ORIGINAL ARTICLE

Outperformance-Related Discomfort: Another Factor in Women's Under-Representation in STEM?

Erika J. Koch[1] · **Abby S. Davis-Janes[1]** · **Tamara A. Franz-Odendaal[2]**

Abstract

Why do women remain underrepresented in some science, technology, engineering, and math (STEM) fields? Research has uncovered various situational factors such as belongingness cues, but one understudied (and related) factor may be outperformance-related discomfort. Specifically, when people outperform others who are upset about being outperformed, they may experience sensitivity about being the target of a threatening upward *c*omparison (STTUC; Exline and Lobel, in Psychological Bulletin 125:307–337, 1999). Three studies examined the potential role of STTUC among women in STEM and how STTUC relates to feelings of belongingness. Study 1 recruited a large internet sample of undergraduate women and found that the tendency to experience STTUC corresponded with relatively low levels of belongingness in both STEM and arts/humanities courses. Replicating prior research, results also showed significantly lower levels of belongingness in STEM vs. arts/humanities courses. Study 2 found higher anticipated levels of perceiving the outperformed person as upset and experiencing STTUC-related concerns among undergraduate women (vs. men) who imagined academically outperforming others. Study 3 examined women and non-binary first-year undergraduates in STEM and found that the tendency to experience STTUC corresponded to relatively low levels of belongingness in STEM at two time points. Taken together, results suggest that experiencing outperformance-related discomfort in STEM may predict relatively low levels of belongingness, which, over time, may contribute to weakening women's interest in pursuing STEM. The present research may be of particular interest to educators, administrators, and policy makers interested in improving women's representation in STEM.

Keywords Sensitivity about being the target of and threatening upward comparison · STTUC · Social comparisons · Social threat · Performance threat · Women in STEM · Sense of belonging

✉ Erika J. Koch
ekoch@stfx.ca

Abby S. Davis-Janes
abbyjanes12@gmail.com

Tamara A. Franz-Odendaal
Tamara.Franz-Odendaal@msvu.ca

[1] Department of Psychology, St. Francis Xavier University, PO Box 5000, Antigonish, NS B2G 2W5, Canada

[2] Department of Biology, Mount St. Vincent University, Halifax, NS, Canada

In 2018, Dr. Donna Strickland became only the third woman to win a Nobel Prize in physics. In one of many interviews after learning of this accomplishment, she discussed an experience that she had as an undergraduate student. When a male student realized that she had outperformed him in a difficult math course, he threatened to "pound" her (McBride, 2018). Although people may not generally respond with such hostility upon realizing that they have been outperformed, Strickland's story illustrates both that people can become quite upset about being outperformed, and that outperformers may be well aware of how outperformed people react. In fact, realizing that an outperformed person is upset may prompt an outperformer to feel awkward, uncomfortable, or even guilty. The purpose of the present research is to examine such outperformance-related discomfort among women in science, technology, engineering, and math (STEM).

Women in STEM

Despite the important contributions that women like Donna Strickland have made to STEM, gender gaps remain in traditionally male-dominated undergraduate fields such as physics, engineering, and computer science. In other undergraduate STEM fields, such as biology, chemistry, mathematics, and statistics, gender representation is nearly equal (Cheryan et al., 2017). As of 2019, women earned about 38.3% of bachelor's degrees across all STEM disciplines at Canadian universities (increasing only about 2% since 2010). In the mathematics, computer science, and information sciences division of STEM, the percentage of women who earned degrees in 2019 is 28.3%. For engineering and engineering technology, only 21% of degrees were awarded to women (Government of Canada, 2019). Research on the experiences of women in STEM has examined several explanations for the persisting gender gap. Below we focus on the importance of a sense of belongingness in STEM.

Objects in the physical environment may signal cues about who does—and who does not—belong in STEM, therefore influencing interest in STEM. In a compelling demonstration of the importance of physical belongingness cues, female undergraduates reported significantly lower interest in enrolling and a lower sense of belonging in computer science when in a classroom with objects that conveyed stereotypes of computer science majors (Star Wars/Star Trek items, video games, science fiction books, and tech magazines) than when in a classroom with no such objects. Classroom environment did not significantly affect male students' interest in computer science (Cheryan et al., 2009). Several studies using photographs or written descriptions of the classrooms replicated this initial finding, even among high school students (Cheryan et al., 2009; Master et al., 2016).

A sense of belonging in STEM may have long-term consequences and may affect retention of women in STEM. Three additional studies found a greater sense of belonging in STEM for men than for women, and in two of these studies, belonging predicted persistence in STEM over time for women (but not men; Lewis et al., 2017). Results of a diary study found that daily sense of belonging predicted interest in STEM courses—but not arts/humanities courses—among undergraduate women (Thoman et al., 2014). Taken together, these findings suggest that a sense of belonging is particularly important for retaining women (but not men) in STEM (but not arts/humanities).

Retaining women in STEM may also involve reducing identity interference (conflict between identities) for women pursuing traditionally male-dominated fields. Several sources of identity incongruity exist for women in STEM fields. Women are more likely than men to have low self-efficacy in traditionally male-dominated STEM fields and are more likely to believe that the demands of a STEM career are incompatible with family responsibilities (Heilbronner, 2013). Several studies have shown that women who experience these forms of identity interference are less likely than men to pursue STEM at the undergraduate level and, if they do, are more likely than men to leave their occupation in STEM for another field later in their careers (Frome et al., 2006; Heilbronner, 2013). Further, longitudinal research has shown that women who experience conflict between their gender identity and STEM identity, compared to women who do not, are at risk of lower well-being, identity satisfaction, and perceptions of STEM performance over time. However, for women who experienced an increase in STEM identification over the period of the longitudinal study, the negative associations with identity interference were lessened (Settles et al., 2009). Thus, although correlational, these findings suggest that bolstering a sense of identification with STEM as well as a sense of congruency between STEM and female gender identities may encourage women to persist in male-dominated STEM fields.

Various programs have sought to increase women's interest in STEM. One promising program involves teaching women that STEM careers can allow them to achieve their communal goals (Belanger et al., 2020). In general, women tend to express more communal self-concepts and endorse communal goals, whereas men tend to express more agentic self-concepts and endorse agentic goals (Diekman et al., 2010). Communal self-concepts involve interpersonal sensitivity and concern for others, whereas agentic self-concepts are oriented more towards self-assertion and independence (Ramsey, 2017). Previous research established that endorsing communal goals negatively predicts interest in STEM (Diekman et al., 2010). In other words, people who endorse communal goals (vs. agentic goals) are relatively less likely to show interest in pursuing a career in STEM. Building upon these findings, recent research found that perceiving opportunities to achieve communal goals in STEM positively predicted belonging in STEM (Belanger et al., 2020, Studies 1 & 2). A follow-up experiment found that working on collaborative STEM lab activities increased both belonging and interest in STEM (Belanger et al., 2020, Study 3). Similar results emerged in a final experiment that directed some participants to simply write about communal pursuits in STEM (Belanger et al., 2020, Study 4). Thus, increasing women's interest in STEM may be as simple as informing them about how STEM can allow them to fulfill their communal goals. However, as described below, this kind of intervention may have some unintended, negative downstream consequences.

