

Introduction

Prior research indicates that the development of a physics identity and increased physics self-efficacy promotes enhanced retention among students, especially among underrepresented minority populations such as female students [1,2].

There has been an increased interest in understanding how student participation in outreach programs supports the development of a physics identity, enhances retention and persistence, and supports a feeling of community [3-5].

We analysed the impact of 5 student-focused physics outreach programs at Texas A&M University (TAMU) on female students.

Methodology

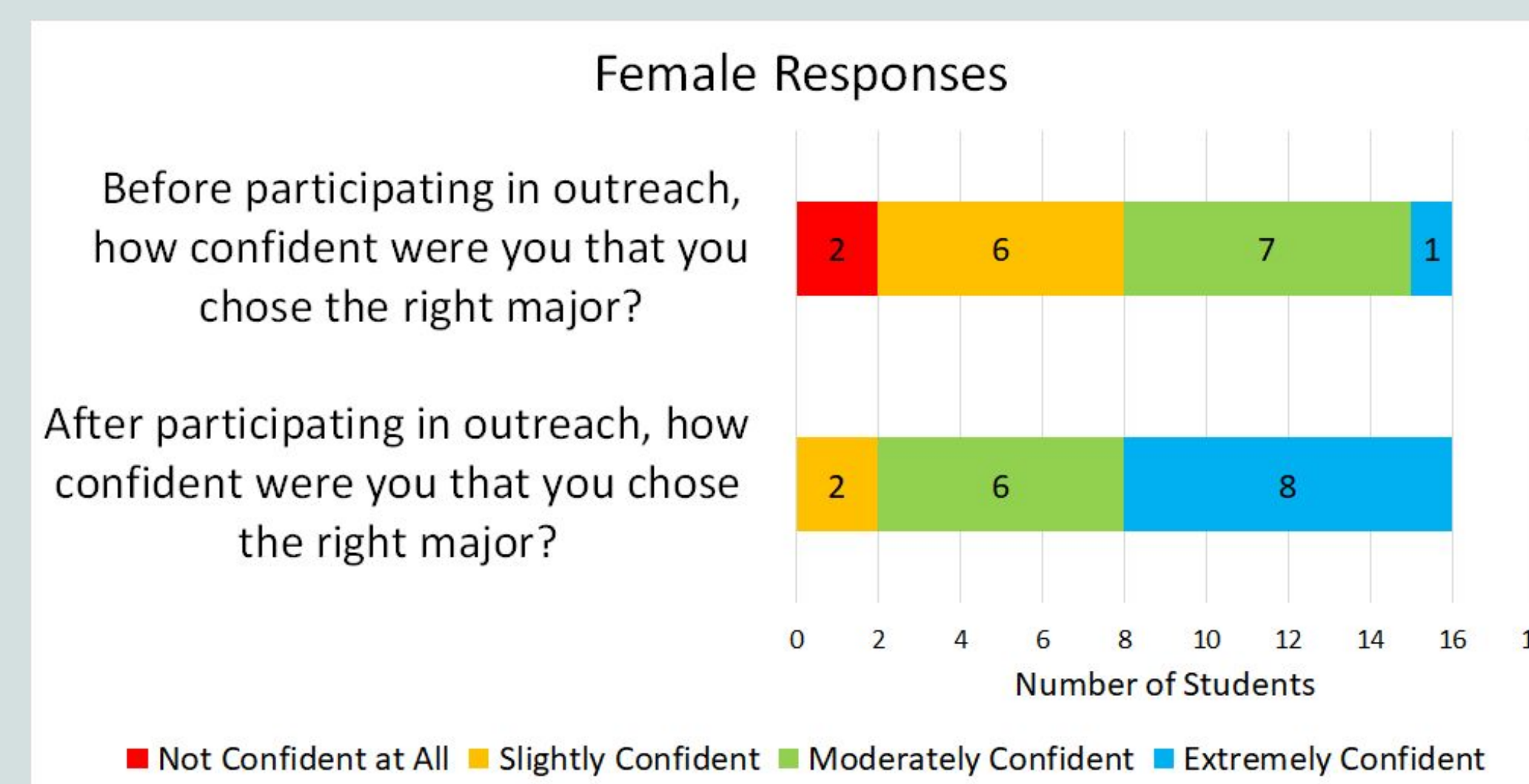
We explored the impact of physics outreach programs on the formation of *physics identity*, *recognition*, and *physics self-efficacy* for female students. We also looked into impacts on motivation, confidence, and self-perceptions of becoming an expert in the field.

Data were collected through a 12 item questionnaire and semi-structured interviews about student experiences in TAMU outreach programs. Current and former graduate and undergraduate students were included in this study.

