Gender in honours mathematics
Identity, belonging, and experience

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University of British Columbia

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**Context:** Honours program intended to prepare students for graduate school

**Leaky pipeline:** About **52-70%** of women leave the program before graduation, compared to only **32%** of men

**Survey results:** 127 men, 41 women, 3 non-binary, 2 prefer not to answer

- **20%** of women&nb are **dissatisfied** with their experience (vs **7%** of men)
- **36%** of women&nb are dissatisfied with available **support** (vs **18%** of men)
- **41%** of women&nb observe **stereotypes** towards women in class
  - vs **5%** of men observing stereotypes towards women

“... I had a few reoccurring gripes with the attitudes of some of my **classmates**. I think too many thought themselves minor geniuses or above people in other disciplines. There was a lot of **gate-keeping** and **posturing**, it was gross.”
A few important points

• This is not a happy talk
• Some of this content requires digesting
• We focus on gender (for the most part) but there are other groups to consider
  • Other groups who may be empowered by similar initiatives
  • We must be mindful of intersectionality
Outline

- Program context
- Student survey
- Student focus groups
- Recommendations
- Informal discussion
Honours mathematics at UBC

- Requires many proof based honours courses
- Intended to prepare students for graduate study in (pure) mathematics
- Not to be confused with the (larger) Majors program

Small program

- About 100 students in total between years 2-4 (in 2019)
- Includes combined honours (Physics, CS, Stats)
- Between 22% and 26% women
What do our students say? Survey results from 2020

We invited students who took one of a selection of honours courses between 2016 and 2019

Who responded?
- 173 total (24% response rate)
  - 127 Men, 41 Women, 3 Non-binary, 2 prefer not to answer
- Program (self-declared)
  - Men: 52 Math, 36 Science, 12 Combined Math, 18 Other
  - Women: 15 Math, 17 Science, 2 Combined Math, 7 Other

Project funded by SoTL Seed program
- Together SoTL specialist: Fabian Fröhlich
A few themes

Survey themes:

• Satisfaction and support (see pitch)
• Gate-keeping
• Stereotyping/prejudice
• Instructors and other students
Gate-keeping

While taking the honours math course(s) I did not have to prove myself constantly.

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Comment: “... think that since there is such a clear path one has to take, other mathematicians in UBC (professors, TAs, other students, etc) hold up a bit of ‘barriers of entry’ if you are not far down the path. I’ve found this is almost synonymous to having taken [the core 3rd year honours courses]. If you haven’t taken those then you’re not ‘really there yet’”
Have you experienced any discouragement/prejudice in a honours math course?

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* 7/9 are in a MATH program

Some students shared their experiences (paraphrased):

- Tired of comments about “being a female in mathematics”
- Pressure to perform well as one of the few women
- Encouraged to leave mathematics while struggling
- Harassment and blatant discrimination
- Social exclusion due to gender
- Homophobic remarks made by other students
“What are some examples of things that made you feel included or excluded?”

Included:
- Professors!
- Group work

Excluded:
- Other students in the class
- Difficulty finding someone to work with
- 64% of W&NB felt intimidated by other students (vs 32% of M)

The W&NB in our classes enjoy math/challenge/rigor/careers but want to feel like they **belong**.
We conducted two focus groups with help of SoTL specialist: Trinh Nguyen.

- One focus group with 2 women
- One focus group with 7 men

We showed them some of the survey data and asked them to comment on:

- factors impacting decision to take Honours math courses
- the class culture in Honours math courses
- belonging and identity of women in math
- possible interventions
Focus group results from 2021

Themes:

• **Societal** and **familial** pressures
• Importance of **teamwork** with other students
• Importance of the **instructor** providing encouragement

Other notes:

• The women identified a “**clique**” of outspoken men who bonded in 1st year or earlier
• While the men appear **oblivious** in the survey, the men in the focus group (after some reflection) identify “**deep-rooted stereotypes and societal expectations**”
Student suggestions for interventions

Student suggestions:

