Maybe She is Relatable: Increasing Women's Awareness of Gender Bias Encourages Their Identification with Women Scientists

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Abstract

In the current research, we explored whether informing women about gender bias in science, technology, engineering, and mathematics (STEM) would enhance their identification with a female scientist, and whether this increased identification would in turn protect women from any adverse effects of gender bias information. We found that, relative to a control information condition, gender bias information promoted beliefs that a successful woman (but not a man) scientist had encountered bias, and encouraged identification with that woman scientist. Feelings of empathic concern was an important mechanism underlying this increased identification (Experiments 2 and 3). Moreover, when presented with a man scientist, information about gender bias in STEM decreased female participants' anticipated belonging and trust in a STEM environment, compared to participants in a control information condition (Experiment 1a and 1b). However, identifying with a woman scientist after learning about sexism in STEM fields alleviated this harmful effect. Finally, compared to those in the control condition, female college students who learned about gender bias reported greater interest in interacting with a woman STEM professor at their university (Experiment 3). Our results suggest that interventions teaching women about gender bias in STEM will help women identify with women scientists.

Keywords: intervention, gender gap, sciences

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There is a well-documented underrepresentation of women in science, technology, engineering, and mathematics (STEM; NSF, 2017), which presents a problem for the STEM workforce because these disciplines are losing talented prospective workers (PCAST, 2012). Understanding and addressing the factors undermining women's interest in STEM is thus imperative for those who want to recruit more women into these fields. Both men and women scientists are typically perceived as masculine (e.g., agentic, assertive) and as requiring obtainment of agentic goals (e.g., fame) for success in their fields (Banchefsky, Westfall, Park & Judd, 2016; Carli, Alawa, Lee, Zhao, & Kim, 2016; Diekman, Brown, Johnston, & Clark, 2010; Nosek et al., 2007). These stereotypes can result in bias and unfair treatment against women in STEM, which in turn creates an unwelcoming environment for women in these fields (Cheryan, 2012; Moss-Racusin Dovidio, Brescoll, Graham, & Handelsman, 2012). Researchers have documented favorable treatment toward men over women in STEM both at the student (Milkman, Akinola, & Chugh, 2014; Moss-Racusin et al., 2012; Sheltzer & Smith, 2014) and at the faculty levels (Bilimoria & Liang, 2013; Renzulli, Grant, & Kathuria, 2006; Reuben, Sapienza, & Zingales, 2014; Rosser, 2012; Williams & Ceci, 2015). Of importance, stereotypes that scientists lack femininity also may make it difficult for women to relate to women scientists, which may in turn harm women's interest in STEM (Cheryan, Drury, & Vichayapai, 2012; Diekman Clark, Johnston, Brown, & Steinberg, 2011).

In the current research, we aimed to develop and test a new intervention for encouraging women's identification with women scientists. We explored whether information about the pervasive sexism in STEM disciplines (e.g., Moss-Racusin et al., 2012) would stimulate empathic concern (e.g., sympathy) for women scientists and, in turn, encourage identification with even highly stereotypic “nerdy” or “awkward” women scientists (Cheryan, Plaut, Handron, & Hudson, 2013). We also recognized that presenting gender bias information may threaten women’s anticipated sense of belonging in STEM environments (Murphy & Taylor, 2012). However, we expected that promoting women’s identification with a successful woman scientist would help alleviate the threat participants experience when learning about gender bias (Stout, Dasgupta, Hunsinger, & McManus, 2011). Thus, we had two related aims—a) to explore whether gender bias information increases women’s identification with women scientists, and b) to examine whether this enhanced identification in turn protects women from any harmful effects of gender bias information.

The Importance of Identification with Female Scientists

In her *stereotype inoculation model*, Dasgupta (2011) suggested that identifying with a successful counter-stereotypic exemplar (i.e., a woman scientist), acts as “social vaccine” and helps “inoculate” or protect stigmatized individuals (i.e., women) from internalizing negative group stereotypes. Dasgupta asserted that as long as women feel similar to a successful woman scientist, they will feel inspired to pursue STEM domains (Dasgupta, 2011; see also Lockwood & Kunda, 1997). Research has found that even brief exposure to a woman scientist enhanced women’s interest, perceived fit, and sense of belonging in STEM (Stout et al., 2011).

However, when women cannot identify and relate with a successful woman scientist, the scientist will not function as a positive role model for encouraging women’s interest in STEM fields. For instance, previous work found that when female college students interacted with a woman computer scientist, who fit the computer scientist stereotype (i.e., was masculine and awkward), they failed to identify with the scientist and, as a result, reported lower interest and belonging in computer science (Cheryan et al., 2012; Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). This finding is discouraging because women and men scientists are stereotyped as lacking feminine traits (e.g., warmth) and being socially isolated, and femininity generally is perceived to be incompatible with science (Carli, et al. 2016; Cheryan et al., 2013; Diekman, et al., 2010; Hartman & Hartman, 2008). Banchefsky and colleagues (2016) showed that the more feminine a woman scientist appears, the less likely people are to believe she is a scientist. As a result, women may struggle to identify with women scientists.

Efforts targeted to recruit women into STEM may benefit from presenting recruits with communal and relatable STEM professionals rather than individuals who embody the scientist stereotypes (Cheryan et al., 2013). However, this may not always be possible, and women in college settings, for example, may see or interact with female professors, graduate students, or older college students in the sciences who appear masculine or cold. In addition, women may be unable to escape the “nerdy” or awkward representation of scientists in the media (Cheryan et al., 2013; Weitekamp, 2017). In the current research, we aimed to develop an intervention for women that could encourage identification with all women scientists, regardless of their level of perceived femininity.

Information about Gender Bias in STEM and Identification with Female Scientists

We specifically anticipated that learning about gender bias in STEM would stimulate a series of processes that would influence beliefs about successful women scientists and encourage identification with these scientists. First, when women are made aware of gender bias in STEM, they may use this information to conclude that women scientists have dealt with past adversity and unfair treatment. Individuals often use their own knowledge to infer beliefs about others’ distress or difficulties (Batson, 2009; Singer, Seymour, O'Doherty, Kaube, Dolan, & Frith, 2004). Hence, even in the absence of direct evidence that a successful woman scientist has encountered bias, after learning about gender bias in STEM, participants may assume that a scientist has faced sexism. Women also may believe that they share common experiences with the woman scientist because both they and the scientist may have encountered similar past unfair treatment and sexism. Perceiving that a woman scientist has dealt with similar discrimination may then encourage feelings of empathic concern or other-oriented emotions (e.g., concern, sympathy) while reading about the woman scientist's career (Batson, 1991; Batson, 2009). People tend to feel empathy-related emotions when learning about another person's hardships, particularly when they have encountered similar past difficulties (Batson, 1991; Batson et al., 1996; Cialdini, Brown, Lewis, Luce, & Neuberg, 1997; Hodges, Kiel, Kramer, Veach, & Villanueva, 2010).

Empathic concern may ultimately result in perceived similarity and identification with a woman scientist (Cialdini et al., 1997; Maner, Luce, Neuberg, Cialdini, Brown, & Sagarin, 2002). For instance, across a series of experiments, Cialdini and colleagues found that manipulations that enhanced participants' empathic concern for a person in need (e.g., encouraging participants to take the perspective of the person, or varying the closeness of their relationship with the person) also resulted in a stronger sense of shared identity with the person (Cialdini et al., 1997; Maner et al., 2002). To explain these findings, Cialdini and colleagues argued that people typically experience empathic concern for those with whom they identify and care about. As a result, when people feel empathic concern for a person facing hardship, they conclude they must also have a bond with this person. Based on this research, we expected that when women believe a woman scientist has faced common forms of gender bias, and they would feel empathic concern for the woman scientist, which would facilitate identification with the scientist.

