchick, 2010; Esmonde, 2011; Glasser & Smith, 2008). As argued by Ho and Mussap (2019), “unnecessary uncertainty is created when the terms used are associated with sex, but gender is supposedly the topic of discussion” (p. 1). Hence, we use the aforementioned terms cautiously to refer to gender, the construct that is the focus of our study.

### **Review of Literature**

In this section, we examine literature pertaining to two key areas of research that are relevant to our study. We begin by discussing the small corpus of literature focused on participants’ views of gender (and related constructs), the focus of our study. Then, we review scholarship regarding the importance of thoughtfully designing gender demographic questions, which was a key aspect of our reimagining of Forgasz and Leder’s data collection instrument to be more inclusive. Although we analyzed our data by four demographic variables (i.e., country, gender, age, and education level), gender is a uniquely complex construct; thus, we strictly explore this variable here.

As mentioned, there is limited research about people’s conceptions of gender. Approximately two decades ago, Pryzgodna and Crisler (2000) investigated the views of both the general public and those on a college campus of the term *gender*. Most participants related the term *gender* to the terms *male* and *female* or to sex. Despite the commonality of such responses, many participants made links between gender and socialization and/or psychology. In a more recent example (Schudson et al., 2019), diverse participants were asked to define the terms *male*, *female*, *man*, *woman*, *masculine*, and *feminine*. The first two terms were generally considered by the participants to be related to biological constructs, whereas the latter two terms were generally considered to be related to sociocultural constructs. The terms *woman* and *man* were defined by the participants using a mix of biological and sociocultural constructs. Different response patterns occurred for different gender groups: Compared to transgender participants, cisgender participants typically held less complex understandings of the terms *woman* and *man*, and tended to define both these terms and *female/male* using more biological than sociocultural content. In a related study (Buck, 2016), heterosexual cisgender undergraduate students were asked to define the term *transgender*. Participants with more positive views of transgender people tended to refer to gender identity in their definition (as opposed to discussing a change of sex or gender; such discussions were associated with more negative views of transgender people and with

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the endorsement of traditional gender roles). Gender identity was the most common type of response, with approximately 60% of participants referring to this idea in their definitions. Compared to men, women tended to provide longer responses, which typically related to multiple codes. Women were more likely to refer to gender identity, whereas men were more likely to adhere to traditional gender roles. In these studies, gender was typically the focus of the group-level analyses, even though other demographic data were collected and reported (e.g., race/ethnicity, occupation). Although gender is an important variable to consider when investigating people’s definitions of the term *gender*, in our study, we also sought to understand if there were differences in the participants’ response patterns by other variables: country, age, and education level.

In addition to considerations when collecting data about participants views of gender, researchers also need to thoughtfully design questions regarding the participants’ own genders, as this variable is often used in data analysis. In the vast majority of research where demographic data pertaining to participants’ genders are collected, participants are forced to choose from binary options, typically “male” and “female” (e.g., in questionnaires), or their genders are assumed based on their appearance (e.g., in observations). Both options are problematic, for similar but different reasons. As noted, using sex terminology (*male/female*) to refer to gender is confusing and conflates the two constructs (Glasser & Smith, 2008; Ho & Mussap, 2019). Additionally, only providing binary choices excludes and marginalizes participants with non-binary genders (Broussard et al., 2018; Fraser, 2018; Waite & Denier, 2019). When non-binary participants encounter such a demographic question, they may skip it or stop completing the questionnaire. In order to be inclusive to participants of all genders, it is recommended to use a completely open-ended question (e.g., text box on a questionnaire) or to provide multiple options as well as a text box (Broussard et al., 2018; Fraser, 2018; Killermann, 2016; Rosenberg, 2017). Assuming participants’ genders based on appearance is a problematic process known as gender attribution: “the process by which an observer guesses which gender they believe another person to be” (Ryle, 2019, Section 90). In so doing, observers draw on (typically stereotypical) gender category referents to assign genders to other people (Speer, 2005). When faced with examples of individuals with non-binary, non-normative gender presentations, people tend to “manage their uncertainty...quickly re-establish the normative order of things and their belief in, and commitment to, dichotomous gender as an objective fact” (Speer, 2005, p. 83).