Sensitivity about being the Target of a Threatening Upward Comparison

As the opening story of Donna Strickland illustrates, success can sometimes upset those who have been outperformed, which outperformers may perceive. Although success may bring positive psychological responses, it may simultaneously bring psychological discomfort (Exline & Lobel, 2001). The term sensitivity about being the target of a threatening upward comparison (STTUC) captures the experience of outperformance-related discomfort (Exline & Lobel, 1999).

To understand the experience of STTUC, consider Jazmin and Amy, two hypothetical undergraduates studying chemistry. The two friends applied to competitive graduate programs, but only Jazmin received acceptances from the schools to which she applied. Unfortunately, no programs accepted Amy. Upon learning of her acceptances, Jazmin understandably felt excited, proud, and relieved; however, upon learning of Amy's rejections, Jazmin also felt sad, worried, and uncomfortable. In other words, Jazmin felt STTUC (Exline & Lobel, 1999). Notably, STTUC can be both an adjective and a noun. Jazmin may feel STTUC or *be* STTUC. The experience of STTUC requires three criteria, which proceed in succession. First, the outperformer must realize that they are the target of an upward comparison. In our example, Jazmin knows that Amy has made an upward comparison with her, as she realizes that Jazmin succeeded (by achieving acceptance to graduate school) where Amy failed. Second, the outperformer must perceive the outperformed person as threatened (i.e., upset) in some way. Jazmin realizes that Amy is upset, as she explicitly informed Jazmin of her frustration and disappointment after receiving only rejection letters. Third, the outperformer must experience at least one type of concern: about themselves, the outperformed person, or their relationship. Jazmin may worry that Amy will be angry at her (self-related concern), that Amy will abandon her hopes of attending graduate school (other-related concern), and/or that their interactions will, at least temporarily, be awkward (relationship-oriented concern).

The limited research on STTUC has examined both factors that predict STTUC and potential consequences of STTUC. One situational factor is deservingness. Specifically, STTUC responses may be strongest when an outperformer believes that they did not deserve to do well, or when they believe that the outperformed *did* deserve to do well (Koch & Totton, 2017). STTUC reactions also appear to be stronger in close (vs. distant) relationships (Altermatt & Ivers, 2011; Exline & Lobel, 2001; Scinta & Gable, 2005). Person variables also predict variability in reactions to outperforming others. Specifically, traits connected to communal (i.e., other-oriented) goals—such as sociotropy (excessive people-pleasing)—tend to predict relatively strong STTUC responses (Exline et al., 2012; Exline & Zell, 2012). Conversely, traits connected to agentic (i.e., self-oriented) goals—such as narcissism—tend to predict weaker STTUC responses and even positive reactions to outperforming others (Exline et al., 2004; Exline & Zell, 2012).

As alluded to in the previous section, highlighting communal goals may, inadvertently, heighten the probability that women in STEM experience outperformance-related discomfort. Specifically, the STTUC framework predicts that "…women should be most susceptible to STTUC when affiliative goals are salient or when situational constraints dictate that women will face sanctions for performance" (Exline & Lobel, 1999, p. 316). Thus, although the interventions described above offered encouraging results, in the long term, such interventions may increase the probability that women in STEM will experience STTUC by making other-oriented goals salient.

The Present Research

The present research sought to test the possibility that women in STEM who are particularly likely to experience STTUC may experience relatively low levels of belongingness in STEM. The discomfort of STTUC may lead women in STEM to question whether they belong in STEM, decrease their interest in STEM, and lessen their identification with STEM. Although interest and identification may overlap considerably, previous research suggests value in examining both variables. For example, a study of recruitment interventions found that (implicit) identification with STEM significantly differed between conditions, whereas (explicit) interest in STEM did not differ between conditions (Cowgill et al., 2021). Another study found that early STEM experiences significantly predicted STEM identity over time, even when statistically controlling interest in STEM (Cohen et al., 2021). In Study 1, we hypothesized that the tendency to experience STTUC would negatively correlate with belongingness in STEM (H1a), interest in STEM (H1b), and identification with STEM (H1c), but these correlations would be less strong for arts/humanities. In Study 2, we hypothesized that perceived threat (STTUC condition 2; H2a) and STTUC-related concerns (STTUC condition 3; H2b) would be higher among women thinking about STEM courses, as compared to women thinking about arts/humanities courses or men thinking about either STEM or arts/humanities courses. In Study 3, we hypothesized that the tendency to experience STTUC would, over time, predict relatively low levels of belongingness in STEM (H3a), interest in STEM (H3b), and identification with STEM (H3c) among first year female undergraduates. All materials and data sets appear on the OSF page (https://osf.io/tv9se/?view_only=5d041d271a68443facb01d51644e3670).

Study 1

Method

Participants

Participants were recruited through Prolific, an online recruitment platform and alternative to Amazon's Mechanical Turk (MTurk). Research demonstrates that Prolific participants tend to be diverse and provide high-quality data (Peer et al., 2017). We posted a study called "Women in University Courses" in Prolific and requested 800 participants, as an a priori power analysis using G*Power estimated that this sample would provide .80 power to detect a small effect. To be eligible for the study, participants had to "have taken (or be enrolled in) at least one course in STEM (Science, Technology, Engineering, and Math: math, engineering, biology, chemistry, physics) and at least one course in Arts/Humanities (English, foreign language, arts, philosophy, history)." Using Prolific's prescreening function, the study was visible only to female-identifying undergraduate students who had reported English as their first language, to ensure comprehension of the STTUC scenarios. Because we used the prescreening function, we did not request that participants report on the specific aspects of their gender identity, so that information is not available. Participants received compensation equivalent to the minimum wage in the UK, in accordance with Prolific's policies. Seven hundred and ninety nine participants provided complete data; 777 participants passed all five attention checks (described below), and we therefore retained their data for the analyses that follow.

Consistent with previous research, the Prolific participants were diverse, reporting a variety of home countries, with most from the United Kingdom ($n = 404$; 50.6%) or the United States ($n = 319$; 39.9%). Participants also reported a variety of ethnicities: White ($n = 627$; 78.5%), Asian ($n = 89$; 11.1%), Black or African American ($n = 66$; 8.3%), Hispanic or Latino ($n = 35$; 4.4%), American Indian or Alaska Native ($n = 10$; 1.3%), Native Hawaiian or Pacific Islander ($n = 6$; .8%), and Other ($n = 26$; 3.3%). Totals exceed 100 because participants could select multiple categories.

