Recognition of Subtle Bias Tempers Explicit Gender Stereotyping Among STEM Students

Abstract

The overarching goal of this research project is to provide a novel contribution to perceived bias research by testing the hypothesis that mere exposure to instances of subtle gender bias in STEM settings can have important effects on observers, depending on whether they recognize such events as gender bias or do not see it as bias. The goal of the first of five experiments was to assess how witnessing subtle gender bias events influences explicit stereotype activation among people who recognize the events as gender stereotyping as well as those who do not. We utilized video materials that were developed and tested in our previous NSF research that show a group of four engineering students, 2 women and 2 men, working together on an engineering design task. There are two versions of the video: one in which the students engaged in subtle gender bias (bias version), and one in which the students engaged in neutral interactions (control version). Over 400 participants were recruited from a large midwestern research university from computer science and engineering majors in which 30% or fewer majors are women. The survey included assessments of perceptions of gender stereotyping in the video, general stereotype endorsement and STEM stereotype endorsement, and three individual difference measures (gender-based rejection sensitivity, sexism sensitivity and negative emotionality) used as covariates in analyses. We found that participants who saw the bias video reported greater explicit stereotyping when they failed to recognize gender bias in the video. When they did recognize bias, they reported explicit stereotyping at levels similar to those in the control condition. This pattern suggests that exposure to subtle gender bias events may have activated gender stereotypes, but when participants recognized the events as gender bias, they tempered their explicit stereotyping.

Introduction and Background

Gender stereotyping is present in many Science, Technology, Engineering, and Mathematics (STEM) settings, with negative consequences for those who are the targets of these negative stereotypes [1]. It can lower representation of women in STEM fields and careers [2] - [7] and, for those who remain, can result in an accumulation of disadvantage in advancement in these fields [8]. This is particularly true when women are severely under-represented in a field, such as some engineering sub-fields and computer science [9].

Several decades of recruiting women into STEM educational programs and workplaces without addressing the negative climate have not produced a successful shift in retention in these fields [2], [7]. These trends are problematic for a number of reasons, especially because they undermine the national goal of increasing the quantity of the STEM workforce [10]; moreover, given the body of research documenting the benefits of diversity in work teams (for a review, see [11]), lowered retention of women undermines the quality of that workforce.

Stereotypes and Schemas

Stereotyping refers to the application of a social group schema in perception and evaluation of members of that group [12]. Schemas are the generalized beliefs held about the characteristics of people, objects, and events [13]. When brought to mind, or activated, schemas can help to guide our responses to people, objects, and events, which helps preserve our cognitive resources; however, they may undermine the fair and objective evaluation of the individual [14]. Whereas general gender stereotypes exist regarding the broad personality traits of men and women (e.g., men as assertive, women as supportive, across domains), gender stereotypes can also exist that are specific to particular domains, including STEM. These stereotypes depict women as being less suitable for STEM than men. Gender bias in STEM can lead to biased behaviors and judgments based on these stereotypes, which can create more negative climates for women in STEM.

Stereotypes can be brought to mind, or activated, by cues in the environment. Such cues include gender compositions (i.e., settings with few women present), physical objects (masculine items that signal that the space is occupied primarily by men), as well as behaviors - the things people say and do - that express their stereotypes. Such expressions of stereotyping can be quite blatant, as when, for example, women are explicitly told that they are unlikely to succeed in STEM and are steered away from STEM careers. However, in today's society stereotyping is more likely to be expressed indirectly, reflected in subtle as opposed to blatant expressions, which are therefore ambiguous. We focus on these subtle stereotypic behaviors in this study, and refer to them as subtle bias events.

Subtle Bias

Given the subtle nature of modern sexism [15], [16], it is likely that gender bias in STEM settings is often subtle, and thus ambiguous as to whether it reflects gender stereotyping [17], [8], [18]. People's stereotypic beliefs can be subtly expressed in their behaviors, often without intention, due to the automatic activation of stereotypes associated with gender schemas [19], [20], [21]. In STEM fields, stereotypic expectations of women's lower competence, performance, and achievement compared to men can be communicated via subtle verbal or nonverbal communications, sometimes referred to as microaggressions [22], [23]. For example, women's engineering contributions may be ignored or discredited, or women may be cast in female stereotypic roles such as team secretary [24].