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Despite the known problems of collecting gender demographic data in binary ways or by appearance, there exist few examples of studies in which researchers asked participants to provide their genders in the ways recommended: using their own words, either orally or in writing. Most of these studies were small-scale studies (See Beischel et al., 2021, for a large-scale example). For instance, in research with queer undergraduate students in STEM fields, Voigt (2020) asked participants for their pronouns and their identification within the queer community, rather than explicitly asking for their genders. Similarly, in Kersey’s (2018) research with transgender students in university STEM fields, participants were asked to provide their pronouns, rather than to explicitly state their genders. In our research, we contribute to this growing body of literature by providing an example of a large-scale study in which gender demographic data were collected in an inclusive manner.

### **Methodology**

The findings reported in this article are part of a larger study about the Australian and Canadian general public’s views of gender and mathematics. In the following sections, we begin by describing the data collection instrument, an open-ended questionnaire. Then, we provide information regarding the process of data collection and the study’s participants. We conclude by outlining our data analysis methods.

#### **Instrument Design**

Our questionnaire was composed of 13 questions and had three sections: 1) demographics, 2) gender and mathematics, and 3) gender and sex terminology. Given the significance of their research on the general public’s views of gender and mathematics, we used Forgasz and Leder’s instrument (See Forgasz et al., 2014) as the starting point for our questionnaire. It is important to note that questions on Forgasz and Leder’s questionnaire were worded in a binary manner (e.g., “Who do parents believe are better at mathematics, girls or boys?”). We describe how we altered this wording in the following sections.

With respect to the demographic section of the questionnaire, as noted earlier, in many questionnaires—including the binary version of this questionnaire by Forgasz and Leder—where the data are collected face-to-face, participants’ genders are assumed based on appearance, which is problematic, as discussed earlier, in general, as well as in relation to this particular study (Author 1, 2017). Furthermore, we felt that it was important to not only ask the participants their genders, but to frame the question as open-ended, rather than forcing participants to select from pre-determined closed categories, in order to provide the most freedom possible in participants’ responses. An open-

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ended gender demographic question is the most inclusive option, and one that will not ‘other’ any group, particularly those with genders outside the binary (Broussard et al., 2018; Fraser, 2018; Killermann, 2016; Rosenberg, 2017).

We thus used the question “What is your gender?” as the first question in the demographic section of our questionnaire. We kept the age and home language questions as in Forgasz and Leder’s questionnaire, but added a question about the highest level of schooling completed by the participant to allow for further analysis by education level.

In the second section of the questionnaire, we focused on participants’ views of gender and mathematics. Thus, questions from Forgasz and Leder’s questionnaire about related fields (e.g., science) or topics (e.g., computer use) were not used. The remaining questions (about mathematics) were re-worded to strictly involve non-binary language (e.g., “Do you believe that mathematics ability is related to gender?”) so that participants were not primed to presume gender as a binary. Participants were prompted to explain their responses to each question.

In the final section of the questionnaire, we investigated participants’ understandings of gender and sex terminology. As our purposeful re-wording of Forgasz and Leder’s questions led to the inclusion of the term *gender* in the first two parts of our questionnaire, the final section of our questionnaire was meant to elucidate how the participants defined and conceptualized this and other key terms. Although we wanted to capture the participants’ initial reactions to the questions in the first two sections, we also needed to understand their conceptions of the term *gender* and any other terms that they may have used in their earlier responses. By explicitly querying participants’ understandings of these constructs, we were able to see if the participants were using terms consistently across questions. Some questions from this final section were: “How would you define the term *gender*?” and “Which terms do you associate with *gender* and which terms do you associate with *sex*?”. As with the previous section, participants were prompted to explain their responses to the gender-focused questions. At the conclusion of the questionnaire, participants were asked if they had any additional comments about gender and mathematics.

Given our objective of exploring the Australian and Canadian general public’s definitions of the term *gender*, in this article, we will be focusing on the following question: “How would you define the term *gender*?” (herein “Gender Definition Question”).