Measures and Procedure

The survey was designed through Qualtrics (Qualtrics, Provo, UT); the complete Qualtrics survey is available on the OSF page (https://osf.io/tv9se/?view_only=5d041d271a68443facb01d51644e3670). All three studies received ethics clearance from the St. Francis Xavier University Research Ethics Board (REB) prior to data collection; Studies 2 and 3 additionally received ethics clearance from the Mt. Saint Vincent REB.

Test of Responses to Outperforming Others (TROO) After providing informed consent, participants completed demographic items and then the TROO*; Exline & Zell, 2012)*, a 15-item measure that assesses individual differences in the tendency to experience STTUC. The TROO consists of scenarios to which participants respond with their predicted affective reaction. Each scenario involves the participant outperforming someone else, and the scenarios cover a variety of domains (e.g., academic, appearance, romantic). To reduce participant fatigue, we presented participants with four (rather than the original eight) affective responses: sadness, happiness, anxiety, and guilt. "Happiness" was a filler designed to disguise the purpose of the study; therefore, we combined only the other three items in analyses. We examined internal consistency by inspecting reliability for each emotion across all scenarios (sadness: Cronbach's $\alpha = .88$; anxiety: $\alpha = .93$; guilt: $\alpha = .92$). The three emotion scales were all highly correlated with each other, rs from .67 to .79, ps $< .001$, so we combined all TROO items to create one STTUC tendency score. An attention check (directing participants to select "3" for the four emotion response items) appeared after the first 10 TROO scenarios.

Sense of Belongingness After participants completed the TROO, Qualtrics randomly assigned them to either the STEM ($n = 395$) or arts/humanities ($n = 404$) condition. All measures that followed referred to the assigned condition. Before viewing the measures, participants read a brief introduction explaining the meaning of the STEM or arts/humanities "academic community." The first measure that followed was a 30-item scale assessing a sense of belongingness in STEM or arts/humanities courses (depending on randomly assigned condition). This measure was a modified version of a previously published scale designed to tap belongingness in math specifically (Good et al., 2012). The stem "When I am in a STEM [Arts/Humanities] setting" preceded the list of items. Participants responded to each item (e.g., "I feel that I belong to the STEM [Arts/Humanities] community") on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. A second directed attention check was embedded in the belongingness items. The belongingness measure was highly reliable ($\alpha = .96$), so after reverse-scoring inversely worded items, we combined the items to create a belongingness scale.

Interest in and Identity with STEM Additional measures assessed interest and identity with STEM or arts/humanities courses. Specifically, four items tapped interest in STEM or arts/humanities (e.g., "How likely are you to take STEM [Arts/Humanities] courses beyond any that you are taking now?"), to which participants responded on a 1 (*very unlikely*) to 7 (*very likely*) scale; Good et al., 2012; Park et al., 2011), and three items tapped identification (e.g.,

"The daily work of a scientist [Arts/Humanities scholar] is appealing to me"), to which participants responded on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale (Woodcock et al., 2012). We combined the items within each measure to create scales of interest ($\alpha = .91$) and identity ($\alpha = .83$). A final item required participants to rank their preference for various majors (Park et al., 2011), but we do not discuss this item further, as it was included for exploratory purposes and is not relevant to any of our hypotheses.

Results and Discussion

Preliminary inspection of the data revealed no evidence of non-normality (all skewness and kurtosis values < |1.0|) and no outliers (i.e., values 3 standard deviations away from the mean). Thus, after discarding the data from the 22 participants who did not pass all attention checks, we retained all remaining data for analyses.

Results supported H1a that a general STTUC tendency (as measured with the TROO) correlates negatively with a sense of belongingness. In other words, women who reported high STTUC tendency tended to report relatively low levels of belongingness in their courses. As Table 1 illustrates, unexpectedly, this pattern held (with a comparable magnitude) for both the STEM and the arts/humanities conditions. Inconsistent with hypotheses (H1b and H1c), STTUC tendency did not correlate significantly with either interest or identification.

Although we did not hypothesize whether belongingness significantly differed between conditions, we tested for differences to see whether results would replicate those of prior research (e.g., Tellhed et al., 2017). Results of an independent samples t-test revealed that, consistent with results of previous research, sense of belongingness was significantly higher in the Arts/Humanities versus the STEM condition. Overall, women randomly assigned to respond while thinking about their Arts/Humanities courses reported a stronger sense of belongingness to those courses ($M = 139.68$, SD

Table 1 Study 1: Correlations Between STTUC Tendency and STEM Outcome Variables

Variable	1	2	3	4
1. STTUC tendency	—	-.21**	.09	.05
2. Belongingness	-.22**	—	.57**	.65**
3. Interest	-.02	.61**	—	.78**
4. Identity	.00	.56**	.77**	—

Correlations for the STEM condition appear below the diagonal, and correlations for the arts/humanities condition appear above the diagonal

STTUC sensitivity about being the target of a threatening upward comparison

**$p < .01$

$= 29.65$) than did women randomly assigned to think about their STEM courses ($M = 128.17$, $SD = 35.06$), $t (741.05) = 4.96$, $p < .001$, 95% CI for mean difference (6.95, 16.08), Hedges' $g = -0.36$. In contrast, interest and identity did not significantly differ between conditions, $ts < 1.0$, $ps > .72$.

In sum, Study 1 offered preliminary evidence for the hypothesis that women who are particularly likely to experience STTUC are also particularly likely to experience relatively low levels of belongingness in their STEM courses. Unexpectedly, the negative correlation between STTUC tendency and belongingness also emerged among women considering their arts/humanities courses.

We built upon these initial findings in Study 2. Study 2 did not target a specific gender group, permitting comparisons in STTUC responses across both gender and type of course (STEM vs. arts/humanities).

Study 2

Method

Participants

To obtain a relatively diverse sample of undergraduates, Study 2 recruited four different samples ($N = 316$). A sensitivity analysis revealed that this sample size was sufficient to detect a small effect ($f = .16$) with adequate power (.80). For the Prolific samples, the study was available to any Prolific participant who, in Prescreening, had reported English as their first language and was currently enrolled in any year of an undergraduate program. For the other samples, an invitation to participate was distributed to the university's social media or student email list. Seventy participants were from a primarily undergraduate university in Eastern Canada; six additional participants were from a similar university. One hundred and twenty participants were recruited from Prolific (from any country), and 120 additional Prolific participants were targeted for having reported Canada as their home country (a funding requirement for Canada's Natural Sciences and Engineering Research Council of Canada [NSERC] Women in Science and Engineering [WISE]). One hundred and ninety three (60.9%) participants identified as female, 114 (36%) as male, and 10 (3.2%) as another gender. Because we had no hypotheses about demographic differences, we did not collect race/ethnicity data in Study 2—a limitation that we addressed in Study 3.