Information about Gender Bias in STEM and Anticipated Belonging in STEM

Although information about gender bias in STEM may beneficially encourage felt similarity with female scientists, we recognize that this information may also stimulate women's concerns about their belonging and trust in STEM environments (Murphy & Taylor, 2012; Schmitt, Branscombe, Kobrynowicz, & Owen 2002). Previous research has found that cues suggesting that women's values did not fit with STEM fields, or that women would be treated unfairly in STEM disciplines, threatened women's sense of belonging in these domains (Cheryan, Plaut, Davies, & Steele, 2009; Diekman et al., 2011; Van Loo & Rydell, 2014). Thus, presenting women with information about gender bias in STEM may cause women to anticipate that they will not belong or feel comfortable in STEM environments.

However, exposure to a relatable and successful female scientist may protect women's sense of belonging against this threatening information (Stout et al., 2011). In particular, two outcomes will most likely arise for a woman who learns about gender bias in STEM. First, she may become more aware of gender bias in STEM, which may then make her question whether she would feel comfortable and have a sense of belonging in a STEM environment. Second, she may identify more strongly with a female scientist, which may enhance feelings that she does belong in a STEM environment. Because these two effects will occur simultaneously, but will go in opposite directions (i.e., one will decrease belonging in STEM while another will increase belonging in STEM), they may ultimately suppress each other or cancel each other out resulting in no effect (see Rucker, Preacher, Tormala, & Petty, 2011). Information about a successful female scientist may alleviate any harmful influence of information about gender bias on women's sense of belonging in the sciences. Following this reasoning, past researchers have assigned adolescent women to attend either a workshop with female scientists discussing their careers or a workshop featuring both successful female scientists and a presentation of gender discrimination in STEM. Presumably because the young women also were learning about successful female scientists, the discussion about discrimination in STEM did not harm their interest in the sciences (Weisgram & Bigler, 2007).

The Current Research

We explored whether information about gender bias in STEM would encourage beliefs that women scientists have encountered gender bias and would foster identification with the women scientists. In Experiment 1a and 1c, we examined whether teaching women about gender bias in STEM promoted their identification with a woman, but not a man, biomedical scientist. In Experiment 1b and 1c, we explored whether learning about gender bias would encourage women to relate with a woman biomedical scientist who was somewhat awkward and lacked femininity (i.e., never wore make-up, had no hobbies). In Experiment 2, we extended these findings to a woman computer scientist and tested potential mechanisms explaining why information about gender bias enhances identification with women scientists. In the final experiment (Experiment 3), we explored whether gender bias information would increase female college students' identification with a female professor in computer science, and would promote interest in taking classes with this professor, having the professor as a mentor, and being a research assistant in the professor's laboratory.

Our first hypothesis (Hypothesis 1) was: learning about gender bias in STEM would stimulate female participants' perceptions that a woman scientist has faced bias and unfair treatment and would increase identification with the woman scientist. A secondary goal of the current research was to ensure that learning about gender bias in STEM did not decrease female participants' anticipated belonging and trust in STEM when participants were also presented with information about a successful woman scientist. Thus, we expected that (Hypothesis 2a): without information about a successful woman scientist, learning about sexism in STEM would increase women's awareness of gender bias in STEM, which would decrease women's anticipated trust and belonging in a STEM environment. In contrast to Hypothesis 2a, we predicted in Hypothesis 2b that: when presented with information about a successful woman scientist, learning about sexism in STEM would increase women's awareness of gender bias in STEM but would not decrease women's anticipated trust and belonging in a STEM environment. Finally, we aimed to test our proposed model for why information about gender bias in STEM stimulates identification with women scientists. In particular, we expected in Hypothesis 3a that: increased perceptions that the woman scientist had faced gender bias would promote beliefs that the scientist had encountered common and similar unfair treatment as participants, which would in turn enhance feelings of empathic concern. And Hypothesis 3b was: feelings of empathic concern would ultimately encourage identification with a female scientist.

Experiment 1a

In the first experiment, we explored whether learning about gender bias in STEM would promote perceptions that a woman scientist (but not a man scientist) had faced bias and is relatable. We also tested whether learning about gender bias in STEM would decrease women's anticipated sense of belonging and trust in a STEM environment, and whether identifying with a female scientist would protect women against the harmful effects of being aware of gender bias in STEM.

As a conservative test of our hypotheses, we examined whether we could encourage women recruited from the general population to identify with female scientists. In particular, discussions within both the academic literature and popular media suggest that the average person tends to distrust science and scientists (Funk & Rainie, 2015; Makri, 2017). Thus, if women from the general population identified with a female scientist, we would provide compelling evidence for our model.

Methods

Participants. We recruited 505 female participants from Amazon's Mechanical Turk (MTurk) website and compensated them $1.00 each for their participation. Throughout the experiment, we employed attention checks to ensure the quality of the data. Five participants (1%) were excluded for not choosing the correct answer on an attention check question (e.g., did not select "Choose this answer" when prompted to "Select the correct answer"). Nine participants were excluded for incorrectly answering at least two of the three easy scientist article attention check questions (1.7%; these questions are described in the Procedure). Three participants (.6%) were excluded for incorrectly answering at least two of the three easy information module attention check questions. These 17 excluded participants did not vary consistently across information condition, χ^2 (1, N = 505) = 0.54, p = .464, or scientist condition, χ^2 (1, N = 505) = 3.07, p = .080. This left a final sample of 488 participants: 410 White (84%); 21 African American (4.3%); 32 Latino (6.6%); 15 Asian (3.1%); 4 American Indian/Alaska Native (.8%); 2 Native Hawaiian or other Pacific Islander (.4%); 4 Other (.8%). Of the participants: 47 currently work in a STEM field (9.6%); 441 Did not currently work in a STEM field (90.4%); 1 had completed less than high school education (.2%); 133 had a high school degree/GED (27.3%); 119 had a 2-year college degree (24.4%); 162 had a 4-year college degree (33.2%); 55

had a master's degree (11.3%); 12 had a doctorate degree (2.5%); 6 had a professional degree (1.2%).

Procedure. The experiment was advertised as exploring how individuals react to and remember informational modules and articles on MTurk. Participants were told they would complete various measures to help the researchers understand their impressions of a module and article. Participants were instructed that the surveys in the experiment would be both directly and indirectly related to the module and article.

Upon beginning the experiment, participants were randomly assigned to view either a gender bias informational module or the control informational module. The gender bias module featured information about gender bias in STEM fields, whereas the control module presented evidence about endangered giant pandas. We initially chose endangered giant pandas as the control subject matter because both gender bias information and endangered animals cover topics participants may find mildly depressing. In addition, we could incorporate scientific facts in both the gender bias module and endangered giant panda informational module; a pilot study revealed that these modules were perceived as equally informative (see Supplemental Materials online at http: for the information presented in the module and a description of the pilot study). These modules presented information in a format similar to a PowerPoint presentation, and participants could control how quickly they proceeded through each slide of the module. Immediately after the modules, participants answered three *module attention check* questions, e.g., "According to the module, in STEM (science technology and engineering) fields, gender bias is:" a) "no longer a problem"; b) "a continuing issue, women are perceived as less competent than men" (correct answer); c) "a continuing issue, men are perceived as less competent than women"; d) "the module did not discuss this topic"; average correct = 98.7%.

