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Sense of Belonging Increases Performance Expectations among Women in STEM Fields

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INTRODUCTION

Although there is a shortage of qualified individuals to fill STEM positions; women and ethnic minority groups are still underrepresented in science fields (Morrison et al., 2011).

Science Identity:

- Science identity is how strongly an individual identifies with being a member of a specific STEM discipline (e.g., chemistry, biology).
- Science identity is associated with positive academic outcomes including greater persistence in STEM, higher grades, and higher self-efficacy (Chemers et al. 2011; Estrada et al. 2011; Syed et al., in press).

Sense of Belonging:

- Sense of belonging is the strength of acceptance an individual feels regarding a specific group or environment.
- Individuals who continue in STEM majors expressed a greater sense of belonging in the science community than those who left for a non-STEM major (Rainey et al., 2018)
- Underrepresented groups receive subtle and overt messages that they do not belong in science and academia which leads to negative outcomes such as lower science identity, lower grades, and switching to a non-STEM major (Ong et al. 2011; Robnett 2016; Rainey et al., 2018).

Science Expectations:

- Science expectations reflect the confidence level an individual has regarding their performance in science-based environments (e.g., research, academics, networking)
- In previous research, risk taking predicts math/science expectations, sense of belonging, and self esteem. Research has shown that women are less likely to take risks which results in lower math/science expectations, sense of belonging, and self-esteem than males (Petzel & Casad, 2020).
- Lower science expectations relate to lower risk-taking behaviors which leads to lower overall well-being for women (e.g., sense of belonging and self-esteem).

AIM

To better understand how women's sense of belonging within STEM relates to their expectations for their performance, and ultimately their underrepresentation in STEM.

HYPOTHESIS

Hypothesis: Sense of belonging will moderate the relationship between science identity and science expectations. Women in male-dominated STEM fields (i.e., engineering, technology, and mathematics) with a stronger sense of belonging in their field and a stronger science identity will have higher expectations for their science performance compared to women with who have weaker sense of belonging and science identity.

METHOD

Participants: Participants ($N = 213$) were women in male-dominated STEM Majors (i.e., engineering, kinesiology, math and statistics, computer science, biotechnology, chemistry, and physics), aged 18 years and older who attended a western university. Participants included Asian/Asian Americans (29.6%), Caucasians (26.6%), Latinas (22.1%), Multiracial (9.5%), African Americans (5.0%) Pacific Islanders (3.0%), Middle Easterners (2.0%), Other (1.5%), and Native Americans (0.5%).

Procedure: Participants completed a 45-minute online survey, hosted by Qualtrics (Provo, Utah). Participants were asked to self-report their experiences in their math and science classes, including attitudes, classroom experiences, and university curriculum.

Measures: To measure the degree to which participants identified as a scientist we used a scale based on Luhtanen and Crocker (1992). The scale consists of 14 items ($\alpha = .857$). All items were rated on a 6-point scale from 1 (*Very strongly disagree*) to 6 (*Very strongly agree*). A sample item includes, "Being a scientist is an important part of who I am."

Sense of belonging was assessed using a 10-item scale ($\alpha = .872$; Good et al., 2012). All items were rated on a 6-point scale from 1 (*Very strongly disagree*) to 6 (*Very strongly agree*). A sample item includes, "I feel accepted when I'm in a STEM setting."

Science performance expectation was assessed using a 5-item scale ($\alpha = .934$; Cadinu et al., 2002). All items were rated on a 6-point scale from 1 (*Very strongly disagree*) to 6 (*Very strongly agree*). A sample item includes, "I expect I will successfully meet my academic goals in science."

RESULTS

In support of the hypothesis a regression analysis showed a two-way interaction between science identity and sense of belonging on science performance expectations. The model was significant $F(3,195) = 19.08, p < .001, b = .266, \Delta R^2 = 0.23, 95\% \text{ CI } [0.110, 0.423]$.

Simple slope analysis showed that when women in male-dominated STEM fields had a stronger sense of belonging and a stronger science identity had higher expectations for their science performance ($b = .543, p < .001$), moderate sense of belonging also predicted higher science performance expectations ($b = .350, p < .001$). However, among women with lower sense of belonging, science identity did not predict higher expectations of science performance ($b = .157, p = .127$).

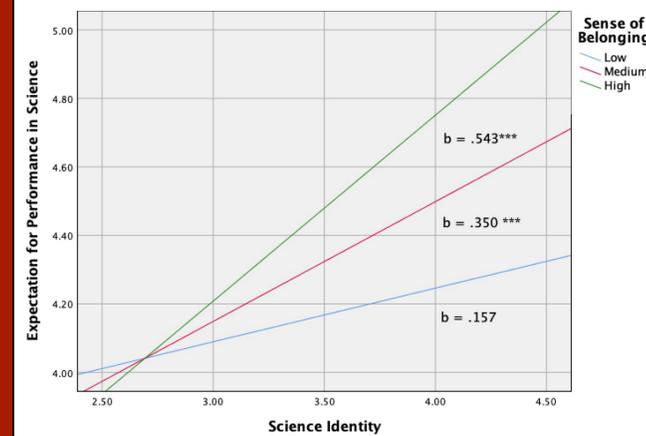


Figure: Interaction between sense of belonging, science identity, and science performance expectations. *** $p < .001$

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DISCUSSION

As predicted a higher science identity and sense of belonging moderates women's performance expectations in science. These results suggest that women in STEM majors that have a more positive sense of belonging and science identity will have higher expectations in their performance in STEM courses, compared to women with lower science identity and sense of belonging. Previous work indicates that sense of belonging in STEM has a significant impact on educational success and persistence, especially for women and students of color (Rainey et al., 2018). Additionally, more women switch out of STEM majors than men (e.g., physics, chemistry, engineering; Seymour & Hewitt, 1997). By decreasing underrepresented groups' lack of sense of belonging there may be a positive impact on their science identity which may lead to higher expectations in their performance in STEM environments and ultimately higher retention rates.

Possible Intervention:

This study provides insight on how underrepresented groups lack of sense of belonging within STEM and that lower science identity negatively predicts their expectations for their science performance. Overall, this leads to underrepresentation in STEM. An individual's science identity and sense of belonging significantly impacts their likelihood to persist and succeed in STEM fields. Universities will be able to utilize this information and create more inclusive environments to improve underrepresented groups' sense of belonging and science identity, which could improve the retention rates among STEM majors.