Measures and Procedure

All participants signed up for a "University courses study" and completed the study online through Qualtrics.

Participants first provided informed consent and then reported demographic information. Qualtrics randomly assigned participants to one of two conditions: STEM courses or arts/humanities courses. Participants read four scenarios that corresponded with their experimental condition. Each scenario involved the participant outperforming a hypothetical target. The first two scenarios were modified versions of those used in the TROO (Exline & Zell, 2012). The remaining two scenarios were developed by considering academic contexts in which outperforming others would be plausible. Thus, the four scenarios involved situations that, presumably, were familiar to undergraduate students: working on a class project, seeing an exam grade on a grade-posting site, receiving graded exams, and comparing grades with a romantic partner. After reading each scenario, participants responded to five items assessing perceived threat (STTUC condition 2; e.g., "sad") and nine items assessing STTUC-related concerns (STTUC condition 3; e.g., "I would feel sorry for the other person"; adapted from Koch & Metcalfe, 2011). The perceived threat items had a 5-point "*not at all*" to "*very*" response format, and the concerns items had a 5-point "*strongly disagree*" to "*strongly agree*" response format. To assess internal consistency of the threat and concerns measures, we first examined each variable within each scenario (αs ranged from .62 to .81 for threat and from .81 to .85 for concerns). Reliability was acceptable for these short scales within each scenario, so we then tested the reliability *across* scenarios (threat α = .82, concerns α = .93). Due to the high reliability across scenarios, we combined the items to create one threat scale and one concerns scale.

Participants then responded to two final sets of items. First, they responded to a multiple-choice manipulation check to ensure that they had attended to the experimental condition ("What kinds of courses did you think about while reading about and then responding to the scenarios?"). Second, because participants might have differed in how familiar and plausible they found the scenarios, they responded to three items assessing how frequently they have been in similar situations, how easy it was for them to imagine the situations, and how much they could relate to the situations on a 0 ("*Not at all*," recoded as 1) to 10 ("*Very or Extremely*") scale (α = .80).

Results and Discussion

We predicted that perceived threat (STTUC condition 2; H2a) and STTUC-related concerns (STTUC condition 3; H2b) would be higher among women thinking about STEM courses, as compared to women thinking about arts/humanities courses or men thinking about either STEM or arts/humanities courses. We began with a preliminary inspection of the data. Most participants (*n* = 270; 85.2%)

correctly reported their experimental condition; we discarded the data from the other participants who failed the manipulation check. Results did not differ significantly across samples, so the analyses presented below combine data from all four samples. We found no evidence of non-normality, with all skewness and kurtosis values < |1.0|. Two participants' concern scores were outliers; however, retaining or discarding their data does not appreciably alter the pattern of results, so we retained them. Due to the small number of participants who selected "other" as their gender (*n* = 10), we did not include their data in the analyses that follow.

For perceived threat, a 2 (gender: male vs. female) x 2 (condition: STEM vs. arts/humanities courses) between-subjects ANOVA revealed a statistically significant main effect of gender ($F[1, 256] = 5.06$, $p = .025$), but no significant effect of either condition ($F[1, 256] = .39$, $p = .53$), or the gender x condition interaction ($F[1, 256] = 1.94$, $p = .17$). Supporting H2a, on average, female participants (*M* = 3.78, *SD* = .48) reported significantly greater perceived threat than did male participants (*M* = 3.63, *SD* = .44), 95% CI for mean difference (0.024, 0.26), Hedges' *g* = .30.

A similar pattern emerged for STTUC-related concerns. Specifically, a 2 x 2 between-subjects ANOVA revealed a statistically significant main effect of gender ($F[1, 256] = 4.98$, $p = .027$), but no significant effect of either condition or the gender x condition interaction, both $Fs < 1.0$. Supporting H2b, on average, female participants (*M* = 2.89, *SD* = .64) reported significantly greater STTUC-related concerns than did male participants (*M* = 2.71, *SD* = .60), 95% CI for mean difference (0.018, 0.33), Hedges' *g* = .28. Thus, on average, women predicted that outperformed persons would be more upset, and they imagined greater levels of concern, than men did across a variety of outperformance-related scenarios.

For exploratory purposes, we examined results for the "ease" score. Results of a 2 x 2 between-subjects ANOVA revealed no significant effect on ease of gender, condition, or their interaction, all $Fs < 1.35$, all $ps > .24$. Thus, participants found the scenarios quite easy to imagine (*M* = 7.61, *SD* = 1.64), regardless of their gender or experimental condition.

In sum, Study 2 revealed that, on average, female undergraduates anticipated greater STTUC-related threat and concerns than men did when imagining outperforming others academically. The type of course (STEM vs. arts/humanities) that participants imagined when responding to the scenarios did not matter. Thus, consistent with predictions of the STTUC framework (Exline & Lobel, 1999), women imagined greater outperformance-related discomfort then men did.

Study 3 built upon the first two studies in several ways. First, we expanded the eligibility criteria to include participants who identify as non-binary, as this group remains understudied in psychology. The terms non-binary, genderqueer, and

gender diverse do not represent a third gender category in addition to the gender binary. Instead, they are blanket terms that individuals may use when they feel that they do not identify with male or female genders, identify with both binary genders at once, identify with no gender at all, or dispute the idea of only two genders (Richards et al., 2016). To our knowledge, only one published study has examined the experiences of non-binary students in STEM, and this study involved only high school students (Xavier Hall et al., 2022). Results of the study revealed that identifying as non-binary predicted relatively low levels of belonging in STEM; measures of identification with and interest in STEM were not included. Second, we moved to a longitudinal study, examining participants at two time points to assess whether the tendency to experience STTUC predicted STEM outcome variables over time.

Study 3

Method

Participants

Participants were 218 first-year students from various universities. To be eligible, participants must have identified as either female or non-binary and as pursuing a traditional STEM field (i.e., biology, chemistry, engineering, mathematics, computer science). An a priori power analysis using G*Power indicated that a sample size of 193 would provide sufficient power for the current study. Participants were recruited from both Prolific and a primarily undergraduate Atlantic Canadian university campus via flyers, the university's student email list, and the university's Women in Science and Engineering (WISE) and Current Students Facebook groups. One hundred and fifty-three participants completed both the Time 1 and Time 2 surveys, for a retention rate of 70%. Three participants failed at least one attention check and were excluded from analyses. Thus, the final sample consisted of 150 female ($n = 141$) and non-binary ($n = 9$) first-year STEM students. A total of 50% of participants identified as White/Caucasian, 16.7% were African, 5.3% were Black/African American, 1.3% were Caribbean, 8.7% were East Asian, 10.7% were Latino/Hispanic, 0.7% were Middle Eastern, 4% were Mixed, 0.7% were Native American or Alaskan Native, 6% were South Asian, 1.3% were White/Sephardic Jew, 1.3% were Black/British, 3.3% were Southeast Asian, and 1.3% identified as Other. (Again, participants could select multiple ethnicities.)