Next, participants read an article about a successful scientist who was the head of a research team at a biomedical research institute (the information presented in the article was fictional). Participants were randomly assigned to one of two variations of this article. The article was identical across the two conditions aside from the fact that in the woman scientist condition, the scientist was named Jennifer Evans, whereas in the man scientist condition, the scientist was named John Evans. In addition, the picture of the scientist was either of a White man or a White woman. These two pictures were chosen from a set of 12 pilot tested pictures (6 women scientists and 6 men scientists) by 92 undergraduate participants because the pilot participants rated these pictures as equally attractive, likable, successful, and competent (all *p*s > .226).

The article began by outlining how the scientist became interested in biomedical research. For example, the article stated "Jennifer [John] was a curious child who loved science, animals, and nature." In the article, the scientist also described his or her success and accomplishments in the field (e.g., the scientist said "It has been exciting to have my work published in Nature and Science, and it was also wonderful to receive a million-dollar grant from National Institutes of Health"). Finally, the article briefly described the scientist's research (e.g., "Jennifer is excited to be developing novel biomarkers and therapies for severely debilitating neurodegenerative disease"). Of note, the article did not discuss any of the scientist's hobbies or interests outside of research and science. Immediately after the article, participants completed three article attention check questions, e.g., "The person in the profile was:" a) "a low-level lab tech"; b) An administrator in human resources; c) "A high level administrator assistant"; d) "The head of bio-medical laboratory group" (correct answer)"; average correct = 98.0%. Thus, this experiment had a two (gender bias versus control information condition) by two (woman versus man scientist condition) design.

After the article, participants rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with statements assessing the extent to which they believed the scientist had faced gender bias (e.g., "The person in this article has faced gender bias"; 2 items, $M = 2.85$, $SD = 1.10$, $r = .67$) and their identification with scientist (e.g., "I identify with this person"; 7 items, $M = 3.34$, $SD = 0.71$, $\alpha = .89$). (All the scales created or modified for this research are presented in the Supplemental Materials at http: , and readers are encouraged to contact the first/corresponding author of this paper to receive any materials or data presented in this paper.)

Participants were next presented with a website for a fictional science and technology company and asked to imagine that they worked at this company. The company was called *LabTech*, and had the slogan "Making Innovative Discoveries." The website also featured a picture of a scientist working in a laboratory with a beaker. It was not possible to ascertain from the picture whether the scientist was a man or woman (e.g., the head was not visible in the picture). Thus, there were no inherent cues on the website suggesting women would or would not belong at the company. Participants rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with statements assessing their anticipated belonging and trust at the STEM company (e.g., "I would belong at this company"; 12 items taken from Good, Rattan, & Dweck, 2012; Purdie-Vaughns, Steele, Davies, Diltmann, & Crosby, 2008; Walton & Cohen, 2007; $M = 2.31$, $SD = 0.74$, $\alpha = .93$). In Supplemental Materials online at http: , we present results from a factor analysis on this scale demonstrating that all items loaded onto a single factor.

To ensure that the gender bias information increased participants' knowledge of gender bias, participants also rated their agreement with (1 = *strongly disagree*, 5 = *strongly agree*) with statements from the awareness of gender bias in the sciences scale (e.g., "In my opinion, women in science fields often are not taken as seriously as their male colleagues"; Pietri, et al., 2017; 8 items; $M = 3.77$, $SD = 0.81$, $\alpha = .92$).

At the end of this experiment and all subsequent experiments, participants received a thorough debriefing describing the true purpose of the experiment. In addition, the debriefing emphasized that "it is important to remember that there have been very successful women in the sciences" and briefly provided examples of successful women scientists. Thus, all participants learned about women scientists prior to exiting the experiment, in order alleviate any potentially detrimental effects associated with gender bias in STEM information.

Results

Including demographic variables in the analyses did not meaningfully change our results and, hence, we ran the most parsimonious model without these variables. As anticipated with an MTurk sample, a very small percentage of our sample worked in STEM fields: 9.6% answered "Yes" to the question "Do you currently work in a STEM (science, technology, engineering, and mathematics" field). Thus, there were not enough participants to meaningfully look at interactions between information and scientist condition for participants who were and were not employed in STEM fields. When we excluded these participants it did not meaningfully change the results, and participants currently employed in STEM fields were equally distributed across the module condition and article condition. Given the small number of STEM-affiliated participants and consistent pattern of results, we decided to keep STEM employees in our final sample. Correlations between the demographic variables and our primary outcome measures as well as chi-square analyses demonstrating participants working in STEM were equally distributed across conditions are available in the Supplemental Materials available at http:.

For all the primary outcome variables, we ran between-subjects factorial ANOVAs with information condition and scientist condition as between-subjects predictors (see Table 1 for all the means and standard deviations across conditions and Table 2 for correlations between outcome variables). For awareness of gender bias in science, the only significant effect was the effect of information condition, $F(1,484) = 66.23$, $p < .001$, $\eta_p^2 = 0.120$, $d = .73$. Gender bias information resulted in higher awareness of gender bias in science than the control information (all other *p*s >.269).

For the measures assessing perceptions of the scientists, participants were more likely to believe the scientists had faced gender bias, $F(1,484) = 12.88$, $p < .001$, $\eta_p^2 = 0.026$, $d = .73$, and were more likely to identify with the scientist, $F(1,484) = 5.34$, $p = .021$, $\eta_p^2 = 0.011$, $d = .21$, in the gender bias information condition than in the control information condition. In addition, participants were more likely to believe the woman scientist had faced gender bias than the man scientist, $F(1,484) = 495.62$, $p < .001$, $\eta_p^2 = 0.506$, $d = 1.96$, and were more likely to identify with the woman scientist than the man scientist, $F(1,484) = 8.23$, $p = .001$, $\eta_p^2 = 0.017$, $d = .27$. These main effects were qualified, however, by significant information condition by scientist condition interactions predicting perceptions that the scientist had faced gender bias, $F(1,484) = 24.32$, $p < .001$, $\eta_p^2 = 0.048$, and identification with the scientist, $F(1,484) = 8.58$, $p = .004$, $\eta_p^2 = 0.017$.

Supporting Hypothesis 1, in the female scientist condition, compared to control information condition, gender bias information increased perceptions that the woman scientist had faced gender bias, $F(1,484) = 35.57$, $p < .001$, $\eta_p^2 = 0.068$, $d = 0.83$, and identification with the woman scientist, $F(1,484) = 13.46$, $p < .001$, $\eta_p^2 = 0.027$, $d = 0.48$. In contrast, there was no effect of information condition in the man scientist condition for any of these outcome variables (all *p*s > .337). Thus, compared to the control information group, information about gender bias increased perceptions that a woman scientist (but not a man scientist) had encountered past gender bias, and promoted identification with the woman scientist.