## **Data Collection**

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Data were collected in July and August of 2017 from public places in two comparable cities (one in each country) by research assistants. We surveyed members of the general public from four matched locations in each city: 1) a shopping area, 2) a tourist area, 3) a train station, and 4) a hipster area. The term *hipster* refers to a subculture of older teenagers and young, middle-class adults who are “unusually aware of and interested in new and unconventional patterns (as in jazz or fashion)” (Merriam-Webster, n.d., para. 1). These four locations were selected, based on our knowledge of the cities, to enable us to encounter individuals from a variety of backgrounds who might provide a range of perspectives. Passersby were approached and asked if they would participate in a brief, audio-recorded survey about gender and mathematics. Participants needed to be 18 years or older (i.e., legally adults in each country) to take part in the study. Surveys typically lasted 3 to 5 minutes.

### **Participants**

As discussed earlier, members of the general public ( $n = 405$ ) from two cities, one in Australia ( $n = 195$ ) and one in Canada ( $n = 210$ ), participated in the study. In order to obtain gender demographic data in an open-ended, inclusive manner, participants were asked, “What is your gender?” and described their genders in their own words. The responses were grouped into three categories: two representing binary genders and one representing non-binary genders. Although, as aforementioned, we see sex and gender as different constructs, most members of the general public use gender and sex terminology interchangeably (e.g., *woman/female*, *man/male*). Hence, we grouped such terms into the binary gender categories, which we entitled “Women/Females” and “Men/Males,” as these were by far the most common responses. A few participants with binary genders used other terms (e.g., “girl,” “bloke”). Responses such as “genderqueer,” “non-binary,” and “third gender” were grouped into the “Non-Binary” category.

The participants’ genders are shown in Table 1.

**[Insert Table 1 here]**

Overall, the proportions of participants who had binary genders were well-balanced. The proportion of participants with non-binary genders was slightly higher than the proportions (less than 1%) reported in other recent large-scale surveys of the general public in Australia, Canada, and other culturally-similar countries (Australian Bureau of Statistics, 2018; Titman, 2014; Waite & Denier, 2019). There were more women/females than men/males who participated in the study in Canada, whereas the reverse pattern held in Australia. There was a higher proportion of non-binary participants in Canada than in Australia.

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In addition to collecting data about the participants’ genders, we collected information about their ages, based on provided ranges. Specifically, 71.9% of participants were ages 18–39, 22.2% of participants were ages 40–59, and 5.9% of participants were ages 60 and older.

With respect to educational background, we asked the participants about the highest level of education that they had completed. Most commonly, participants had completed a university degree, either at the undergraduate (34.3%) or graduate (23.5%) level. In comparison, 21.5% of participants had completed high school, whereas 17.0% had completed college. We use the term *college* to refer to post-secondary institutions at which programs are offered that are typically applied in nature (e.g., laboratory technician, paralegal) or preparatory for undergraduate studies at the university level. Very few (3.0%) participants had an educational level less than high school.

### **Data Analysis**

In the following sections, we discuss our analysis methods. First, we discuss the ways that we qualitatively analyzed, using emergent coding methods (Creswell, 2014), the responses to the Gender Definition Question. Then, we discuss the quantitative analysis methods that we used for the codes that were applied to the qualitative responses to this question. In order to enable analysis, the audio-recorded questionnaire responses were transcribed verbatim by a transcription company.

### ***Qualitative Analysis Methods***

Authors 1 and 2 developed and agreed upon codes after examining a representative sample of responses for each location. We initially grouped the responses to the question into five themes. Responses in which participants strictly provided the terms *male* and *female* (without any explanation) were coded as “Male/Female.” The second code, entitled “Feelings/Identification,” was applied to responses in which participants defined gender as a personal sense of self. The third code, “Biology,” was used for responses in which participants defined gender by drawing on common ideas about sex. That is, such participants provided physical descriptions, mentioned chromosomes, and/or discussed other biological aspects in their response. The fourth code, “Sexual Orientation,” was used for responses where participants defined gender as sexual orientation (e.g., homosexual). Some participants explicitly referred to gender as a social construct, thus leading to our fifth code, entitled “Social Construction.”