Measures and Procedure

At Time 1 (early October in the fall 2021 semester), all participants completed the study through Qualtrics. After providing informed consent, they completed the same measures in the same order as in Study 1: the TROO (Exline & Zell, 2012), and the STEM outcome measures: belongingness ($\alpha = .95$), identity ($\alpha = .79$), and interest ($\alpha = .79$; with several attention checks interspersed among items). (Participants also responded to an item assessing their intention to persist in STEM courses, but we do not discuss this item further, as it is nearly identical to an item in the interest scale.) In addition, participants completed the Single-Item Self-Esteem scale (SISE; Robins et al., 2001). Participants rated the statement "I have high self-esteem" on a 5-point scale ranging from 1 (*not very true of me*) to 5 (*very true of me*). The single-item measure provides a concise assessment of self-esteem that limits the number of items administered in large-scale surveys, pre-screening packets, or longitudinal studies. The measure shows high convergent validity with the Rosenberg Self-Esteem Scale, a validated 10-item measure of global self-esteem (Robins et al., 2001). These findings indicate that the measure is appropriate for assessing self-esteem as a covariate in the present study. We wanted to control for trait self-esteem, as previous research established that TROO scores tend to correlate positively with self-esteem (Exline & Zell, 2012). At Time 2 (February of the winter 2022 semester), participants completed the STEM outcome measures again (belongingness [$\alpha = .95$], interest [$\alpha = .84$], and identity [$\alpha = .80$]).

Participants were compensated for their participation at both Time 1 and Time 2. Prolific participants received payment equivalent to the minimum wage in the UK, and university participants who opted to provide their email address received a $5 gift card from a local business and entry in a lottery for a $100 gift card. The Qualtrics survey and data file are available on the OSF page. (This study is labeled "Study 4 repeat…" in OSF. The first attempt at running study 4 yielded too few participants for a reliable sample [27 participants at T1 and 5 at T2]).

Results and Discussion

Preliminary Analyses

Inspections of the data revealed no concerns about non-normality, all skewness and kurtosis levels $< |3|$. Three outliers were identified for the Time 2 Interest variable; however, excluding the data from these three participants did not alter the pattern of results, so we retained them. Participants who dropped out of the study after Time 1 did not systematically differ from participants that completed the survey at both time points on any of the crucial Time 1 variables: STTUC tendency, trait self-esteem, belonging, interest, and identity all ts < 1.50, ps $> .14$. The sample size for non-binary participants ($n = 9$) was insufficient to conduct separate analyses.

Removing non-binary participants from analyses did not alter the overall pattern of results; thus, we retained them for the following analyses.

Table 2 displays the correlation matrix for all predictor and outcome variables for the participants who completed measures at both time points. As Table 2 indicates, STTUC tendency (i.e., TROO scores) significantly, negatively correlated with Time 1 belonging, Time 2 belonging, and trait self-esteem. However, STTUC tendency did not significantly correlate with STEM interest or identity at either time point. An inspection of the correlation matrix revealed no concerns about multi-collinearity; thus, we proceeded to our multiple regression analyses. Although the final sample size did not provide the statistical power we desired, a sensitivity analysis showed that the sample was sufficient to detect effects as small as $r = .27$.

Additional Analyses

A Reviewer suggested that, because the outcome variables were highly correlated, a factor analysis (with direct oblimin rotation) should explore whether the three outcome variables might be better represented as a single construct. Kaiser's criterion (number of eigenvalues > 1) suggested the retention of seven factors, although the data do not meet all of the requirements for using this criterion. A scree plot suggested between three and five factors, but again, the less than ideal sample size limits the utility of this criterion. A follow-up MAP test suggested four factors, but a parallel analysis suggested 37 factors (the number of items). In sum, these analyses suggest no evidence that the three distinct scales should actually be treated as one, but the analyses also do not provide clear-cut evidence of a three-factor solution for these three measures.

Primary Analyses

To test our hypotheses that that the tendency to experience STTUC (as measured by the TROO) at Time 1 would predict STEM outcome variables at Time 2, we planned to run a series of simultaneous regression analyses. As noted previously, and consistent with previous research, trait self-esteem (as measured by the SISE) significantly correlated with TROO scores; thus, we included self-esteem as a covariate.
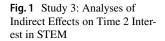
Belonging in STEM

In an initial regression analysis, Time 1 predictor variables were STTUC tendency, Time 1 belonging, and self-esteem, and the outcome variable was Time 2 belonging. The overall model was statistically significant, $p < .001$, explaining 53% of the variance in Time 2 belonging. Inconsistent with H3a, results revealed only Time 1 belonging as a significant predictor of Time 2 belonging, β (standardized beta) = .67, B (unstandardized beta) = .71, 95% CI (.58, .84), $p < .001$. Neither STTUC tendency, $\beta = -.046$, $B = -.031$, 95% CI (-.11, .052), $p = .45$, nor self-esteem, $\beta = .099$, $B = .054$, 95% CI (-.014, .12), $p = .12$, emerged as a significant, unique predictor of Time 2 belonging. However, the strong correspondence between Time 1 and Time 2 belonging suggested little change over time to model. Therefore, we next examined whether the tendency to experience STTUC corresponded with STEM variables at each time point separately.
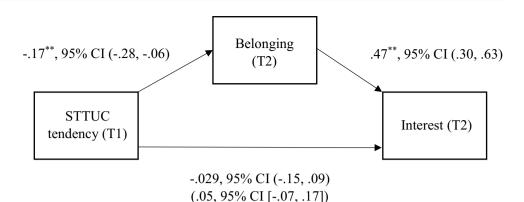
As noted previously, Table 2 indicates that TROO scores significantly, negatively correlated with both Time 1 and Time 2 belonging. A follow-up regression analysis revealed that this pattern held even when controlling for the statistical overlap between self-esteem and STTUC tendency. Specifically, and indirectly supporting H3a, STTUC tendency did not significantly predict Time 2 belonging, $\beta = -.14$, $B = -.097$, 95% CI (-.21, .012), $p = .08$, but the finding becomes statistically significant when including self-esteem, $\beta = .31$, $B = .17$, 95% CI (.082, .26), $p < .001$. The same pattern emerged for Time 1 belonging, $\beta = -.14$, $B = -.093$, 95% CI (-.20, .011), $p = .079$, with the finding becoming statistically significant when including self-esteem, $\beta = .31$, $B = .16$, 95% CI (.079, .24), $p < .001$. Thus, participants likely to