Although these subtle bias events may seem minor, these small instances of gender bias can accumulate resulting in significant gender disparities over time [8]. Cumulative effects of these small yet persistent acts of subtle gender bias can have deleterious consequences for women including diminished self-esteem, lower scores on standardized tests and lowered career aspirations [17]. Table 1 provides examples of subtle gender bias in a STEM context, along with the underlying gender stereotype reflected in the event.

Table 1
Examples of subtle gender bias in a STEM context.

Example of subtle gender bias event	Underlying gender stereotype
A woman is expected to adopt a female stereotypic role (e.g., to take notes), whereas men adopt male stereotypic roles (e.g., a leader or technical expert).	Women primarily support men's work in STEM and should take on roles that are considered to align with their assumed female skill set.
A woman's idea is ignored, yet accepted when repeated later by a man.	Men are more credible sources of good ideas in STEM than women.
Men in the group cut off and interrupt a woman proposing an idea.	Women's STEM contributions are not as important as men's contributions.
Somebody assumes that a woman has been admitted to the field or hired solely because of her gender.	Women are less skilled in STEM and need special consideration to be eligible for admission.
Men in a group over-explain concepts to a woman assuming that she is unfamiliar or unskilled in the STEM domain.	Women are less accomplished in STEM and therefore need help to understand complex topics.

Witnessing Subtle Bias

While being directly targeted by gender bias can clearly have a significant influence on the individual, merely being a witness to bias targeting someone else can have a significant impact as well [25], [26]. For instance, the cues hypothesis [27] asserts that stereotype-consistent cues in STEM settings (such as a lack of female representation) can trigger negative outcomes, because stereotypes are activated and become relevant in the situation. Cheryan and colleagues [28] examined the role of physical object cues and found that the mere presence of masculine objects in a computer science setting deterred women from computer science majors and careers, consistent with work showing the negative effect of stereotypes on motivation, and sense of belonging [27], [29].

In this study, we propose that when people witness subtle bias events in STEM environments, this can serve as a cue that activates STEM specific gender stereotypes. Once activated, people may engage in explicit stereotype endorsement, i.e., explicitly endorse those stereotypes as true or valid, given that the subtle bias event serves to support and maintain the stereotype. For example, when the contributions of women in a technical discussion are ignored in favor of men's contributions, this may serve to activate and validate the stereotypic belief that women are less capable in STEM than men. This can produce a negative recursive cycle: witnessing stereotyping serves to reinforce stereotypic beliefs which then leads to biased behaviors in the observer that are witnessed by others. This cycle can create a negative climate and ultimately contribute to the underrepresentation of women in STEM.

Recognition of Subtle Bias

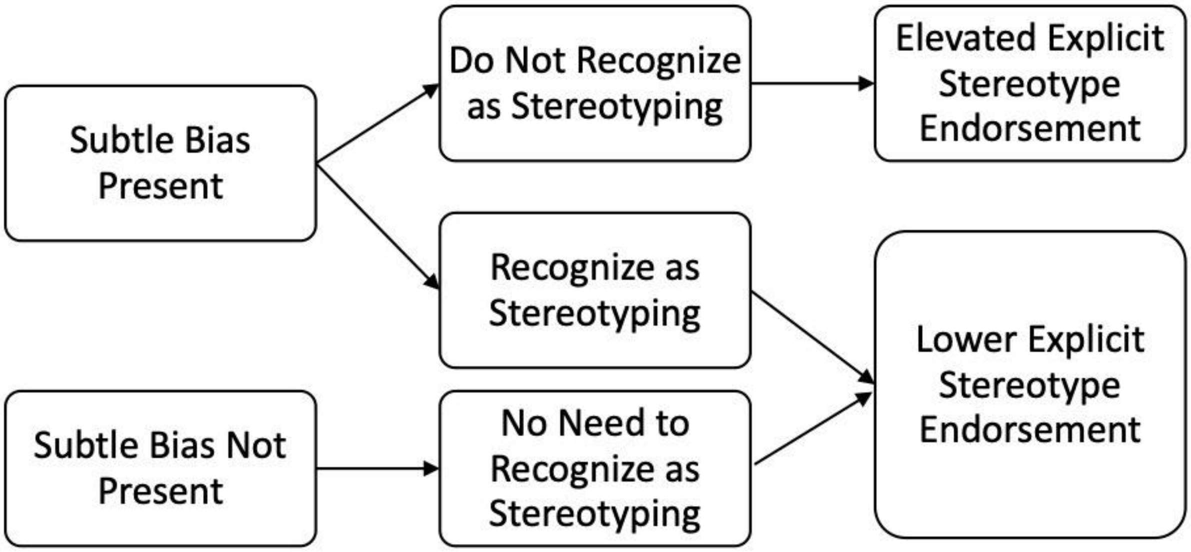
Although witnessing subtle bias events may activate stereotypes, this may not always lead to biased behaviors if people explicitly reject the stereotypes. Research indicates that people can explicitly disavow their activated stereotypes. Devine and colleagues [30] demonstrated that people can become less stereotypically biased when they are aware of what stereotyping is; are motivated to act against it; and practice specific strategies in a sustained effort to avoid stereotyping. Therefore, the negative recursive cycle may be broken if people are motivated to explicitly disavow stereotypes and actively strive to be non-biased [30].