Gender bias in STEM information resulted in significantly less predicted belonging and trust than control information, $F(1,484) = 4.86$, $p = .028$, $\eta_p^2 = .010$, $d = .19$, and the woman scientist condition resulted in significantly higher predicted belonging and trust than the man scientist condition, $F(1,484) = 4.02$, $p = .046$, $\eta_p^2 = .008$, $d = .18$. The predicted interaction between information condition and scientist condition did not reach significance, $F(1,484) = 2.27$, $p = .132$, $\eta_p^2 = .005$, but the pattern of results was in the expected direction (see Table 1). Supporting Hypothesis 2a, in the man scientist condition, gender bias information resulted in significantly less anticipated belonging and trust at the company than the control information, $F(1,484) = 7.03$, $p = .008$, $\eta_p^2 = .014$, $d = .34$. In contrast, in the woman scientist condition, there was no effect of information condition, $F(1,484) = .24$, $p = .626$, $\eta_p^2 = 0.00$, $d = .06$, supporting Hypothesis 2b. Thus, the female scientist protected participants from the perceived threat associated with heightened knowledge about gender bias in STEM.

Moderated mediation analyses. We reasoned there was no effect of information condition in the woman scientist condition because learning about gender bias increased participants' awareness of gender bias in science (which harmed belonging and trust), but also enhanced identification with the scientist (which bolstered belonging and trust; see Table 2). To test this possibility, we ran a moderated parallel mediation analysis using PROCESS Macro (Hayes, 2013) Model 8 and 10,000 bootstrap resamples, with information condition as the independent variable, scientist condition as the moderator, awareness of gender bias in science and identification with the scientist as the mediators, and anticipated belonging and trust at the company as the outcome (see Figure 1a). In the woman scientist condition, there was a significant indirect effect of information condition on belonging via both awareness of gender bias in science, -.18; 95% CI[-.27, -.11], and identification with the scientist, .15; 95% CI[.08, .25], and because these indirect effects were going in opposite directions, they suppressed each other (i.e., resulted in a null effect; see Figure 1b). Put a different way, in the woman scientist condition the total effect (-.05) of information condition on belonging and trust is the combination of the direct effect ($\acute{c}$ = -.02) plus the indirect effect of awareness of gender bias (-.18) and the indirect effect of identification with the scientist (.15). Thus, the indirect effect of identification with the scientist nullified the indirect effect of awareness of gender bias in science attributions in the woman scientist condition, and the total effect of information condition on anticipated belonging and trust at the STEM company was not significant.

In contrast, in the man scientist condition, there was a significant indirect effect of information condition on belonging and trust via awareness of gender bias in science, -.14; 95% CI[-.21, -.08], but no significant indirect effect via identification, -.02; 95% CI[-.10, .06], (see Figure 1c). As a result, in the man scientist condition, there was a significantly negative total effect (the direct effect $\acute{c}$ = -.09 plus the two indirect effects -.14 and -.02, which equals -.25) of information condition on participants' anticipated belonging and trust at a STEM company. Because participants did not identify more strongly with the man scientist after learning about gender bias in STEM, this information harmed their anticipated belonging and trust in a STEM environment.

Discussion

In Experiment 1a, we demonstrated that increased knowledge of gender bias in STEM promoted beliefs that a successful female scientist (but not a male scientist) had faced bias and unfair treatment, and enhanced identification with the female scientist. Although the interaction between information condition and scientist condition predicting belonging and trust failed to reach conventional levels of significance, we found the expected pattern of results. In the man scientist condition, compared to control information, information about gender bias decreased female participants' anticipated belonging and trust at a STEM company. However, identifying with a woman scientist after learning about sexism in STEM, mitigated the harmful effect of gender bias information on predicted belonging and trust.

Experiment 1b

It is possible that the woman scientist from Experiment 1a was perceived as a "mildly stereotypical" scientist because she did not discuss masculine hobbies or tendencies that aligned with the stereotypes about scientists (Carli et al., 2016; Cheryan et al, 2013). Thus, the primary goal of Experiment 1b was to replicate Experiment 1a with a "highly stereotypical" woman scientist, who clearly embodied the masculine scientist stereotype (e.g., lacked warmth; Carli et al., 2016; Cheryan, 2013). We aimed to ensure that information about gender bias could increase identification with all women scientists (even those who never wear make-up, only love research and science fiction). In the current experiment after viewing either the control or gender bias information module, participants read about the "mildly stereotypical" woman scientist from Experiment 1a, or a new "highly stereotypical" woman scientist. We predicted two main effects would emerge in that participants would identify more strongly with the "mildly stereotypical" woman scientist than the "highly stereotypical" woman scientist, and would relate more with both scientists in the gender bias than control information condition.

We also assessed perceptions of the woman scientists' warmth and competence. Because learning about gender bias enhanced the relatability of the woman scientist in Experiment 1a, we anticipated that relative to control information, gender bias information would increase the perceived warmth of the woman scientists. We also wanted to ensure that participants were not perceiving the woman scientists as less competent after learning about gender bias. In previous work, researchers found that individuals who were viewed as high in warmth but low in competence were also pitied and looked down upon (Cuddy, Fiske, & Glick, 2007). Thus, in Experiment 1b, we aimed to rule out the possibility that participants were simply identifying with the woman scientist after learning about gender bias because they felt sorry for her.

Method

We recruited 225 female participants from MTurk in exchange for $1.00 compensation. One participant (.4%) was excluded for not choosing the correct answer on an attention check question (e.g., did not select "Choose this answer"). Five participants missed two or more of the three attention check questions for the scientist article (2.2%) and five participants missed two or more of the three attention check questions for the information module (2.3%). These 11 excluded participants did not vary across information condition, $\chi^2(1, N = 225) = .13$, $p = .723$, or scientist condition, $\chi^2(1, N = 225) = 2.44$, $p = .119$. This left a final sample of 214 female participants whose ages were: $M = 37.8$, $SD = 12.1$, range = 20-78. Participants had the following characteristics: 171 White (79.9%); 12 African American (5.6%); 17 Latino (7.9%); 8 Asian (3.7%); 2 American Indian/Alaska Native (.9%); 0% Native Hawaiian or other Pacific Islander; 4 Other (1.9%); 18 currently work in a STEM field (8.4%); 196 did not currently work in a STEM field (91.5%); 1 had completed less than high school education (.5%); 55 had a high school degree/GED (25.7%); 56 had a 2-year college degree (26.2%); 77 had a 4-year college degree (36.0%); 17 had a master's degree (7.9%); 5 had a doctorate degree (2.3%); 3 had a professional degree (1.4%).

Procedure. Similar to Experiment 1a, Experiment 1b was advertised on MTurk as examining how people react to and remember informational modules and articles. For this experiment and all subsequent experiments, we utilized MTurk worker identification numbers as a method to block any participants who completed previous studies in this research. During the experiment, participants were first randomly assigned to view the same gender bias in STEM or panda control informational modules from Experiment 1a, and completed the same module attention check questions as in Experiment 1a (average correct = 98.3%).

To build upon the pilot study (in Supplemental Materials at http:) and ensure the information in both the gender bias and control modules were well matched, after viewing the module, participants rate their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with the statements: “This module was engaging” (M = 3.77 SD = 1.08); “This module kept my attention” (M = 4.14 SD = .93); and “This module was sad” (M = 3.85 SD = .98).