Table 2 Study 3: Correlations Between STTUC Tendency and STEM Outcome Variables

	1	2	3	4	5	6	7	8
1. STTUC tendency (T1)	—							
2. Self-esteem (T1)	-.29**	—						
3. T1 belonging	-.25**	.35**	—					
4. T1 interest	.02	.10	.30**	—				
5. T1 identity	.00	.13	.45**	.66**	—			
6. T2 belonging	-.24**	.35**	.72**	.23**	.41**	—		
7. T2 interest	-.03	.22**	.33**	.71**	.53**	.42**	—	
8. T2 identity	-.06	.16*	.41**	.46**	.70**	.51**	.69**	—

STTUC sensitivity about being the target of a threatening upward comparison

**$p < .01$; *$p < .05$

Fig. 1 Study 3: Analyses of Indirect Effects on Time 2 Interest in STEM

-.17**, 95% CI (-.28, -.06)   Belonging (T2)   .47**, 95% CI (.30, .63)

STTUC tendency (T1)   Interest (T2)

-.029, 95% CI (-.15, .09)
(.05, 95% CI [-.07, .17])

experience STTUC tended to report relatively low levels of belonging in STEM. The conceptual and statistical overlap between the tendency to experience STTUC and trait self-esteem (which also correlates strongly with general belonging) cannot account for these results.

Interest in and Identification within STEM

As Table 2 reveals, STTUC tendency did not significantly correlate with either interest or identity. Therefore, we did not run the planned regression analyses. Thus, inconsistent with H3b and H3c, the tendency to experience STTUC did not correspond with interest in or identification with STEM.

Summary

Results partially supported our hypotheses. Although the tendency to experience STTUC did not significantly predict belonging in STEM at Time 2 when controlling for belonging at Time 1, STTUC tendency did significantly and negatively correlate with belonging at both time points. Inconsistent with hypotheses, the tendency to experience STTUC did not correlate significantly with either interest in or identification with STEM.
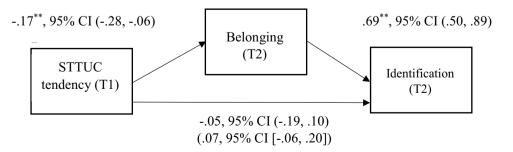
Exploratory Analyses

Inspection of the correlation matrix in Table 2 reveals that, although STTUC tendency did not significantly correlate with either STEM identity or interest, belongingness scores

significantly, positively correlated with both identity and interest. This pattern, combined with previous research supporting belonging as a mediator between STEM beliefs and STEM interest (e.g., Good et al., 2012), led us to speculate about indirect effects of STTUC on identity and interest via belonging. Perhaps non-male STEM undergraduates use the negative affect inherent in STTUC as information (Clore & Huntsinger, 2007), leading them to conclude that they do not belong in STEM (Koch, 2023), which may, in turn, lead them to question both their interest in and identification with STEM. To test these possibilities, we conducted two simple mediation analyses using the PROCESS macro (Model 4) in SPSS (Version 27) with 10,000 bootstrapped samples. STTUC tendency was entered as the sole predictor variable, with belonging as the proposed mediator, and either interest or identity as the outcome. As Figures 1 and 2 reveal, although, as previous analyses indicated, there was no direct relationship between STTUC tendency and either interest or identification, there were significant indirect effects (for interest: indirect effect = -.078, bootstrapped 95% CI [-.15, -.023]; for identification: indirect effect = -.12, bootstrapped 95% CI [-.22, -.036]). Specifically, STTUC tendency (Time 1) significantly, negatively predicted belongingness scores (T2), which, in turn, significantly, positively predicted both interest in and identification with STEM (T2). In other words, the tendency to experience STTUC indirectly predicted relatively low levels of both interest and identification via relatively low belongingness.

The diverse composition of our sample permitted us to examine whether the negative relationship between STTUC tendency and belongingness differed across ethnicities. A

Fig. 2 Study 3: Analyses of Indirect Effects on Time 2 Identification with STEM

-.17**, 95% CI (-.28, -.06)   Belonging (T2)   .69**, 95% CI (.50, .89)

STTUC tendency (T1)   Identification (T2)

-.05, 95% CI (-.19, .10)
(.07, 95% CI [-.06, .20])

sense of belonging may be particularly important for People of Color (PoC) who, like women, tend to be underrepresented in STEM. When a stigmatized identity becomes salient, people may tend to question whether they belong in an environment (Cohen & Garcia, 2008). For example, recent evidence suggests that Black medical students tend to feel a lower sense of belonging in medical school than White students do (Perry et al., 2021). We divided the sample into PoC and non-PoC (i.e., White/Caucasian). Correlational analyses revealed that the original, inverse pattern remained for PoC, $r(67) = -.31$, $p = .01$, but dropped to non-significance for non-PoC, $r(80) = -.072$, $p = .53$. Thus, although results overall indicate that female and non-binary undergraduates who tend to experience STTUC also tend to report relatively low levels of belonging in STEM, this pattern was particularly pronounced for people of color. This finding was unexpected and therefore warrants replication. Additional analyses involving belongingness appear on the OSF page.

General Discussion

The present research suggests that, as hypothesized, out-performance-related discomfort (i.e., STTUC) may be a contributing factor to women's underrepresentation in some STEM fields. Study 1 established a modest yet significant negative relation between the tendency to experience STTUC and a sense of belongingness in STEM (and arts/humanities) courses among undergraduate women. In other words, women who reported that they tend to experience STTUC also reported that they tend to experience low levels of belongingness in their courses. Thus, although the inverse relationship between STTUC tendency and belongingness emerged for both types of courses, the lower overall levels of belongingness in STEM point to the importance of focusing on this domain. Study 2 found, consistent with predictions of the STTUC framework (Exline & Lobel, 1999), that female undergraduates reported higher average levels of both perceived threat (STTUC condition 2) and outperformance-related concerns (STTUC condition 3) than did men for both STEM and arts/humanities courses in hypothetical scenarios. These findings suggest that undergraduate women may have particularly strong reactions to STTUC.

Finally, Study 3 found a significant, negative relation between the tendency to experience STTUC and belongingness in STEM among female and non-binary first-year undergraduates in STEM. In other words, non-male undergraduates who tend to experience outperformance-related discomfort also tended to report relatively low levels of belongingness in their STEM courses. This result held at two time points and even when controlling the statistical overlap between STTUC tendency and trait self-esteem. (However,

we acknowledge that various other factors [e.g., coping with COVID-19, dealing with a difficult transition to university] may affect belongingness). Exploratory analyses reiterated the importance of belongingness, suggesting that although the tendency to experience STTUC did not directly predict interest in or identification with STEM, STTUC tendency may *indirectly* decrease interest and identification through the pathway of belongingness. Of course, the correlational nature of Study 3 precludes strong causal claims, but results of the exploratory analyses are certainly consistent with this proposed causal pathway. The lack of a significant direct relationship between STTUC tendency and either interest in or identification with STEM was inconsistent with hypotheses and warrants further investigation. Given the fundamental importance of belongingness (Baumeister & Leary, 1995), perhaps the STEM students frequently monitored the environment for cues of belonging (or rejection), but their sense of interest in and identification with STEM make take time beyond their first year of university to develop.