The initial factor that may lead people to disavow stereotypes activated by witnessing subtle gender bias is their proclivity to recognize subtle gender bias as stereotyping. Previous research suggests that people may be able to temper or even reduce negative outcomes of stereotype activation if they are educated on recognizing subtle bias as being influenced by gender stereotypes. For example, a "teaching intervention" [29] that raised awareness of gender stereotyping and its demonstrated effect on women's math performance was found to buffer the negative effects of stereotyping of women.

Extending this previous work, we propose that an ability to recognize subtle bias as being caused by gender stereotyping may reduce the likelihood of witnesses to explicitly endorse stereotypes, and increase the likelihood that they will explicitly disavow stereotypes.

People are likely to differ in their tendency or ability to identify subtle gender bias as gender stereotyping. Because subtle gender bias is by its nature ambiguous, it may be interpreted in different ways by different people. For example, engineering students working on teams may witness a woman team member being assigned to secretarial roles, such as note taking or report writing, as opposed to more technical roles, following stereotypes of men as engineering experts and women as their supporters. Indeed, research shows that women are disproportionately assigned non-technical roles in engineering student teams [24]. Some observers may easily identify that the woman is being targeted by these stereotypes. Other observers may see this event as not being related to stereotyping at all, but rather simply the way role assignment played out on the team (e.g., as people "playing to their strengths"). We propose that when people do not recognize subtle bias events as stereotyping, they are more likely to engage in greater explicit endorsement of gender stereotypes, seeing as the event they witnessed served to support and maintain those stereotypes. In contrast, people who do recognize the subtle bias event as stereotyping may be more likely to explicitly disavow stereotypes by engaging in less explicit stereotype endorsement. Figure 1 provides a conceptual model of this process.

Figure 1
Conceptual model showing differences in the response of individuals to environments in which subtle bias may be present.



Hypothesis

In this study, we test this conceptual model, specifically exploring whether witnessing subtle gender bias events in a student engineering team context can activate STEM specific gender stereotypes in observers. Because the subtle gender events occur in a STEM setting, it is likely that STEM specific (over general gender stereotypes about broader personality traits) may be activated. Moreover, we examine whether recognizing subtle gender bias events as gender stereotyping can lead observers to explicitly disavow stereotypes, compared to those who do not recognize subtle gender bias events as stereotyping.

Method

Participants

For this study, 437 undergraduate student participants from the University of Michigan were surveyed via the online survey platform Qualtrics. Ten participants were removed for being first year students who had not yet declared a major, fourteen participants were excluded for poor data quality (measured by questions such as, "Did you put forth your best effort in this study?" and, "Is there anything going on in your life or current environment that made it difficult to participate fully, or may have changed how you normally would have answered?"), five participants were removed for failing to properly complete all measures, and four nonbinary participants were removed due to it being impossible to perform meaningful analyses with such a small group of non-binary participants. The final sample included 404 participants: 194 identified as women (48.0%); 210 as men; 197 as White (48.8%); 140 as Asian/Asian American

(34.7%); 10 as Middle Eastern/North African (2.5%); 13 as Latinx (3.2%); 10 as Black (2.5%); 4 as Native American (1.0%); 29 as another race (7.2%); and one participant opted not to disclose their race (0.2%). The mean age of the sample was 20.48 years old (SD = 1.61). All participants were enrolled in engineering majors in which women make up 30% or less of the student body (i.e., Aerospace Engineering, Computer Engineering, Computer Science, Electrical Engineering, Mechanical Engineering, Naval Engineering, Nuclear Engineering, and Data Science).