Next, participants were randomly assigned to view the same “mildly stereotypical” woman scientist article from Experiment 1a or a “highly stereotypical” woman scientist article. The “highly stereotypical” scientist was modeled from previous work by Cheryan and colleagues (2011). In particular, we edited certain parts of “mildly stereotypical” woman scientist’s profile from Experiment 1a to decrease the “highly stereotypical” woman scientist’s relatability and ensure she fit with stereotypes about scientists (Cheryan et al., 2013). For example, this “highly stereotypical” woman scientist stated “I don’t really have hobbies, watch much TV, read for fun, or go on bike rides or walks. Staying active is not important to me. I guess I’m not like most other people in that respect. What I get really excited about is science and research. Though, I do occasionally enjoy binge watching Mystery Science Theater on Netflix.” In addition, the “highly stereotypical” woman scientist was not overly concerned about her appearance and said “I don’t spend much time getting ready in the morning. I don't wear make-up and I normally just throw my hair into a ponytail. My main goal is to get into laboratory and work on research!" After reading the article, participants completed the same article attention check questions as in Experiment 1a (average correct = 98.8%). Thus, in this experiment we used a 2 (gender bias versus control information condition) by 2 ("mildly stereotypical" woman scientist versus "highly stereotypical" woman scientist condition) design.

After viewing the article**,** participants completed the same measures from Experiment 1a assessing perceptions that the scientist has faced gender bias (M = 3.54, SD = .86, r = .39) and identification with the scientist (M = 3.55, SD = .76, α = .91). Participants also rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with three new statements about the scientist, i.e., "The person in this article was warm (competent) (successful)" to examine the extent to which participants believed the scientist was warm (M = 3.86, SD = .81), competent (M = 4.68, SD = .54), and successful (M = 4.72, SD = .48). Participants were also presented with the same fictional STEM company website from Experiment 1a and indicated their predicted belonging and trust at this company (M = 3.27, SD = .74 α = .94). As a manipulation check, participants once again completed a measure assessing their awareness of gender bias in science (M = 3.82, SD = .81, α = .91). Finally, we asked participants to "please briefly describe what you think the purpose of this study was" and provided them with a free response textbox to write their answer.

Results

For all the primary outcome variables, we again ran between-subjects factorial ANOVAs with information condition and scientist condition as between-subjects predictors (see Table 1 for means and standard deviations across conditions, and Table 2 for correlations between outcome variables). As in Experiment 1a, gender bias information resulted in higher awareness of gender bias in science than the control information condition, $F(1,210) = 23.50$, $p < .001$, $\eta_p^2 = .101$, $d = .66$. Although there was no main effect of scientist condition, $F(1,210) = .01$, $p = .929$, $\eta_p^2 = .00$, $d = .05$, there was an unexpected significant interaction between information condition and scientist condition, $F(1,210) = 4.52$, $p = .035$, $\eta_p^2 = .021$. The effect of information condition was marginal in the "highly stereotypical" female scientist condition, $F(1,210) = 3.61$, $p = .059$, $\eta_p^2 = .017$, $d = .41$, and was significant in the "mildly stereotypical" female scientist condition, $F(1, 210) = 24.98$, $p < .001$, $\eta_p^2 = .106$, $d = .90$. Nevertheless, in both conditions gender bias information increased awareness of gender bias in the sciences relative to the control information. Although the modules had different effects on awareness of gender bias, participants perceived these modules as equally engaging, attention grabbing, and sad (all *p*s > .157). Moreover, no participants correctly identified the experiment's hypothesis (i.e., information about gender bias in STEM would increase identification with women scientists), which suggests our results were not due to a demand effect.

In line with Hypothesis 1, for perceptions that the scientist had faced gender bias, there was only a main effect of module condition, $F(1, 210) = 29.22$, $p < .001$, $\eta_p^2 = .122$, $d = .75$ (all others *p*s > .836). Participants believed both scientists had faced more bias in the gender bias information condition than the control information condition. Participants identified more with the "mildly stereotypical" woman scientist than the "highly stereotypical" woman scientist, $F(1, 210) = 8.03$, $p = .005$, $\eta_p^2 = .037$, $d = .37$. However, providing additional support for Hypothesis 1, gender bias information increased identification with both women scientists, $F(1, 210) = 4.84$, $p = .029$, $\eta_p^2 = .023$, $d = .29$, and the interaction between information condition and scientist condition was not significant, $F(1, 210) = .19$, $p = .662$, $\eta_p^2 = .001$. Participants also perceived the "mildly stereotypical" female scientist as warmer than the "highly stereotypical" female scientist, $F(1, 210) = 17.22$, $p < .001$, $\eta_p^2 = .076$, $d = .55$. Thus, our manipulation to create a "highly stereotypical" woman scientist was successful. Nevertheless, gender bias information enhanced the perceived warmth of both woman scientists, $F(1, 210) = 4.55$, $p = .034$, $\eta_p^2 = .021$, $d = .26$, and the interaction between conditions was not significant, $F(1, 210) = .11$, $p = .743$, $\eta_p^2 = .001$.

There were no significant condition effects or interactions predicting competence (all *p*s > .173) or success (all *p*s > .215). In line with stereotypes about scientists (Carli et al., 2016), a paired sample *t*-test revealed that participants perceived both women scientists as being significantly more competent than warm, $t(213) = 12.70$, $p<.001$, $d = 1.10$. Regarding anticipated belonging and trust at the STEM company, the "mildly stereotypical" woman scientist resulted in more belonging and trust than "highly stereotypical" woman scientist, $F(1, 210) = 5.81$, $p = .017$, $\eta_p^2 = .027$, $d = .33$. This finding is consistent with past work, which has found that relatable women scientists resulted in more belonging in STEM fields than "highly stereotypical" (e.g., "socially awkward" and "nerdy") women scientists (Cheryan, et al., 2012). The effect of information condition, $F(1, 210) = .55$, $p = .461$, $\eta_p^2 = .003$, $d = .11$, and the interaction between conditions, $F(1, 210) = .01$, $p = .929$, $\eta_p^2 = .00$, were both non-significant.

Mediation analyses. We also aimed to replicate our mediation analyses from Experiment 1a. In particular, we ran a parallel mediation analysis employing Hayes' (2013) PROCESS Macro Model 4 and 10,000 bootstrap resamples with information condition as the predictor, awareness of gender bias in STEM and identification with the scientist as the mediators, and belonging and trust as the outcome variable. Replicating Experiment 1a, there was a significant indirect effect of information condition on belonging and trust via identification with the scientist, 0.11, 95% CI[0.01, 0.23], and awareness of gender bias in STEM, -0.14, 95% CI[-

0.23,- 0.07]. Of note, we saw a similar pattern of results when we examined each scientist condition separately. Supporting Hypothesis 2b, identifying with the woman scientist protected participants from the detrimental influence of awareness of gender bias in science on anticipated belonging and trust in a STEM environment.

Discussion

In Experiment 1b, we found that participants identified more with the “mildly stereotypical” woman scientist than “highly stereotypical” woman scientist, and viewed “mildly stereotypical” scientist as warmer (a feminine trait) than the “highly stereotypical” scientist. However, compared to the control information condition, learning about gender bias in STEM enhanced identification with and the perceived warmth of, both women scientists. Of note, information about gender bias did not influence beliefs about the women scientists’ success or competence, which suggests that increased knowledge of gender bias did not evoke feelings of pity toward the scientists.