- Better **course descriptions** and/or advising for honours courses
- Explicit course structures to encourage (random) **group work**.
- Instructors to provide more **support** and a personal approach to teaching
- Need for **tutoring** in advanced courses (friends/office hours insufficient)
  - Classmates may be unfriendly, friends may drop the course
  - Office hours may be monopolized by intimidating students
- Implementation of **active learning**
  - Dedicated time to do math during class
- **Role models** for women
  - Women note being inspired by successful women
Recommendations for Instructors

• Have a conversation with your **over-contributors**
  • This has been surprisingly effective in other disciplines

• Visibility of **allyship** – the default is “instructors are unsupportive”
  • Students need to explicitly see instructors and classmates (men) being supportive
  • Course syllabus & LMS page need to signal inclusion

• Exude a **growth mindset** and encourage students to do the same
  • This is one of the big ways to combat stereotype threat

• Find a way to integrate **active learning** in honours courses
  • Explicit and structured **teamwork**
  • Active learning gives all students a boost while also leveling disparities
Recommendations

Recommendations for the Department

- Integrate **transfer students** into the program
  - Both socially and mathematically
- Explicit **role models**: A diverse group of graduate students talk about their research for a few minutes on a Friday
- **TA office hours** for key courses
- Host department panels and community building **events**
  - The men in the focus group really came around
- **Mentorship** program pairing undergrads with senior undergrads or grads
- **Collaborate** with other units
- Establish affinity group **spaces** and empower student **affinity groups**
- Make being **socially responsible** a part of the program
  - We have our students for 3 to 4 years – we can teach them
Thanks

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Some conversation topics

- Student responses
- What to do next
- Getting other department members on-board
- Anything else!
Attrition: Registration by year level (2013-2018)

Honours 2nd Year
- W: 28.3%
- M: 71.7%

Honours 3rd Year
- W: 23.7%
- M: 76.3%

Honours 4th Year
- W: 19.3%
- M: 80.7%

Major 2nd Year
- W: 40.4%
- M: 59.6%

Major 3rd Year
- W: 46.6%
- M: 53.4%

Major 4th Year
- W: 44.5%
- M: 55.5%
More from the data

Consider all students who at some point registered in Honours Math:

• Either combined or non-combined
• With their ‘1st year’ in 2012-2015

Interesting features

• Transfer students:
  • 35%/21% (Women/Men) are not @UBC for 1st year
• Retention rate:
  • 48% of women graduated in Honours math
    • For H. Math non-combined, the number is around 30%
  • Versus 68% for men.
• Most women who leave Honours retain the Math Major
Satisfaction and support

I am satisfied with the overall experience in hon. math courses.

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I am satisfied with the resources available when I needed help.

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Stereotyping and prejudice

While taking the honours math courses I observed stereotypes towards women.

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I felt the people in my class believed that women are as good as men at math.

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* 60% for Women in a MATH program
What isn’t different?

Similar gender split for:

- Math involves real-life problems (61% W&NB | 62% M)
- The level of rigour is satisfying (77% W&NB | 79% M)

Mathematics itself is not the problem.
Main takeaways:

- W&NB are less satisfied with the program and with the available support
- W&NB describe gate-keeping
- W&NB experience stereotyping and stereotype threat
- W&NB may be discouraged with lack of social support
- Individual instructors can have a big impact on students
- The W&NB in our classes enjoy math/challenge/rigor/careers but want to feel like they belong
What does the literature say?

This phenomenon is not unique to UBC

- disparity in confidence at the same grade level [1]

Important questions involve:

- Sense of belonging [2]
- Alignment of career goals with math culture [3]

[1] Women 1.5 Times More Likely to Leave STEM Pipeline after Calculus Compared to Men: Lack of Mathematical Confidence a Potential Culprit, Ellis et al
What does the literature say?

How have other departments been successful?

- **Active learning** interventions in STEM [4]
- Restructuring **intro** classes, discouraging **show-boating**, early **research** opportunities [5]
- Training on **growth mindset** for both instructors and students [6]

[4] Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math, Theobald et al
[5] Increasing female participation in computing: The Harvey Mudd College story, Klawe
[6] Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence, Aronson et al
Whether or not this is our fault is not relevant

- What’s important now is that this is our responsibility

We’ve known about these problems for a long time

- We have an opportunity to work together and do some real good