Questionnaire answers were transformed to numerical values from a 5-point Likert scale. Interview questions were based on the view of identity as a complex dynamic system [6]. Analysis of interviews was done by a quantitative coding process to identify themes. The code was completed by 3 researchers with an interrater reliability $\kappa > 0.6$.

Questionnaire Results

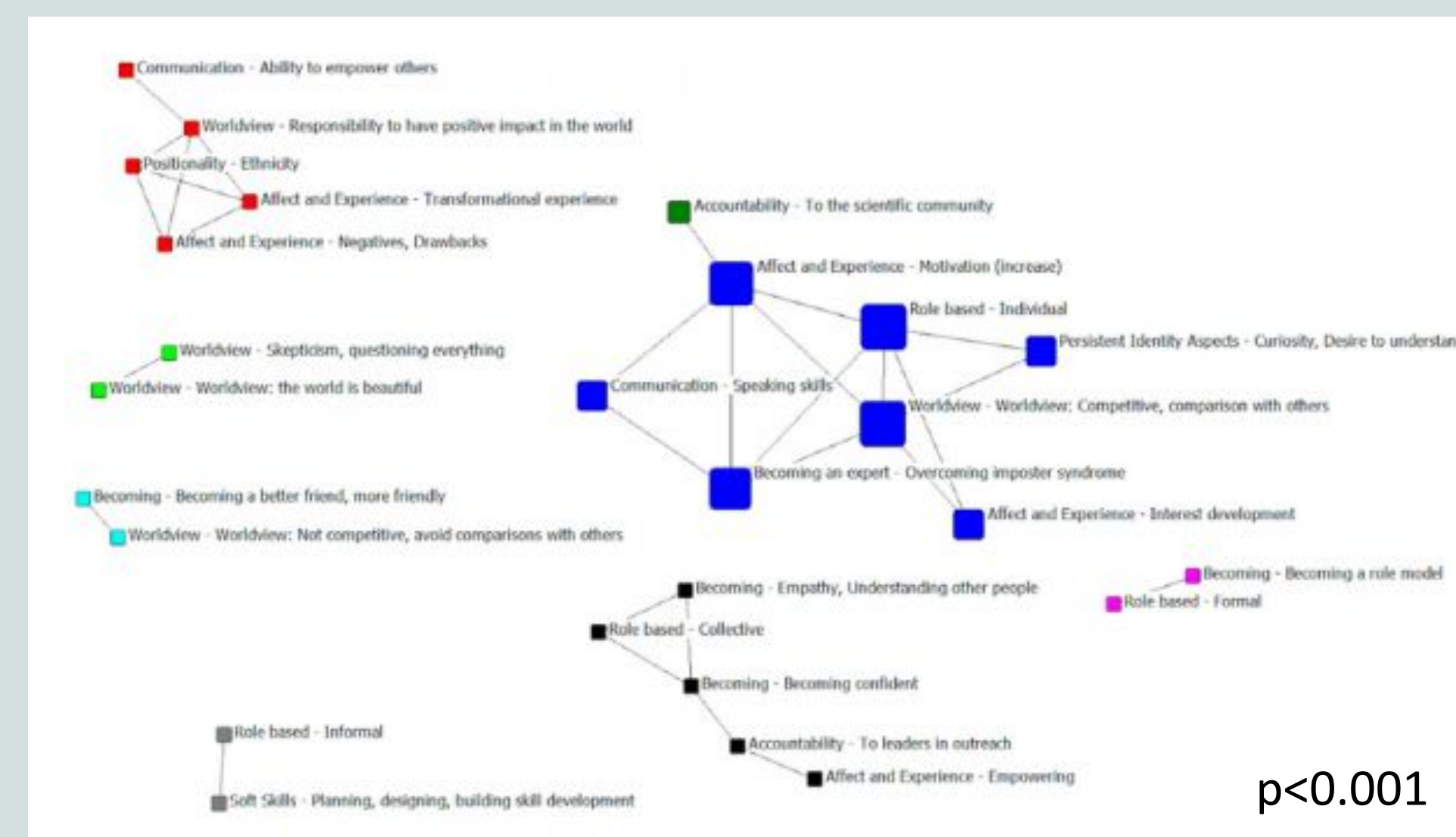
- Out of 117 responses to the questionnaire, 32 responses were from female students. Respondents were not required to answer every item.
- The majority of female participants felt that physics outreach had a positive impact on improving networking within the department (4.25 out of 5)
- Outreach also had a positive impact on sense of belonging for female students (4.41 out of 5)



- Female students reported themselves as less confident in choice of major than male students before participating in outreach ($p=0.013$, $d=0.747$). This difference disappeared after participating in outreach ($p=0.486$, $d=0.155$).