There were several responses in which participants’ definitions for gender included more than one of the aforementioned categories. We first grouped these responses into one category, “Multiple Responses,” and then

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further specified which categories were used in the participants’ responses (e.g., Feelings/Identification and Biology). We used the code “Don’t Know” to refer to responses in which participants expressed uncertainty about defining the term *gender*. This code was only used if the participant clearly did not have a definition for the term *gender* (e.g., “I’m not sure. It’s hard to define.”). In cases where the participant expressed uncertainty but also gave some indication of a potential definition (e.g., “I’m not sure. I think that it’s about how a person describes themselves.”), the response was coded based on the definition given. We also grouped responses that were unclear (“Unclear Response”). For this code, responses included a random list of terms without explanations, and/or participants may have provided vague definitions or contradicted their own definitions. For example, a participant may have used the term *appearance*, but it was unclear whether the participant was describing anatomical features or gender presentation. Cases where the audio recording was not clear enough to discern the participant’s response also were given this code. Finally, a code of “No Answer” was used in cases where the participant did not answer the question.

**Coding Process.** Two members of the research team (Authors 3 and 4) were instructed by Author 2 through group coding sessions to ensure consistency of application and understanding of the codes. Data were first coded by one of these two research team members. The research team met regularly during these initial coding periods to ensure consistency of application and understanding of the codes. During one of these meetings, we noticed that some responses to the question that seemed to fit the “Male/Female” code actually included a third term (e.g., *transgender*) in addition to the aforementioned terms. We thus created an additional code for these responses: “Male/Female/Other.” Hence, the resulting list of codes used was:

- Male/Female
- Male/Female/Other
- Feelings/Identification
- Biology
- Sexual Orientation
- Social Construction
- Multiple Responses
- Don’t Know
- Unclear Response
- No Answer

Once the first round of coding was complete, the second research team member independently coded the dataset and highlighted instances where their code differed from that of the first coder. We calculated inter-rater

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reliability by dividing the total number of non-matching codes by the total number of codes (Miles & Huberman, 1994). For this question, the percentage agreement was 92.6%. Hence, the inter-rater reliability for the coding was well above the suggested level of 80% agreement on 95% of the codes (Miles & Huberman, 1994). All instances of differing codes were reviewed by Authors 1 and 2, who, upon discussion, agreed on a final code for each response.

### ***Quantitative Analysis Methods***

Once we applied the codes to the responses using the methods outlined, we quantified the responses and conducted statistical analyses. Unfortunately, the sample size and therefore the cell sizes were too small for tests of statistical significance to be conducted. Hence, the quantitative data were analyzed through descriptive statistics (e.g., counts, percentages). Responses were analyzed with respect to four demographic categories—country, gender, age, and educational level—in order to identify patterns.

### **Findings**

In the following sections, we present the findings from our qualitative and quantitative analyses of the responses ( $n = 405$ ) to the Gender Definition Question (“How would you define the term *gender*?”). Findings are presented for the dataset as a whole and then by four demographic categories: country, gender, age, and education.

Where possible, we provide illustrative examples from participants in both countries. Participants are identified by codes. The first letter in the code refers to the country (A = Australia, C = Canada). The first number refers to the location (1 = shopping area, 2 = tourist area, 3 = train station, and 4 = hipster area). The alphanumeric portion at the end of the code refers to the participant’s number within that location (e.g., C1P5 = the fifth participant in the shopping area in the Canadian city).

### **Overall Findings**

After examining the dataset as a whole, categories with few participants (i.e., under 5% of the entire sample) were combined. Namely, the following categories were combined and will be referred to herein as “Other Responses”: No Answer (3.2%), Male/Female/Other (4.7%), Don’t Know (3.2%), and Sexual Orientation (0.7%).

The overall pattern of responses to this question is shown in Figure 1.