The present findings make several theoretical contributions to the research literature. First, the studies examined STTUC in a domain that, to our knowledge, had not been examined before: women studying STEM. In this context, we found that the tendency to experience STTUC predicts relatively low levels of belongingness among women in STEM—a novel finding. Thus, the present research adds to the small literature on STTUC. Second, the present research also contributes to the broader literature on women in STEM. Considerable evidence has demonstrated the powerful effects of belongingness cues on women's sense of belonging in STEM. Experiencing STTUC may be yet another of these cues.

Strengths, Limitations, and Future Research Directions

Several strengths of the present research enhance confidence in the results. The sample sizes of Studies 1 and 2 were well-powered to detect significant effects. Although attrition led to some loss of statistical power in Study 3, the study still had a high retention rate and was both gender- and ethnically diverse, increasing the generalizability of the results. The studies also used a mix of experimental and correlational methods.

The present research also had several limitations that future research may address. We did not collect racial/ethnic data in Study 2—a limitation that limits the generalizability of the results. However, Study 3 recruited an ethnically diverse sample, permitting exploratory analyses involving ethnicity. As noted above, Study 3 was ultimately underpowered, although it still found significant results. Future research may start with a larger sample size to ensure that, even after attrition, the final sample is sufficiently powered. Although the longitudinal nature of Study 3 was a strength, the time span (approximately four

months) was fairly short. Future research may, for example, recruit first-year female (and perhaps gender-diverse) STEM students and track them over the course of their four-year undergraduate degree.

We hope that future research will continue to investigate STTUC as a factor in women's decisions to pursue a STEM education and, ultimately, a STEM career. The present research focused on undergraduates; future research may examine the possibility of STTUC in graduate students and among women established in STEM careers. Diary studies may be useful in elucidating the potential effects of daily STTUC experiences on a sense of belonging in STEM. Researchers interested in continuing to understand the experiences of non-binary individuals in STEM may recruit participants from that population specifically. Perhaps members of a gender minority group already question whether they belong in STEM, and repeated STTUC experiences may further weaken an already low sense of belonging. Finally, gender dynamics may be an area worth studying. Do women who outperform men in STEM respond differently than do women who outperform other women in STEM? Only future research can answer that question.

Practice Implications

The present research has important implications for how educators provide feedback to their students. Praising high achievement in public settings may inadvertently diminish a sense of belongingness by creating STTUC. For example, a study of undergraduates in a large class found that, overall, students would prefer private praise from their professor, rather than public recognition in class for achieving a high exam grade (Exline et al., 2004). Thus, educators may choose to avoid singling out students for their high performance, while still acknowledging their accomplishments privately. When educators deem public praise appropriate (e.g., at an awards banquet), they may be able to reduce STTUC by emphasizing why award-winners *deserved* their success. Prior research demonstrates that STTUC may be particularly intense when people feel that they did not deserve to succeed (Koch & Totton, 2017). We also situate our findings in the broader research context illustrating the importance of fostering a sense of belonging for women in STEM (e.g., Tellhed et al., 2017).

Conclusion

The present research suggests that STTUC may help explain women's underrepresentation in some STEM fields at the undergraduate level, with fewer women

at higher levels (i.e., the "leaky pipeline"; Dlouhy & Froidevaux, 2022). The tendency to experience outperformance-related discomfort corresponded with relatively low belongingness in STEM (and arts/humanities) courses, women tended to anticipate stronger STTUC responses than men did when imagining outperforming classmates, and female and non-binary students in STEM who tend to experience STTUC also tended to report low levels of belongingness in both their first and second semesters of their undergraduate STEM program. These results highlight the importance of belongingness in retaining women in STEM. Perhaps an increase in women's belongingness in STEM will help ensure that Donna Strickland does not remain on such a short list of female Nobel Prize winners.

Declarations

References

Altermatt, E. R., & Ivers, I. E. (2011). Friends' responses to children's disclosure of an achievement-related success: An observational study. *Merrill-Palmer Quarterly, 57*(4), 429–454. https://doi.org/10.1353/mpq.2011.0018

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Belanger, A. L., Joshi, M. P., Fuesting, M. A., Weisgram, E. S., Claypool, H. M., & Diekman, A. B. (2020). Putting belonging in context: Communal affordances signal belonging in STEM. *Personality and Social Psychology Bulletin, 46*(8), 1186–1204. https://doi.org/10.1177/0146167219897181

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*(6), 1045–1060. https://doi.org/10.1037/a0016239

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin, 143*(1), 1–35. https://doi.org/10.1037/bul0000052

Clore, G. L., & Huntsinger, J. R. (2007). How emotions inform judgment and regulate thought. *Trends in Cognitive Sciences, 11*(9), 393–399. https://doi.org/10.1016/j.tics.2007.08.005

Cohen, G. L., & Garcia, J. (2008). Identity, belonging, and achievement: A model, interventions, implications. *Current Directions in Psychological Science, 17*(6), 365–369. https://doi.org/10.1111/j.1467-8721.2008.00607.x

Cohen, S. M., Hazari, Z., Mahadeo, J., Sonnert, G., & Sadler, P. M. (2021). Examining the effect of early STEM experiences as a form of STEM capital and identity capital on STEM identity: A gender study. *Science Education, 105*(6), 1126–1150. https://doi.org/10.1002/sce.21670

Cowgill, C., Halper, L., Rios, K., & Crane, P. (2021). "Why so few?": Differential effects of framing the gender gap in STEM recruitment interventions. *Psychology of Women Quarterly, 45*(1), 61–78. https://doi.org/10.1177/0361684320965123

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science, 21*(8), 1051–1057. https://doi.org/10.1177/0956797610377342

Dlouhy, K., & Froidevaux, A. (2022). Evolution of professionals' careers upon graduation in stem and occupational turnover over time: Patterns, diversity characteristics, career success, and self-employment. *Journal of Organizational Behavior, 25*(5), 641–665. https://doi.org/10.1002/job.2615

Exline, J. J., & Lobel, M. (1999). The perils of outperformance: Sensitivity about being the target of a threatening upward comparison. *Psychological Bulletin, 125*(3), 307–337. https://doi.org/10.1037/0033-2909.125.3.307