Interview Results

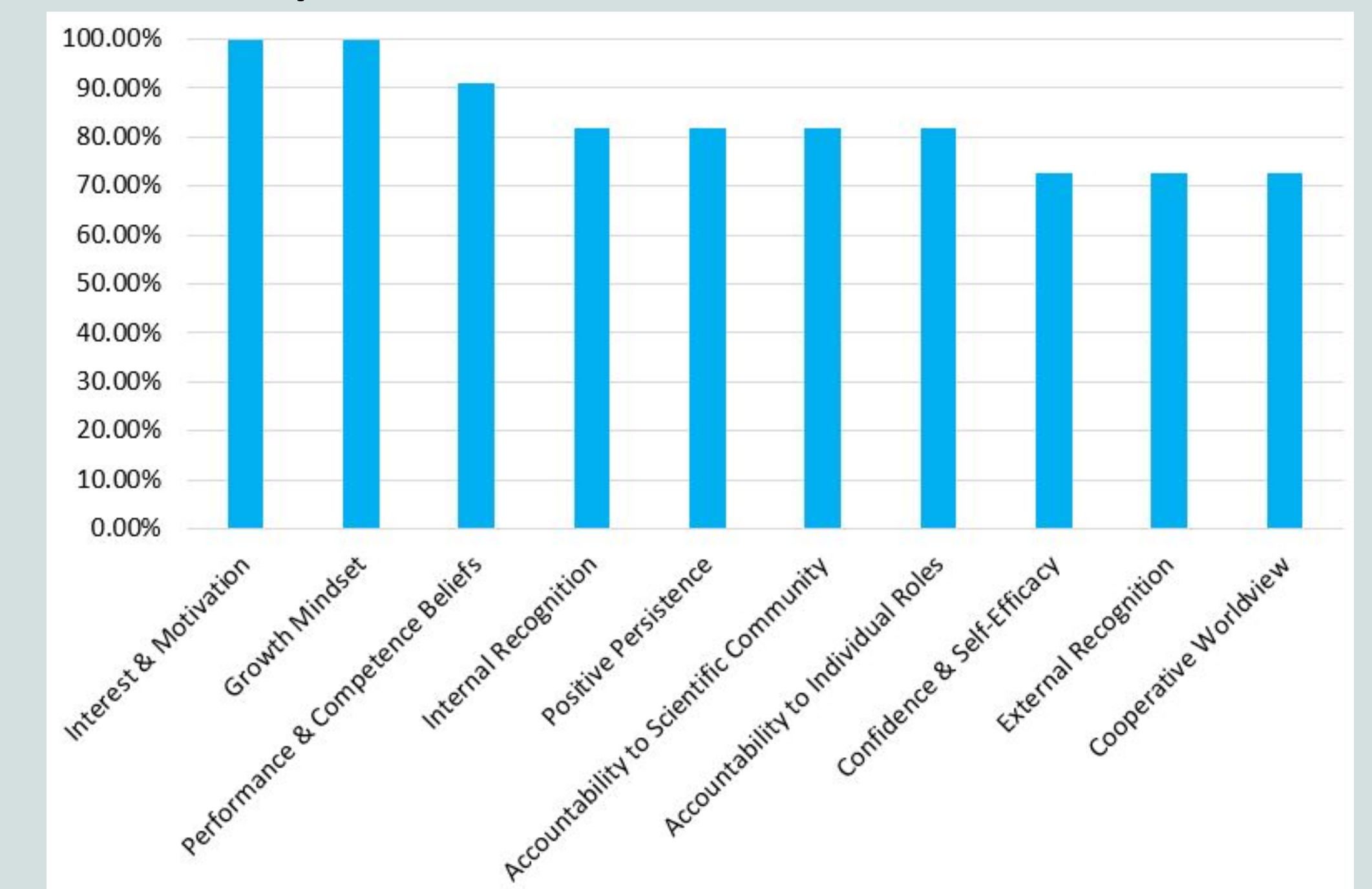
- Out of 35 interviews, 11 responses were from female students.



- This student social network map for female students shows connected themes from the interviews [7].

Interview Results

- The 11 interviews from female students were further examined for particular themes.



- This graph shows the percentage of interviewees that spoke on these themes at least once.
- The majority of interviewees reported that outreach impacted their interest and motivation, growth mindset, performance/competency beliefs, recognition, positive persistence, and confidence and self-efficacy.

"I wasn't sure if [physics] was a good fit for me, but I've definitely been really reaffirmed that [physics] is something that **I want to do** and something that **I can do**, something kind of **I'm actually able to do.**"

Conclusion and Further Work

- Female students feel more confident in their choice of major after participating in physics outreach. They report a positive impact on their sense of belonging and physics identity. This could help with retention of female students in physics, and similar outreach programs can be implemented by other STEM disciplines.
- We plan to collect a broader set of data to look at the full impact of physics outreach programs on female students and other underrepresented groups.