**[Insert Figure 1 here]**

The modal response category was to describe gender as the way that a person feels or how they identify. For example, participants responded, “What you choose to identify as” (A1P10) and “By the title that a person decides

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they fit in best with, whether that may be male or female or other” (C3P16). The next most common response category pertained to responses in which participants simply provided the terms *male* and *female*, without any further description or explanation. Examples of such responses included: “Gender would be male/female” (A2P45) and “Male or female” (C3P48). As mentioned, these terms are typically used when discussing sex, rather than gender. The third most common response category pertained to anatomy, chromosomes, and/or some other aspect(s) of biology—that is, sex, rather than gender. In this case, representative examples included: “I guess for me, gender would be physical gender, so your physical traits that you were born with” (A1P25) and “The genitalia that you were born with” (C1P28). The final response category with a reasonable number of responses was Social Construction. For example, such participants responded, “Gender is a social construct and sex is how we’re anatomically put together” (A4P7) and “I would say it’s a socially constructed norm by society of what a female and male should do” (C3P54). Together, the gender-related responses (which were coded as Feelings/Identification and Social Construction) totalled 34.3% of the responses, compared to 37.2% for the sex-related responses (which were coded as Male/Female and Biology).

Although a small proportion (5.7%) of the responses, interesting trends emerged from our analysis of the responses that related to multiple codes. Of these responses, 30.4% of the participants described gender as a combination of the way that a person feels or identifies and one’s biological makeup. Participant responses of this nature included: “That’s controversial. Well, I guess you could—just in terms of anatomy and your genetics and how you were born, but it can also be based on how you identify.” (A4P48) and “I guess there’s different things. There’s identity components; there’s also biological components” (C2P11). In 26.1% of the responses with multiple codes, participants defined gender as a combination of the way that a person feels/identifies and a social construction. Representative examples included “Gender is more of a social construct, however you identify in society and how you manage yourself in society. It’s very hard to define gender. I think it’s more of a fluid thing than binary.” (A2P22) and “The social construction, or self-identification” (C4P1).

### **Findings by Demographic Group**

In order to compare the demographic groups, the three most common codes for each category are provided in Tables 2 to 5. We begin by exploring country-level comparisons, followed by comparisons by gender, age group,

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and educational group. In each table, the codes are provided in different colours to easily enable visual comparisons.

We conclude by making comparisons across the four demographic categories.

### ***Trends by Country***

The three most common codes by country are shown in Table 2.

**[Insert Table 2 here]**

As shown, similar proportions of Australian and Canadian participants provided responses that were coded as Feelings/Identification or that were coded as Biology. The stark difference in response patterns by country pertained to responses that were coded as Male/Female: This was the modal category for the Australian participants, with nearly one-third of participants providing such a response, whereas Male/Female was not even in the top three response categories for the Canadian participants.

### ***Trends by Gender***

The three most common codes by gender are shown in Table 3.

**[Insert Table 3 here]**

As shown, clear similarities were evident in the response patterns of participants with binary genders (i.e., women/females and men/males), with the same top three response categories, in the same order and with similar percentages. In contrast, although the modal response category for the non-binary participants was the same as for the participants with binary genders, the second most common response category was Social Construction, which did not even feature among the top three responses for the participants with binary genders.

### ***Trends by Age Group***

The three most common codes by age group are shown in Table 4.

**[Insert Table 4 here]**

As shown, there were some similarities between the middle age group and the youngest and oldest age groups. Namely, nearly identical proportions of participants in the two oldest age groups provided a response that was coded as Male/Female (which was the modal category for both groups), whereas this response category was only the third most common for the youngest age group, with a far lower proportion of participants than in the oldest two age groups. Similar proportions of participants from the youngest two age groups provided a response aligning with the

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Biology category, which was the second most common response for both groups. Only in the youngest age group was Feelings/Identification amongst the top three response categories; indeed, this was the modal response category.

### ***Trends by Educational Group***

The three most common codes by educational group are shown in Table 5.

**[Insert Table 5 here]**

As shown, the response patterns were very similar amongst the four highest educational groups, with Feelings/Identification as the modal response category and Biology and/or Male/Female as the second most common response category. In contrast, Male/Female was the modal response category for the ‘less than high school’ group, with more than twice the proportion of respondents, compared to the other groups in which Male/Female was in the top three response categories. However, when Biology was amongst the top three response categories (i.e., for all but the ‘college’ group), the proportion of participants with such responses was very similar in each group.

### ***Overall Trends Across Demographic Groups***

Feelings/Identification was the modal category for Canadian participants, all gender groups, the youngest age group (18–39), and all but the lowest educational group (i.e., ‘less than high school’), with percentages ranging from 20.0% to 42.9%. Notably, this theme was not even in the top three categories for the lowest educational group or the two older age groups.