Experiment 1c

In Experiment 1c, we aimed to replicate Experiment 1a, with two modifications. First, the woman scientist condition featured the “highly stereotypical” scientist to further demonstrate that gender bias information enhances identification with a woman scientist who is initially perceived as lacking warmth. Second, we slightly modified the man scientist article to enhance his relatability. Although in Experiment 1a, the scientists were only “mildly stereotypical” and did not strongly conform to scientists’ stereotypes, they also were not overly relatable (i.e., did not discuss hobbies or a life outside of research). In Experiment 1a, we found that information about gender bias did not encourage identification with a man scientist and the man scientist in comparison to the woman scientist did not alleviate the negative consequences of gender bias information (i.e., decreased belonging and trust). However, researchers have found that when men scientists were relatable, they could enhance women's sense of belonging in STEM (Cheryan et al., 2012). In the first two experiments, we found that the woman scientist protected women from the harmful effects associated with gender bias information because this information simultaneously encouraged identification with the woman scientist. We did not anticipate that gender bias information would promote identification with any man scientist, and hence, we predicted that a man scientist, regardless of his relatability, could not mitigate the threat associated with awareness of gender bias. Nevertheless, we tested this possibility in the current experiment.

Methods

Participants. We recruited 537 female participants from MTurk website with $1.00 compensation per person. Three participants (.6%) were excluded for not choosing the correct answer on an attention check question (e.g., did not select "Choose this answer"). Twelve participants missed two or more of the three attention check questions for the scientist article (2.2%) and seven participants missed two or more of the three attention check questions for the information module (1.3%). These 22 excluded participants did not vary across information condition, $\chi^2(1, N = 537) = .87$, $p = .351$, or scientist gender condition, $\chi^2(1, N = 537) = .81$, $p = .369$. This left a final sample of 515 female participants with the following characteristics: 416 White (80.0%); 21 African American (4.1%); 23 Latino (4.5%); 30 Asian (7%); 2 American Indian/Alaska Native (.2%); 0% Native Hawaiian or other Pacific Islander; 14 Other (2.7%); 46 currently work in a STEM field (8.9%); 469 did not currently work in a STEM field (91.1%); 4 had completed less than high school education (.8%); 126 had a high school degree/GED (24.5%); 99 had a 2-year college degree (19.2%); 200 had a 4-year college degree (38.8%); 72

had a master's degree (14.0%); 6 had a doctorate degree (1.2%); 8 had a professional degree (1.6%).

Procedure. As with the past two experiments, Experiment 1c was advertised on MTurk as a scientific study that looked at how people reacted to and remembered informational modules and articles. Participants were first randomly assigned to view the gender bias in STEM or panda control information modules from the previous experiments, and completed the module attention check questions (average correct = 98.5%). Next, participants were randomly assigned to view the "relatable" man or "highly stereotypical" woman scientist article. The "highly stereotypical" woman scientist was depicted in the same article employed in Experiment 1b. We modified the information about the man scientist from Experiment 1a to enhance his relatability. For instance, the man scientist said "I have hobbies, love spending time with my friends and family, watching TV, reading for fun, going on bike rides or walks. I like to stay active. But I also get really excited about science and research." After reading the article, participants completed the same article attention check questions as in Experiment 1a (average correct = 98.1%). Thus, this experiment had a 2 (gender bias versus control information condition) by 2 ("relatable" man scientist versus "highly stereotypical" woman scientist condition) design.

After reading the article, participants completed the all same measures from Experiment 1a assessing perceptions that the scientist has faced gender bias ($M = 2.88$, $SD = 1.01$, $r = .63$) and identification with the scientist ($M = 3.30$, $SD = .77$, $\alpha = .90$). Participants were also shown the STEM company website and indicated their predicted belonging and trust at this company ($M = 3.35$, $SD = .72$, $\alpha = .93$). Finally, participants completed a measure indexing their awareness of gender bias in science ($M = 3.74$, $SD = .83$, $\alpha = .91$).

Results

For all the primary outcome variables, we again conducted between-subjects factorial ANOVAs with information condition and scientist condition as between-subjects predictors (see Table 1 for means and standard deviations across conditions and Table 2 for correlations between outcome variables). As in Experiment 1a, gender bias information resulted in higher awareness of gender bias in science than the control information, $F(1,511) = 71.41$, $p <.001$, $\eta_p^2 = .123$, $d = .73$ (all other *p*s > .480). Also replicating Experiment 1a, participants were more likely to believe the scientist had faced gender bias in the gender bias in STEM information condition than in the control information condition, $F(1,511) = 8.14$, $p < .001$, $\eta_p^2 = .024$, $d = .26$, and in the woman scientist than in the man scientist condition, $F(1,511) = 413.43$, $p <.001$, $\eta_p^2 = 0.445$, $d = 1.75$. However, these main effects were again qualified by a significant information condition by scientist condition interaction, $F(1,511) = 16.73$, $p < .001$, $\eta_p^2 = .032$. Supporting Hypothesis 1, in the woman scientist condition, compared to control information condition, gender bias information increased perceptions that the woman scientist had faced gender bias, $F(1,511) = 28.65$, $p < .001$, $\eta_p^2 = 0.053$, $d = .70$. In contrast, there were no effects of information condition in the man scientist condition ($p > .687$).

For identification with the scientist, gender bias information resulted in marginally higher identification with the scientist than control information, $F(1,511) = 3.16$, $p = .076$, $\eta_p^2 = .006$, $d = .15$, and there was no main effect of scientist condition ($p > .595$). There was, however, the predicted information condition by scientist condition interaction, $F(1,511) = 4.48$, $p = .035$, $\eta_p^2 = .009$. Replicating Experiment 1b, compared to control information, gender bias information increased identification with the “highly stereotypical” woman scientist, $F(1,511) = 7.48$, $p = .006$, $\eta_p^2 = 0.014$, $d = 0.34$. In contrast, the control information and gender bias information means did not differ in the man scientist condition ($p >.808$). In the control information condition, participants tended to identify more with the “relatable” man scientist than the “highly stereotypical” woman scientist, $F(1,511) = 3.58$, $p = .059$, $\eta_p^2 = 0.007$, $d = 0.23$. Gender bias information increased the relatability of the “highly stereotypical” woman scientist, and the effect of scientist condition was in the opposite direction and non-significant in the gender bias information condition ($p > .267$; see Table 1).

Gender bias in STEM information resulted in significantly less predicted anticipated belonging and trust in the STEM company than control information, $F(1,511) = 13.86$, $p < .001$, $\eta_p^2 = .026$, $d = .32$, and the woman scientist condition resulted in marginally higher predicted belonging and trust than the male scientist condition, $F(1,511) = 3.13$, $p = .077$, $\eta_p^2 = .006$, $d = .14$. These main effects were qualified by a significant interaction between information condition and scientist condition, $F(1,511) = 4.04$, $p = .045$, $\eta_p^2 = .008$. In line with Hypothesis 2a, in the man scientist condition, gender bias information resulted in significantly less anticipated belonging and trust at the company than the control information, $F(1,511) = 16.64$, $p < .001$, $\eta_p^2 = .032$, $d = .55$. Although the man scientist was relatable, he did not protect participants’ sense of belonging and trust at the STEM company. In contrast, in the woman scientist condition, there was no effect of information condition ($p > .228$) on belonging and trust, providing support for Hypothesis 2b.