Procedure

In an online experiment, we utilized video materials that show a group of four engineering students, 2 men and 2 women, working together on an engineering design task. In the subtle bias video version, 5 of the 9 interactions shown depict the scenarios described in Table 1. In the control version, all 9 interactions shown are stereotype-neutral. These videos were the results of a pre-tested suite of eleven videos down-selected for those that were perceived as reflecting greater gender bias than control versions, while not differing in terms of factors such as being realistic and easy to comprehend.

Participants began the study by providing informed consent and then filling out the demographic portion of the survey. Following this introductory section, participants were randomly assigned to view one version of the video, being told that the study concerns testing their memory for videotaped interactions.

Participants were then told they were to complete a series of tasks. This included the primary outcome variables, explicit general stereotype endorsement and explicit STEM stereotype endorsement, plus the recognition of subtle bias events as stereotyping measure, and control variables described below.[1] Following completion of the measures, the experiment ended and the participants read a debriefing statement.

Predictor

Recognition of subtle bias as stereotyping[2]. Participants were asked to rate the interactions between students in the video on the degree to which they were perceived to be influenced by gender bias, gender stereotyping and sexism. Participants responded to these three items on a 1 - 7 Likert scale ranging from 1 “not at all influenced by [gender bias/gender stereotyping/sexism]” and 7 “extremely influenced by [gender bias/gender stereotyping/sexism]”, $\alpha = .95$.

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[1] Participants also completed a measure of implicit stereotyping, the science/gender Implicit Association Test (IAT, [31]). Assessments using implicit measures are designed to reduce control over responding. Analyses of the IAT scores showed few significant effects (see Footnote 3), perhaps because implicit associations are more difficult to change given their uncontrollable nature. Therefore, we focused on results from the explicit stereotype endorsement measure.

[2] In addition, participants completed open-ended measures of recognition of subtle bias as gender stereotyping. Participants were asked to think back on the video they saw earlier in the study, and describe the interactions; independent judges scored them as to whether they reflected recognition of stereotyping. Few significant outcomes emerged using the open-ended assessment, perhaps because the mean scores for recognizing stereotyping on this assessment were very low, with most participants scoring zero (i.e., did not spontaneously report stereotype recognition). Therefore, results are reported here from only the close-ended recognition of stereotyping assessment.

Dependent measures

Explicit STEM Stereotype Endorsement Scale. This scale included three items adapted from Schmader, Johns, & Barquissau [32] based on stereotypes that men are more suited to STEM than women (e.g., “In general, men may be better in science and engineering than women”). Participants responded to all items on a 1-7 Likert scale with 1 being “strongly disagree” and 7 being “strongly agree”, α = .79.

Explicit General Stereotype Endorsement Scale. This scale included three items based on general traits stereotypically associated with men and women (e.g., “Men are naturally assertive and ambitious”; “Women are naturally submissive and caring”). Participants responded to all items on a 1-7 Likert scale with 1 being “strongly disagree” and 7 being “strongly agree”, α = .66.

Control variables

People may naturally differ in their sensitivity to gender bias, which could influence how they respond to witnessing it. Therefore we assessed three individual difference factors, Gender Based Rejection Sensitivity [33], Sexism Sensitivity, and Negative Emotionality [34]. These were used as covariates in analysis, to assess the effect of witnessing subtle gender bias taking into account one’s predispositional sensitivity to gender bias and experiencing negative emotions.

Gender Based Rejection Sensitivity Scale (GBRS). [33] The GBRS was used to measure a participant's concern about and expectations for being excluded, marginalized, or disrespected on the basis of gender. The GBRS provided participants with six scenarios and two questions measuring their concern/anxiety about experiencing gender bias, and their perceived likelihood that a gender biased outcome would occur. For example, “Imagine that you have to give an oral presentation in a very important course. After everyone gives their presentations, the professor announces that he will post the grades outside of the classroom.,” followed by “How concerned/anxious would you be that you might receive a lower grade than others because of your gender,” and “I would expect to receive a high grade on the presentation.” Items measuring concern about being excluded were answered on a 1-7 Likert scale ranging from 1 “very unconcerned” to 7 “very concerned”, and items measuring expectations for being excluded were answered on a 1-7 Likert scale ranging from 1(not at all likely) to 7(very likely). GBRS scores were computed following the standard rubric [33], α = .83.