For Australian participants, as well as the older age groups (40–59 and 60+) and the lowest educational group, Male/Female was the modal category, with a minimum of 30.2% of participants in any of these groups providing this response. This response was particularly common for participants with less than a high school education (58.3%). This category featured in the top three for all demographic groups except for Canadian participants, non-binary participants, and participants with a high school diploma.

Another common code, featuring in the top three response categories for 10 of the 13 demographic groups, was Biology (i.e., describing gender as pertaining to biological aspects like genitalia or chromosomes). However, this response was selected by fewer than one-fifth of the participants in any demographic group.

## **Discussion**

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In this article, we reported findings from a study of the general public’s views of gender and mathematics, conducted in comparable cities in Australia and Canada. We focused on the participants’ definitions of the term *gender*, ascertained through the Gender Definition Question (“How would you define the term *gender*?”). In this section, we summarize key trends in our findings. First, we provide a general overview of our findings. Then, we focus on country-level differences. Finally, we discuss patterns of responses by the participants’ genders.

The modal category, with more than one-quarter of the responses, was to describe gender as a person’s feelings or self-identification. Such descriptions are in alignment with most scholarly definitions of gender (e.g., Ehrensaft, 2012; Moleiro & Pinto, 2015; Steensma et al., 2013). Importantly, Feelings/Identification was the modal category for all of the demographic groups save for Australia, the two oldest age groups, and the ‘less than high school’ educational group; indeed, this category did not even feature in the top three response categories for three of these four groups (It was the second most common response for Australian participants). For these four groups, the modal category was Male/Female. In total, approximately one-fifth of the participants simply used the terms *male* and *female*, and another fifth described gender in terms of biological aspects (e.g., genitals, chromosomes). This latter type of description relates to sex, rather than gender (van Anders et al., 2017). The use of the terms *male* and *female* could be linked to ideas about sex, as these terms are typically used to refer to this construct (Ho & Mussap, 2019). However, given the evidence from our analysis of the remainder of the questionnaire data (Authors, 2018a, 2018b), it is possible that these participants were simply using the terms *male* and *female* to refer to gender rather than to intimate any ideas about biology.

Nonetheless, the commonality of responses involving solely the terms *male* and *female* is clearly indicative of binary conceptions, which were much more evident amongst the Australian participants than by Canadian participants. Namely, Male/Female was the modal response category for the Australian participants, with nearly one-third of these participants providing such a response. In contrast, Male/Female was not amongst the top three responses for the Canadian participants, for whom the modal response category was Feeling/Identification. These response patterns are indicative of more inclusive, contemporary understandings of gender by the latter group. Both historically and currently, Canada has been and continues to be generally more progressive than Australia in terms of gender and sexuality policies and viewpoints (Equaldex, 2020; Poushter & Kent, 2020; World Economic Forum, 2020), so these country-level differences in views are not surprising. Additionally, a far higher proportion (nearly

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60%) of participants with an education level less than a high school diploma, compared to the other educational groups, provided a response aligning with the Male/Female category. People with lower levels of education appear less likely to have been exposed to—or at least, to hold—more nuanced, inclusive understandings of gender and related constructs (Dugan et al., 2009), so it is perhaps unsurprising that these participants had such a pattern of responses.

Non-binary participants responded to the Gender Definition Question in very different ways than did participants with binary genders. Male/Female and Biology, conceptions that do not align with current, scholarly definitions of *gender*, were not amongst the top three response categories for this group, whereas they were the second and third most common response categories for participants with binary genders. In contrast, Social Construction was the second most common response category for the non-binary participants, whereas this response category was not among the top three for the participants with binary genders (or for any other demographic group). As members of the queer community, non-binary participants are presumably more knowledgeable than those with binary genders about gender and related constructs, including the importance of accurate terminology (Ho & Mussap, 2019), than those outside the queer community. As a point of comparison, large proportions of women/females (approximately 35%) and men/males (approximately 40%) provided responses that aligned with the Male/Female or Biology categories. Such responses may have been simply due to differences in understandings of the terms, or they may be indicative of these participants’ congruity of their own sexes and genders. That is, if a cisgender person’s sex assigned at birth is used to refer to their gender, there is no incongruity (Olver, 2019). In contrast, referring to a non-binary or transgender person by their sex assigned at birth causes distress and discomfort to this person, as their sex assigned at birth does not align with their gender (Chodzen et al., 2019; Seelman, 2017).