Mediation analysis. Finally, we ran the same parallel moderated mediation analysis as in Experiment 1a and found very similar results (see Figure 2a). In the woman scientist condition, there was a significant indirect effect of information condition on belonging and trust via identification, .07, 95% CI[.02, .14], and awareness of gender bias, -.12, 95% CI[-.20, -.07], (see Figure 2b). In contrast, in the man scientist condition, there was a significant indirect effect of information condition on belonging and trust through awareness of bias, -.14, 95% CI[-.21, -.08], but the indirect effect of identification was not significant, -.01, 95% CI[-.06, .04], (see Figure 2c). Thus, identifying with the woman scientist (even though she was "highly stereotypical" and lacking in warmth), once again protected participants from the harmful effects of awareness of gender bias in STEM on anticipated belonging and trust in a STEM environment.

Discussion

Replicating Experiment 1b, we found that gender bias information encouraged identification with a highly stereotypically female scientist who lacked warmth. Moreover, in the "relatable" man scientist condition, relative to control information, information about gender bias decreased female participants' anticipated belonging and trust at a STEM company. Thus, although the man scientist was relatable, he did not protect female participants from the harmful effects associated with gender bias information. In contrast, identifying with the "highly stereotypical" woman scientist after learning about sexism in STEM mitigated the harmful effect of gender bias information on anticipated belonging and trust.

Experiment 2

In Experiment 2, our goal was to explore why gender bias information in STEM promoted identification with women scientists. We anticipated that learning about gender bias would enhance perceptions that the woman scientist had faced gender bias (replicating the previous experiments), which would in turn increase beliefs that the scientist had encountered common and similar forms of discrimination as participants, leading to increased feelings of empathic concern (Hypothesis 3a). Moreover, we expected that feeling empathic concern for the woman scientist would encourage identification with the woman scientist (Hypothesis 3b).

Although we expected empathy would function as a significant mediator, we also recognized that other mechanisms may underlie this effect. In particular, believing that a woman scientist has encountered common bias and unfair treatment may also increase perceptions that the woman scientist has faced situations generally similar to those participants had faced, and the belief that she can easily take the perspective of participants. Both of these modified beliefs may then promote identification with the scientist. Previous research has found that thinking another person could take one's perspective or had encountered similar past experiences enhanced felt similarity with that individual (Goldstein, Vezich, & Shapiro, 2014; Walton, Cohen, Cwir, & Spencer, 2011). Thus, as an exploratory analysis (i.e., not directly predicted in our hypotheses), we examined whether beliefs that the female scientist had the ability to take participants' perspective and had faced similar past situations acted as significant mediators for increased identification.

It is important to note that these additional potential mechanisms underscoring identification still would be a consequence of perceptions that the female scientist has encountered bias. In contrast, a completely alternative viewpoint to our proposed model may suggest that learning about gender bias in STEM would increase the salience of female participants' gender identity, which in turn would stimulate identification with a woman scientist. Researchers have found that when women make attributions to sexism or perceive that their gender is devalued they report higher identification and satisfaction with their gender group (Leach, Rodriquez Mosquera, Vliek, & Hirt, 2010; Schmitt et al., 2002). However, we did not predict that information about gender bias in STEM would necessarily promote increased gender identification because participants were learning about bias in a very specific domain (STEM disciplines) and were not receiving information about women's general devaluation in society.

Nevertheless, to address this alternative gender identity salience explanation in Experiment 2, we added measures of gender identification and included a new control information condition that discussed the benefits of group identification and the specific advantages for women when they feel a connection and bond with other women. Similar to the gender bias module, our new gender identity control module described topics related to women and gender identity. If gender bias information increased identification with a woman scientist, because it made women's gender identity salient, then we would expect to see no difference between the gender bias and the gender identity informational modules on encouraging identification with female scientists.

We also predicted that increased identification with the woman scientist would shield participants' anticipated belonging and trust at a STEM company from the harmful effects associated with awareness of gender bias in STEM. However, it is also possible that reading about a successful female scientist after learning about gender bias may demonstrate that women can be successful despite facing gender bias, which may also protect women's belonging and trust. We explored this possibility in Experiment 2.

Finally, we wanted to ensure that our results were not unique to biomedical scientists and would generalize to scientists in other fields. This was particularly important because women are starting to achieve parity in the biological sciences, but still are highly underrepresented in other STEM fields such as computer science (NSF, 2017). Thus, instead of presenting participants with Dr. Jennifer Evans, the biomedical scientist, in the following experiments, participants learned about Dr. Jane Evans, the successful computer scientist.

Methods

Participants. We recruited 323 female participants from MTurk for $1.00 compensation. Two participants (.6%) were excluded for not choosing the correct answer on an attention check question (e.g., did not select "Choose this answer" when prompted to "Select the correct answer”). Two participants were excluded for incorrectly answering the easy scientist article attention check question (.6%). Finally, seven participants (2.8%) were excluded for incorrectly answering at least two of the three easy information module attention check questions. These 11 excluded participants did not vary consistently across information condition, $\chi^2(1, N = 323) = .24$, $p = .889$. This left a final sample of 312 female participants with the following characteristics: 259 White (83.0%); 29 African American (9.3%); 10 Latina (3.2%); 9 Asian (2.9%); 0% American Indian/Alaska Native; 1 Native Hawaiian or other Pacific Islander (0.3%); 4 Other (1.3%); 33 currently work in a STEM field (10.6%); 279 did not currently work in a STEM field (89.4%); 0% had completed less than high school education; 87 had a high school degree/GED (27.9%); 69 had a 2-year college degree (22.1%); 110 had a 4-year college degree (35.3%); 34 had a master’s degree (10.9%); 4 had a doctorate degree (1.3%); 8 had a professional degree (2.6%).

Procedure. Similar to the previous two experiments, Experiment 2 was advertised as exploring how individuals reacted to and remembered informational modules and articles on MTurk. Participants were first randomly assigned to view either the gender bias in STEM informational module, the panda control informational module, or a new gender identity control informational module. Because identification with groups in general (Hogg, Sherman, Dierselhuis, Maitner, & Moffitt, 2007), and women’s identification with their gender group specifically (Schmitt et al., 2002), has been found to predict psychological well-being, we developed a new module that discussed the psychological benefits of group identification. This module used “women as a case study” for why group identity is valuable and presented studies demonstrating the advantages of gender identification as well as the positive experiences of women who had joined women affinity groups. This control module discussed issues related to gender identity, but had no mention of gender bias in STEM.

As another modification to the current experiment, rather than allowing participants to control how quickly they proceeded through the module, we created a video that slowly presented the information featured in the module (i.e., during the video, we displayed each sentence in the module for 3 to 5 seconds before proceeding to the next sentence). Immediately after the modules, participants completed three module attention check memory questions (e.g., for the gender identity module a question was: “This module was about:” a) “The benefits of watching less TV”; b) “The benefits of identifying with groups” (correct answer); c) “The benefits of a good night’s sleep”; d) “The benefits of having children later in life”; average correct = 93.2%. (The module attention check questions for the new gender identity control module and the information presented in new module are available in Supplemental Materials online at http: .)

All participants were then presented with an article about a woman computer scientist. This article was similar to the article in Experiment 1a. However, rather than featuring a biomedical scientist, this article described a successful computer scientist (Dr. Jane Evans), whose research focused on creating new programs for artificial intelligence (e.g., the article stated “Jane is excited to be developing a new coding language for Artificial Intelligence (AI) with her colleagues”). The article also featured a picture of a White woman’s hands typing on a computer keyboard. After reading the article, participants answered one article attention check question, which could easily be answered if participants read the article, e.g., “The article talked about:” a) “Jane, who works with small children”; b) “Jane, who is a successful computer scientist” (correct answer); c) “Bill, who is the CEO at a large tech company”; d) “Maintaining a healthy lifestyle with a busy work schedule." Thus, Experiment 2 had a three conditions (gender bias versus gender identity control versus panda control information). Immediately after reading the article, participants first indicated the extent to which they felt empathic concern "while reading the article and thinking about Jane." In particular, participants rated how much they felt (1 = *not at all*, 7 = *extremely*) each of five other-oriented empathic emotions (sympathetic, warm, compassionate, tender, moved; Batson, 1991; $M = 4.24$, $SD = 1.36$, $\alpha = .89$).