Sexism Sensitivity Scale. The sexism sensitivity scale is an alternative measure developed by the authors to measure a participant's individual vigilance for gender bias events. The participants responded to six items on a 1-7 Likert scale ranging from 1 “strongly disagree” to 7 “strongly agree”. The scale includes items such as, “In general, I think people of my gender are not taken seriously,” α = .89.

Negative Emotionality Scale [34]. The negative emotionality scale was used to measure an individual's general tendency to experience aversive emotions including anxiety, moodiness, and perceived victimization. Participants responded to ten items on a 1-7 Likert scale ranging from 1 "strongly disagree" to 7 "strongly agree". Example items include statements such as, "I worry about terrible things that might happen," α = .89.

Results

The study used a 2(video condition: bias/control) x 2(recognition of stereotyping: high/low) x 2(gender: man/woman) between-subjects design, with GBRS, Sexism Sensitivity, and Negative Emotionality included as covariates.

Two regression analyses were performed regressing explicit STEM specific, and explicit general stereotype endorsement on video condition, participant gender, recognition of subtle gender bias as stereotyping, and their interaction terms.[3]

Explicit STEM Stereotype Endorsement

Results of the regression analysis for explicit STEM stereotype endorsement (overall $M = 2.00$, $SD = 1.21$) revealed a significant main effect of condition, $B = .54$, $t = 2.07$, $p = .04$, such that participants reported greater explicit stereotype STEM endorsement in the bias ($M = 2.28$) than the control condition ($M = 1.95$).

This main effect was qualified by a significant condition by recognition of stereotyping interaction, $B = -.27$, $t = -2.02$, $p = .04$. Simple effects analyses revealed that among those who did not recognize stereotyping in the video, explicit STEM stereotype endorsement was higher in the bias than control video condition, consistent with the main effect of condition. However, among those who did recognize stereotyping in the video, explicit STEM stereotype endorsement was not different between bias and control video conditions, Moreover, in the control condition, explicit STEM stereotype endorsement was not significantly different between those who recognized less stereotyping in the video (-1 *SD*) and those who recognized more stereotyping in the video (+1 *SD*). In the bias condition, explicit STEM stereotype endorsement was higher among those who recognized less stereotyping in the video (-1 *SD*) compared to those who recognized more stereotyping in the video (+1 *SD*). This pattern suggests that viewing the bias video increases explicit STEM stereotype endorsement, but those who recognize stereotyping in the video temper their explicit STEM stereotype endorsement ratings (Table 2). Put another way, witnessing subtle bias events led observers to endorse stereotypes that men are better suited for STEM than women, but only if they did not label the event as gender stereotyping; if they did label the event as gender stereotyping, they explicitly disavowed the STEM stereotype.

[3] Results of the regression analysis for implicit stereotyping (IAT) revealed a significant main effect of gender, such that women ($M = .47$) demonstrated greater implicit stereotyping than men ($M = .09$), $B = -.45$, $t = -5.33$, $p < .001$. A significant main effect of condition also emerged, such that participants demonstrated greater implicit stereotyping in the control ($M = .27$) than bias condition ($M = .21$), $B = -.17$, $t = -2.00$. $p = .047$. No other significant effects emerged, all *B*s < |.17|, all *t*s < |1.63|, all *p*s > .10.

Table 2

Explicit STEM stereotype endorsement by video condition and level of recognizing stereotyping in the video.