Exline, J. J., & Lobel, M. (2001). Private gain, social strain: Do relationship factors shape responses to outperformance? *European Journal of Social Psychology, 31*(5), 593–607. https://doi.org/10.1002/ejsp.79

Exline, J. J., Single, P. B., Lobel, M., & Geyer, A. L. (2004). Glowing praise and the envious gaze: Social dilemmas surrounding the public recognition of achievement. *Basic and Applied Social Psychology, 26*(2–3), 119–130. https://doi.org/10.1207/s15324834basp2602&3_2

Exline, J. J., & Zell, A. L. (2012). Who doesn't want to be envied? Personality correlates of emotional responses to outperformance scenarios. *Basic and Applied Social Psychology, 34*(3), 236–253. https://doi.org/10.1080/01973533.2012.674412

Exline, J. J., Zell, A. L., Bratslavsky, E., Hamilton, M., & Swenson, A. (2012). People-pleasing through eating: Sociotropy predicts greater eating in response to perceived social pressure. *Journal of Social and Clinical Psychology, 31*(2), 169–193. https://doi.org/10.1521/jscp.2012.31.2.169

Frome, P. M., Alfeld, C. J., Eccles, J. S., & Barber, B. L. (2006). Why don't they want a male-dominated job? An investigation of young women who changed their occupational aspirations. *Educational Research and Evaluation, 12*(4), 359–372. https://doi.org/10.1080/13803610600765786

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics.

Journal of Personality and Social Psychology, 102(4), 700–717. https://doi.org/10.1037/a0026659

Government of Canada. (2019). *Persistence and representation of women in STEM programs*. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/75-006-x/2019001/article/00006-eng.htm

Heilbronner, N. N. (2013). The STEM pathway for women: What has changed? *Gifted Child Quarterly, 57*(1), 39–55. https://doi.org/10.1177/0016986212460085

Koch, E. J. (2023). Success with a twinge of distress: Antecedents and consequences of outperformance-related discomfort. *Social and Personality Psychology Compass*. https://doi.org/10.1111/spc3.12736

Koch, E. J., & Metcalfe, K. P. (2011). The bittersweet taste of success: Daily and recalled experiences of being an upward social comparison target. *Basic and Applied Social Psychology, 33*(1), 47–58. https://doi.org/10.1080/01973533.2010.539960

Koch, E. J., & Totton, S. F. M. (2017). "What've I done to deserve this?" The role of deservingness in reactions to being an upward comparison target. *Journal of Social and Personal Relationships, 34*(1), 3–25. https://doi.org/10.1177/0265407515619043

Lewis, K. L., Stout, J. G., Finkelstein, N. D., Pollock, S. J., Miyake, A., Cohen, G. L., & Ito, T. A. (2017). Fitting in to move forward: Belonging, gender, and persistence in the physical sciences, technology, engineering, and mathematics (pSTEM). *Psychology of Women Quarterly, 41*(4), 420–436. https://doi.org/10.1177/0361684317720186

Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology, 108*(3), 424–437. https://doi.org/10.1037/edu0000061

McBride, J. (2018). *Nobel laureate Donna Strickland: 'I see myself as a scientist, not a woman in science.'* The Guardian. https://www.theguardian.com/science/2018/oct/20/nobel-laureate-donna-strickland-i-see-myself-as-a-scientist-not-a-woman-in-science

Park, L. E., Young, A. F., Troisi, J. D., & Pinkus, R. T. (2011). Effects of everyday romantic goal pursuit on women's attitudes toward math and science. *Personality and Social Psychology Bulletin, 37*(9), 1259–1273. https://doi.org/10.1177/0146167211408436

Peer, E., Brandimarte, L., Samat, S., & Acquisti, A. (2017). Beyond the Turk: Alternative platforms for crowdsourcing behavioral research. *Journal of Experimental Social Psychology, 70*, 153–163. https://doi.org/10.1016/j.jesp.2017.01.006

Perry, S. P., Wages, J. E., Skinner-Dorkenoo, A. L., Burke, S. E., Hardeman, R. R., & Phelan, S. M. (2021). Testing a self-affirmation intervention for improving the psychosocial health of Black and White medical students in the United States. *Journal of Social Issues, 77*(3), 769–800. https://doi.org/10.1111/josi.12448

Ramsey, L. R. (2017). Agentic traits are associated with success in science more than communal traits. *Personality and Individual Differences, 106*, 6–9. https://doi.org/10.1016/j.paid.2016.10.017

Richards, C., Bouman, W. P., Seal, L., Barker, M. J., Nieder, T. O., & T'Sjoen, G. (2016). Non-binary or genderqueer genders. *International Review of Psychiatry, 28*(1), 95–102. https://doi.org/10.3109/09540261.2015.1106446

Robins, R. W., Hendin, H. M., & Trzesniewski, K. H. (2001). Measuring global self-esteem: Construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Personality and Social Psychology Bulletin, 27*(2), 151–161. https://doi.org/10.1177/0146167201272002

Scinta, A., & Gable, S. L. (2005). Performance comparisons and attachment: An investigation of competitive responses in close relationships. *Personal Relationships, 12*(3), 357–372. https://doi.org/10.1111/j.1475-6811.2005.00120.x

Settles, I. H., Jellison, W. A., & Pratt-Hyatt, J. S. (2009). Identification with multiple social groups: The moderating role of identity change over time among women-scientists. *Journal of Research*

in Personality, 43(5), 856–867. https://doi.org/10.1016/j.jrp.2009.04.005

Tellhed, U., Bäckström, M., & Björklund, F. (2017). Will I fit in and do well? The importance of social belongingness and self-efficacy for explaining gender differences in interest in STEM and HEED majors. *Sex Roles, 77*(1–2), 86–96. https://doi.org/10.1007/s11199-016-0694-y

Thoman, D. B., Arizaga, J. A., Smith, J. L., Story, T. S., & Soncuya, G. (2014). The grass is greener in non-science, technology, engineering, and math classes: Examining the role of competing belonging to undergraduate women's vulnerability to being pulled away from science. *Psychology of Women Quarterly, 38*(2), 246–258. https://doi.org/10.1177/0361684313499899

Woodcock, A., Hernandez, P. R., Estrada, M., & Schultz, P. W. (2012). The consequences of chronic stereotype threat: Domain disidentification and abandonment. *Journal of Personality and Social Psychology, 103*(4), 635–646. https://doi.org/10.1037/a0029120

Xavier Hall, C. D., Wood, C. V., Hurtado, M., Moskowitz, D. A., Dyar, C., & Mustanski, B. (2022). Identifying leaks in the STEM recruitment pipeline among sexual and gender minority US secondary students. *PLoS ONE*, *17*(6) Article e0268769. https://doi.org/10.1371/journal.pone.0268769