A Longitudinal View of Gender Balance in a Large Computer Science Program
University of Michigan

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Snapshot of Gender Balance

Comparing Computing Majors Over Time

- 2008-2009: 14 Women, 151 Men
- 2016-2017: 171 Women, 617 Men

Graph showing the increase in the number of students (men and women) over academic years.
Snapshot of Gender Balance

Gender Balance ‘17-'18

University
50.3% Women
49.7% Men

Computer Science
27.5% Women
72.5% Men
Snapshot of Gender Balance

Gender Balance in Courses WN ‘18

- Non-Engineering
  - CS1
  - 42% Women
  - 57% Men

- Upper Levels
  - 20% Women
  - 79% Men
Women are twice as likely to consider leaving a CS major as compared to men [Barker ‘09]

Even if they choose to stay, many women do not move to take an industry or academic job in the computing field [Beede ‘11, Mavriplis ‘10]

Why do women and other minorities leave?
○ They feel out of place and as if they do not belong [Sax ‘18]
○ Lack of self confidence [Beyer ‘03]

Why do women and other minorities stay?
○ Same-gender student interaction, pace and workload of classes, prior experience, and faculty encouragement, etc [Barker ‘09, Cohoon ‘08, Sax ‘18, Miliszewska ‘06]
Research Questions

- Where in the Computer Science curriculum does the gender balance change?
- Do grades play a role in this change?
Curriculum Overview

UofM’s Course Sequence

[Diagram showing the course sequence with nodes for non-engineering CS1, engineering CS1, CS2, Discrete Math, CS3, and upper levels.]
Dataset

- 30,890 Records
  - Fall 2008 - Fall 2018
- 21,351 Records
  - Fall 2013 - Fall 2018

- 10 years
- 5 years

21,351 Records
Outline

1. Failure rates & Withdrawal rates
2. Attrition rates
3. Effects on Attrition
4. Conclusions
Are women failing?

- Women fail less than men in non-engineering CS1, CS2, and in Upper Levels*

*statistically significant, p < 0.05
Are women withdrawing?

- Women withdraw more in non-engineering CS1, CS2, and CS3*
  - Difference in means is at most 2.2%

*statistically significant, p < 0.05
Failure Rate Discussion

- **No evidence** that women are failing out of the CS sequence
- In **CS2** and **non-ENGR CS1**, men fail more but women withdraw more
  - Reaction to poor performance may differ depending on their gender
  - **Conjecture**: Women withdraw when they would have passed while men do not withdraw when they are in danger of failing, resulting in more men failing.
Withdrawal Rate Discussion

- In non-ENGR CS1, CS2, and CS3, women withdraw at a higher rate than men.
- Differences in withdrawal rates between men and women could partly explain the lack of women in CS courses.
- However, this is likely not a large contributor.
  - Magnitude of the difference in withdrawal rates is not great.
  - Difference only exists in half of the courses in the sequence.
  - Largest difference comes in CS3 with around a 2%.
Are women passing and choosing not to go on?

- Women have higher attrition rates than men in both CS1 courses, CS2, and Discrete Math*
- Means differ as much as 14.6% (engineering CS1)
- Attrition decreases as we move through the course sequence

*statistically significant, $p < 0.05$
Attrition Rate Discussion

- Women, despite passing, do not move to the next class in the sequence
  - True for Engineering CS1, Discrete Math, and CS2 but not for CS3
    - Means differ by 14.6% in ENGR CS1, 9.2% in Discrete Math, and 8.1% in CS2.
- Once students reach CS3, most, regardless of gender, move on to upper level courses
- *Why* are women choosing not to go on, particularly in courses before CS3?
Are women receiving the same grades as men?

- Women receive lower grades in engineering CS1, CS2, Discrete Math, and CS3*
- Women have the same or higher cumulative GPAs than men*  

*statistically significant, p < 0.05
Grades Discussion

- **ENGR CS1, CS2, Discrete Math, and CS3**: women receive lower grades than men.
- **ENGR and non-ENGR women** have **equally high GPAs** as ENGR men and **higher GPAs** than non-ENGR men
  - Women perform just as well if not better in other non-CS, technical courses
- **Why** are women receiving lower grades in CS courses but not others?
How do grades and gender effect attrition?

- Grades are the largest factor in a student's decision to move on
- Gender, independent of grade, has an effect on a student's decision to move on*

*statistically significant, $p < 0.05$
What causes Attrition Rate discrepancy?

- Gender, independent of any grade received, has an effect on whether or not the student moves on.
- Grades have the largest effect on a student’s decision to move on.
- **What this means:** eliminating the grade disparity will improve gender balance but it **would not** bring the balance to equality.
Outline

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Conclusions & Future Work

- Despite increase in women, there is still a lack of women continuing through the entire program.
- Gender disparity in attrition rates in CS1, CS2, and Discrete Math
  - Suggests the problem lies in classes before CS3.
- There are factors other than grades that affect a student’s decision to move on in CS.
Future Work

- Why is there a grade imbalance in some classes but not others?
- How can we rid of the grade imbalance?
- What factors contribute to a student’s decision to move on (other than gender/grades)?
- Why is gender a contributing factor to whether a student moves on?
- How can we rid of gender as a factor in a student’s decision to move on?
- Study replications at other institutions will help solidify this work