Recognition of stereotyping	**Video Condition**		
	Control	**Bias**	
-1 SD (did not recognize stereotyping)	2.08	2.77	$b = .69$ $t = 2.98$ $p = .003$
+1 SD (did recognize stereotyping)	1.81	1.79	$b = -.02$ $t = -.10$ $p = .92$
	$b = -.07$ $t = -1.21$ $p = .23$	$b = -.26$ $t = -4.16$ $p = .000$	

Explicit General Stereotype Endorsement

Results of the regression analysis for explicit general stereotype endorsement (overall $M = 3.13$, $SD = 1.10$) revealed no significant main effects or interactions, all Bs < $|.35|$, all ts < $|1.30|$, all ps > .20. Taken together. These results suggest that the effect of witnessing subtle bias events on stereotype endorsement are specific to the stereotype that men are better suited to STEM than women, not to stereotypes about men's and women's general traits (e.g., men as naturally assertive; women as naturally submissive).

Discussion

Our primary goal for this study was to examine the relationship between the ability to recognize subtle bias events as being based on gender stereotypes and explicit STEM stereotype endorsement. Participants viewed a video that showed subtle gender bias events in an engineering team setting, or a neutral video, and then completed two measures of explicit stereotype endorsement - one concerning broad traits stereotypically associated with gender, and one concerning stereotypes about men's superior suitability for STEM. Using these explicit STEM stereotype endorsement measures allowed us to capture the degree to which participants believed these gender stereotypes are true and valid. The measures provided participants the opportunity to explicitly reflect on their beliefs when responding, thus granting them a measure of control when responding. This allowed participants to explicitly disavow gender stereotypes as true and valid, if they so desire.

The regression analysis performed for explicit STEM stereotype endorsement's relationship with recognition of subtle bias events as gender stereotyping showed that participants reported greater belief in the validity of these stereotypes after witnessing subtle gender bias events in the video compared to when they did not see subtle bias events based on gender in the video. These results show that simply witnessing subtle gender bias events can increase conscious endorsement of gender stereotypic beliefs about men's superior suitability in STEM. This was true across participant gender, illustrating that both men and women alike may endorse STEM stereotypes as a consequence of witnessing subtle gender bias. Although not measured here, these activated stereotypes could (consciously or subconsciously) lead witnesses to engage in subtly stereotypic behaviors themselves, with a negative effect on those around them.

However, the main effect of video condition on explicit STEM stereotype endorsement was qualified by a significant interaction between video condition and recognition of stereotyping. When watching the video with *no* subtle gender bias events (control video), there was no difference in how strongly participants endorsed STEM stereotypes based on recognition of stereotyping. When watching the video *with* subtle gender bias events, though, those who recognized the subtle gender bias events as stereotyping reported weaker endorsement of STEM stereotypes compared to those who failed to recognize the subtle gender bias events as stereotyping. In other words, participants who saw subtle bias and *failed* to recognize it as such had significantly greater explicit endorsement of STEM stereotypes than both those who saw subtle bias and recognized it as stereotyping and those who did not see bias at all (control video). Of interest, this pattern emerged only regarding explicit STEM stereotype endorsement (regarding stereotypes of men's greater suitability for STEM than women), as opposed to explicit general gender stereotype endorsement (regarding stereotypes of men being assertive and women being caring), which likely emerged because the subtle bias events witnessed occurred in the STEM context regarding STEM-specific gender stereotypes.

Considering that our primary outcome measure involved a self-report assessment of stereotype endorsement, one could argue that those who recognize bias and subsequently explicitly reject stereotypes are simply misrepresenting their beliefs to appear as "politically correct" to the researchers or society. While this is a criticism affecting all self-report measures, it may be particularly relevant to assessment of stereotype endorsement. Yet, even if people are engaging in this type of socially desirable response, there is likely still great value in their choice to represent themselves as non-biased people. Previous research [30] has shown that self-awareness regarding one's own biases/prejudices, and a desire to reduce them, are important first-steps in being able to actually reduce those same biases/prejudices. Thus, when individuals have the ability to recognize bias, they therefore have the opportunity to consciously reject those biases, which can help contribute to a more inclusive environment for all.

It is interesting to note that despite the interactions depicted in the control video being pre-tested to assure they were perceived as less gender biased than the interactions in the bias video, some participants still perceived a degree of gender bias in the control video (evidenced by the average rating of recognition of bias being 1.94 in the control condition, as opposed to the lowest possible value of 1.0, "not at all influenced by gender bias/discrimination/sexism"). This may be due to several influences, for example, the perception that *all* mixed gender interactions are likely influenced by attitudes about gender, at least to some degree; or that people who spend significant time in STEM settings may therefore encounter stereotyping occasionally which makes them highly vigilant for perceiving gender bias. Future research should explore the individual differences that may lead individuals to perceive bias when witnessing (relatively) neutral events.