### **Limitations and Future Research Directions**

It is important to note some of the limitations of our study. Although we have provided some perspective on the general public’s views about gender, we acknowledge that our findings are not generalizable because of our research context. Specifically, our participants were only from two countries, Australia and Canada, and data were only collected from one city per country (albeit from four diverse locations per city). Furthermore, our sample was small in relation to the cities’ populations.

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Similarly, the number of non-binary participants in our study was small ( $n = 7$ ). As noted earlier, although the proportion of non-binary participants in our study was slightly higher than estimates from larger questionnaires conducted with the general public in Australia and Canada, we acknowledge that such a small sample size limits our ability to make generalizations for this group. Yet, the extant literature is lacking in non-binary perspectives (Hegarty et al., 2018; Liszewski et al., 2018), and efforts to include and represent all members of our society in research should be prioritized (Fraser, 2018). Indeed, researchers should specifically focus on perspectives of underrepresented and typically marginalized groups, in addition to ensuring that research is conducted in inclusive ways.

Another limitation of our study is that few participants whose level of education was less than a high school diploma ( $n = 12$ ) took part. Although this small number of participants could be related to the fact that our participants needed to be 18 years or older, age and level of education are not mutually inclusive. The views of adults with low levels of education is an understudied research area. Instead, research about adults with low levels of education tends to be limited to studies about their cognitive abilities (e.g., Julayanont et al., 2015; Wood et al., 2006). Again, researchers should provide opportunities for all groups in society to have a voice and be included, particularly in studies of the general public.

Finally, our sample population was heavily skewed towards participants ages 18 to 39, resulting in challenges for generalizing the findings from our study. This outcome could be the result of our research design. Our participants were recruited based on foot traffic in busy areas of the cities. It is reasonable to assume that this methodological choice would limit our access to older groups of the population. When considering conceptions of gender, compared to older adults, individuals from younger age groups generally hold more varied and inclusive conceptions of gender (Cichy et al., 2007; Fitzpatrick Bettencourt, 2011). Although not representative of the general public as a whole, researchers may consider conducting more targeted research focusing on this particular demographic, as we inadvertently did with our sample. Given this group’s cumulative power to affect future society (e.g., as parents, educators, voters, and/or policymakers), the views of this demographic are especially pertinent.

## **Conclusion**

Despite the limitations of our study, we believe that it makes a valuable contribution to the extant literature. To begin, we have provided valuable information about the general public’s views of the term *gender*. Although we

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know of a few studies (e.g., Buck, 2016; Schudson et al., 2019) where people’s definitions of similar terms (e.g., *woman*, *transgender*) were investigated, we are not aware of any recent studies in which participants’ definitions of the term *gender* were queried. There is a plethora of studies about gender and various topics (e.g., STEM, media, business), but, in these studies, the term *gender* is presumed to be a taken-as-shared topic, which is a flawed presumption. As we have demonstrated in our study, members of the general public hold quite varied understandings of this term—some that are contradictory (e.g., a view of gender as biology versus a view of gender as one’s feelings/self-identification). Hence, it is inappropriate to assume that all participants have the same view of a term like *gender*. We recommend that researchers either provide a clear definition of the term prior to the questions that involve the term or, as we have done, ask the participants for their views of the term explicitly, and then link these responses to the participants’ responses to the other questions that involve gender.

Although we are encouraged by the occurrence of more progressive views, in particular from participants in Canada and those in the youngest age group (18–39), it is clear from our findings that many members of the general public still hold traditional and/or inaccurate views about gender. Indeed, there seems to be a divide between people who hold views that are in alignment with most scholarly definitions (i.e., gender as a person’s feelings or self-identification, or as a social construct) and those who still hold ‘sex’ views (i.e., gender as defined by biological features).

