Gender in honours mathematics

Identity, belonging, and experience

Matt Coles, Costanza Piccolo

University of British Columbia

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Pitch (2 min)

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."

Guidelines

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

Some context

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.

	SA/A	N	SD/D
W&NB	25%	20%	55%
M	36%	27%	36%

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**'"

Stereotyping and prejudice

Have you experienced any discouragement/prejudice in a honours math course?

	Yes	No	Prefer not to answer
W	9*	26	6
M	1	126	0
NB	0	3	0

* 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

Included/Excluded

"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**.

What do our students say? Focus group results from 2021

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

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

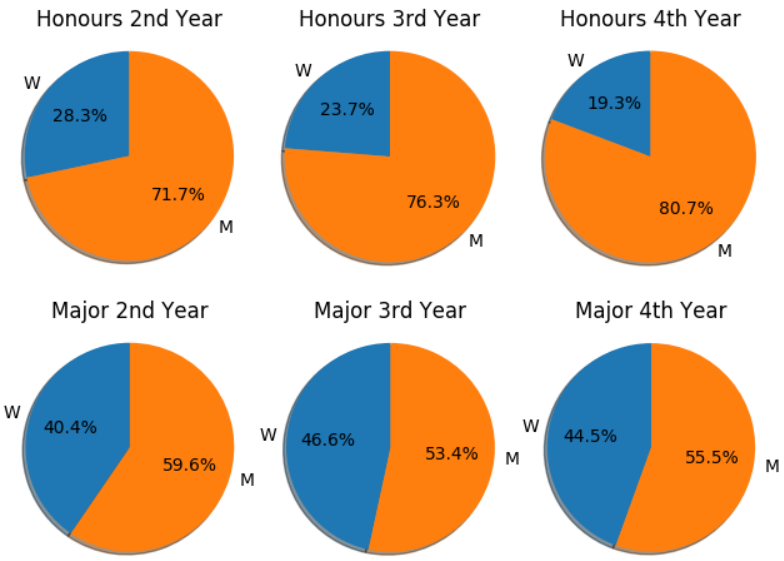
Thanks

colesmp@math.ubc.ca

Some conversation topics

- Student responses
- What to do next
- Getting other department members on-board
- Anything else!

Attrition: Registration by year level (2013-2018)



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.

	SA/A	N	SD/D
W&NB	70%	9%	20%
M	81%	12%	7%

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

	SA/A	N	SD/D
W&NB	52%	9%	36%
M	66%	18%	18%

Stereotyping and prejudice

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

	SA/A	N	SD/D
W&NB	41% *	11%	45%
M	5%	15%	80%

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

	SA/A	N	SD/D
W&NB	39%	41%	20%
M	66%	27%	6%

* 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.

Takeaways

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
[2] Why Do Women Opt Out? Sense of Belonging and Women's Representation in Mathematics, Good et al
[3] On the Persistence and Attrition of Women in Mathematics, Piatek-Jimenez

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

Thanks (colesmp@math.ubc.ca)

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