It is also important to recognize that the current study focused on subtle bias events based on gender. However, other social identity groups are also negatively stereotyped and underrepresented in STEM, including racial/ethnic minorities (e.g, Native American, African American, Latinx people) [23], and sexual minorities (including LGBTQ individuals) [35]. In addition, this study utilized a binary view of gender, and did not present any findings regarding people who identify as non-binary. Future research should broaden the range of social identity groups included, so as to increase understanding of how witnessing and recognizing bias affects individuals more broadly.

Despite these limitations, these findings highlight the importance of being able to recognize subtle bias events as stereotyping. While some individuals are the direct targets of bias, many others may be witness to this bias. Indeed, it is likely that more people witness subtle bias in workplace and academic settings every day than are direct targets of bias themselves. Being able to recognize that bias happening in one's environment is a manifestation of stereotyping can lead people to endorse stereotypes less strongly, thus potentially creating the opportunity for them to choose to avoid discriminatory behavior themselves. This lends credence to the utility of training programs and other educational interventions that teach individuals about stereotypes, subtle bias, and how to recognize when it is happening around them. Previous research has found that bias education programs can reduce implicit bias, increase awareness of bias, and reduce instances of bias [30], [36]. Further, research into STEM specific bias education programs has shown that they help to increase the retention rates of women in STEM and that these effects are persistent over time [36]. Our research suggests that such programs may result in more people being able to recognize stereotyping, and thus be able to reject activated stereotypes when they witness subtle gender bias in their environment. This may break the negative recursive cycle in which witnessing bias begets more stereotype endorsement and more gender discrimination, which may ultimately help improve the climate in STEM settings.

Future research in this direction will include a shift from dependent measures of self-perception and self-report to behaviors indicative of gender stereotype endorsement, such as evaluations of men's vs. women's STEM performances, selecting STEM team members, or assigning roles on a team. This will show whether awareness might influence not only a tempering of self-report, but tempering of behaviors that reinforce stereotypes as well.

In addition, as mentioned above, we recommend expanding this line of research to address the potential benefits of subtle bias recognition on the climate for other marginalized groups in STEM. Finally, although it wasn't the primary focus of this research project, it may also be interesting to explore why some individuals detected bias in the control video. This raises the question whether accumulated bias experiences influence one's ability to objectively witness a STEM team interaction.

Conclusions and Recommendations

In this study we examined how an ability to recognize subtle bias as stereotyping can reduce the explicit endorsement of gender stereotypes that is raised when people witness subtle bias happening around them. Our results support the proposed conceptual model in Figure 1. We found that simply witnessing subtle bias events based on gender can increase conscious endorsement of gender stereotypic beliefs for both men and women. Further, we found that those who witness bias and do not recognize it as stereotyping appear to have stereotypes activated which leads to greater explicit endorsement of stereotypes compared to those who did not witness bias. In other words, if bias is recognized, in terms of explicit endorsement of STEM stereotypes, it is as if the bias didn't happen. Thus, recognition of bias potentially serves the role of blocking a recursive process allowing the propagation of STEM gender stereotypes, degradation of the climate for women in STEM, and negative outcomes for all involved in this setting.

These results are important and relevant to how we educate and develop future engineering professionals. Having a greater understanding of how gender biases (even in subtle expressions) affect one's ability to work, collaborate, and support others in an academic setting provides valuable insight into the creation of supportive environments for women in engineering. In this study, individuals who were able to identify subtle bias events were in an empowering position to believe in or defy gender stereotypes when they witnessed them first-hand. The model proposed here suggests there is value in open discourse of the issues of stereotyping and bias in STEM, as individuals may learn more about how to recognize bias. Having this ability could allow them to make more egalitarian, or stereotype-defying behavioral choices when choosing partners for projects, assigning technical roles on teams, evaluating the contributions of others, and other common STEM activities. Utilizing the model, intervention methods and/or educational tools could be developed by STEM educators to provideSTEM students with information and resources about how subtle bias is evidenced in STEM settings, which can help them learn to recognize it and avoid it in their own behaviors and choices.

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