Our study also serves as an example of an inclusive way to collect gender demographic data. Although such processes are slowly being integrated into research, closed, binary questions remain common (Lindqvist et al., 2020), and more inclusive question formats and wording tend to be used in small-scale studies (e.g., Kersey, 2018; Voigt, 2020; see Lindqvist et al., 2020, for a large-scale example). In our study, we collected gender demographic data from over 400 participants in two countries using an open-ended question. Although there were some challenges with the coding and categorizing of these data, we have demonstrated that it is feasible to collect gender demographic data in inclusive, open-ended ways in large-scale studies. We hope that our example prompts other researchers who are conducting such studies to alter their gender demographic questions to be more inclusive.

We are in a critical moment of societal growth and potential change. Current initiatives to promote equity, diversity, and inclusion through the formation of advisory groups and committees, and the development of policies and guidelines, increase the focus on gender and sexuality, among other equity topics. Just as we hope that the

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general public’s views on gender continue to evolve and become more inclusive and nuanced, we also hope to see continued evolution in our perspectives and approaches as researchers. It is our obligation as researchers to be accountable in the methods and methodologies that we use in all stages of our research, from project conception to sharing findings. Although just a start, we hope that our example will inspire other researchers to (continue to) look at gender in more complex and inclusive ways by asking “deep questions.” It is only with ongoing collective efforts that all members of our society will be included and represented in research.

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## Tables

**Table 1**

*Participants’ Genders, By Country and Overall*

Location	Total # of Participants	Women/ Females	Men/Males	Non-Binary People
Australia	195	88 (45.1%)	105 (53.8%)	2 (1.0%)
Canada	210	109 (51.9%)	96 (45.7%)	5 (2.4%)
Total	405	197 (48.6%)	201 (49.6%)	7 (1.7%)

*Note.* Percentages apply to rows.

**Table 2**

*Top Three Responses to the Gender Definition Question, by Country*

Country	Modal Response Category	Second Most Common Response Category	Third Most Common Response Category
Australia (n = 195)	Male/Female (30.2%)	Feelings/Identification (25.1%)	Biology (17.4%)
Canada (n = 210)	Feelings/Identification (27.6%)	Other Response (17.1%)	Biology (16.7%)

*Note.* Percentages apply to rows.

**Table 3**

*Top Three Responses to the Gender Definition Question, by Gender*

Gender	Modal Response Category	Second Most Common Response Category	Third Most Common Response Category
Women/Females (n = 197)	Feelings/Identification (28.9%)	Male/Female (19.3%)	Biology (14.7%)
Men/Males (n = 201)	Feelings/Identification (23.4%)	Male/Female (21.9%)	Biology (19.9%)
Non-Binary People (n = 7)	Feelings/Identification (42.9%)	Social Construction (28.6%)	Multiple Responses (14.3%)

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			Other Response (14.3%)
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Note. Percentages apply to rows.

**Table 4**

*Top Three Responses to the Gender Definition Question, by Age Group*

Age Group	Modal Response Category	Second Most Common Response Category	Third Most Common Response Category
18–39 Years Old (n = 291)	Feelings/Identification (32.3%)	Biology (18.2%)	Male/Female (13.4%)
40–59 Years Old (n = 90)	Male/Female (37.8%)	Biology (16.7%)	Other Response (13.3%)
60+ Years Old (n = 24)	Male/Female (37.5%)	Unclear Response (25.0%)	Other Response (16.7%)

Note. Percentages apply to rows.

**Table 5**

*Top Three Responses to the Gender Definition Question, by Educational Group*

Educational Group	Modal Response Category	Second Most Common Response Category	Third Most Common Response Category
Less than High School (n = 12)	Male/Female (58.3%)	Biology (16.7%)	Other Response (8.3%)
		Multiple Responses (16.7%)	
High School (n = 87)	Feelings/Identification (31.0%)	Biology (18.4%)	Other Response (14.9%)
College (n = 69)	Feelings/Identification (29.0%)	Male/Female (26.1%)	Unclear Response (17.4%)
University Undergraduate (n = 139)	Feelings/Identification (28.8%)	Male/Female (20.9%)	Biology (18.0%)
University Graduate (n = 95)	Feelings/Identification (20.0%)	Male/Female (17.9%)	Other Response (12.6%)

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		Biology (17.9%)	
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*Note.* Percentages apply to rows.