We made slight modifications to improve the measure of perceptions that the scientist has faced bias, and we expanded the measure from 2 to 4 items (e.g., "Most likely, Jane has encountered discrimination"; $M = 3.95$, $SD = 1.43$, $\alpha = .94$). Participants rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with items from an additional new measure that assessed the extent to which participants felt Jane had faced similar bias and unfair treatment as the participants ("To what extent do you think you and Jane have faced similar unfair treatment in the past?"; 4 items, $M = 3.95$, $SD = 1.43$, $\alpha = .96$).

Participants also indicated their identification with the scientist using the same measure from the previous experiments ($M = 3.51$, $SD = .71$, $\alpha = .91$). To further examine how easily participants could relate to the female scientist, participants also completed the self-other overlap scale (Goldstein et al., 2014). This assessment consists of eight items indexing the extent to which (1 = *not at all*, 7 = *very much*) participants felt similar to the female scientist (e.g., "To what extent do you feel you are similar to Jane?"). The 9^{th} item featured seven Venn diagrams with differing degrees of overlap. Participants indicated which Venn diagram best represented their relationship with Jane (1 = *two non-overlapping circles,* 7 = *two nearly completely overlapping circles*; $M = 3.56$, $SD = 1.43$, $\alpha = .96$).

Participants also rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with statements from two new measures indexing the extent to which they believed the scientist could take their perspective (e.g., "To what extent do you think Jane could easily take your perspective?" Goldstein et al., 2014; 3 items, $M = 4.67$, $SD = 1.17$, $\alpha = .75$), and had experienced similar past situations as the participants ("To what extent do you think you and Jane have had similar experiences?"; 2 items, $M = 3.77$, $SD = 1.41$, $r = .84$). Moreover, participants indicated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with items from an index assessing beliefs that *the scientist was an example that women can be successful despite gender bias* (e.g., "Jane is an example that women can be successful in STEM despite encountering discrimination"; 4 items, $M = 4.28$, $SD = .74$, $\alpha = .96$).

Similar to Experiments 1a, 1b, and 1c, after completing measures assessing perceptions of the scientist, participants viewed a fictional STEM company website, and rated their level of belonging and trust at the company using the same items from the previous experiments ($M = 3.09$, $SD = .71$, $\alpha = .92$). Participants also completed the same awareness of gender bias in science index from the first two experiments ($M = 3.77$, $SD = .74$, $\alpha = .88$).

Finally, participants rated their agreement (1 = *strongly disagree*, 5 = *strongly agree*) with statements from Leach et al.'s (2008) multi-component identification scale, which is a nuanced measure of gender identification. Leach and colleagues created the multi-component identification scale to capture different aspects of individuals' identification with their in-group, including the centrality of in-group to their identity (e.g., "Being a woman is an important part of my identity"; 3 items, $M = 3.95$, $SD = .82$, $\alpha = .80$), the solidarity with the in-group (e.g., "I feel solidarity with women"; 3 items, $M = 3.94$, $SD = .87$, $\alpha = .91$), the satisfaction with the in-group (e.g., "I think that women have a lot to be proud of"; 4 items, $M = 4.19$, $SD =.67$, $\alpha = .86$) and finally, the level of self-stereotyping or feeling like a typical member of the in-group (e.g., "I am similar to the average woman"; 2 items, $M = 3.79$, $SD = .93$, $r = .83$).

Results

We anticipated that participants would report altered perceptions (e.g., increased identification) of the woman scientist in the gender bias in STEM information condition compared to our two control information conditions (i.e., the panda information condition and the gender identity information condition). Likewise, we did not expect the two control information conditions to differ significantly from each other. To evaluate this possibility, we conducted one-way ANOVAs and ran focused orthogonal contrasts to compare the gender bias in STEM information condition to both control information conditions (2 -1 -1), as well as the gender identity information condition to the panda information condition (0 +1 -1). The means and standard deviations across condition are presented in Table 3, and correlations between outcome variables are presented in Table 4.

First, we found that the gender bias information resulted in significantly higher awareness of gender bias in the sciences than the control information modules, $t(309) = 5.33$, $p < .001$, $d = .61$, and that the two control modules did not differ significantly from each other ($p > .809$). Providing additional support for Hypothesis 1, relative to participants in both control information conditions, participants in the gender bias information condition reported more empathic concern while reading about the scientist, $t(309) = 4.03$, $p < .001$, $d = .46$; higher perceptions that the scientist has faced bias, $t(309) = 3.84$, $p < .001$, $d = .44$; marginally higher perceptions that the woman scientist has faced similar unfair treatment as participants, $t(309) = 1.73$, $p = .084$, $d = .20$; increased identification with the scientist, $t(309) = 2.87$, $p = .004$, $d = .33$; and greater self-other overlap with the scientist, $t(309) = 3.26$, $p = .001$, $d = 0.37$. The two control conditions did not differ on empathic concern, perceptions the scientist has faced bias and similar unfair treatment, identification, or self-other overlap with scientist (all *p*s > .244).

Compared to participants in the control information conditions, participants in the gender bias information condition also reported higher perceptions that the scientist could take their perspective, $t(309) = 2.37$, $p = .018$, $d = .27$; and that the scientist had experienced similar past situations, $t(309) = 2.49$, $p = .013$, $d = .28$. The two control conditions did not differ in beliefs that the scientist has experienced similar past situations (*p*s > .529). However, unexpectedly, participants in the gender identity control information condition reported higher perceptions that the scientist could take their perspective than participants in the panda control information condition $t(309) = 2.13$, $p = .034$, $d = 0.24$.

Participants were also more likely to believe that the scientist was an example that women can be successful in STEM, despite facing bias, in the gender bias in STEM information condition than in the two control information conditions, $t(309) = 2.87$, $p < .001$, $d = .29$, and the two control information conditions did not differ from each other ($p > .933$) on beliefs that women can be successful in STEM, despite facing bias. However, perceptions that the scientist was an example that women can be successful in STEM, despite facing gender bias, did not correlate with belonging and trust, $r(310) = -.04$, $p = .515$. Thus, although in the gender bias information condition participants believed Dr. Jane Evans was an example of women overcoming gender bias, these beliefs did not relate to feeling a sense of belonging in STEM environments.

Unexpectedly, we found a marginal tendency for the gender bias in STEM information module to result in less anticipated belonging and less trust at the STEM company than the control information modules, $t(309) = 1.76$, $p = .079$, $d = .20$. However, this difference appears to be driven primarily by the gender identity informational module (see Table 3). It is possible that because the gender identity module discussed the encouraging experiences women had in their women affinity working groups, it promoted positive expectations about working in companies. Finally, we found no significant effects (for any of the contrasts) on the subscales of the gender identification measure (all *p*s > .392).

Mediation analyses. Because identification and self-other overlap with the scientist measures were highly correlated (see Table 4), we calculated the z-scores for each scale and took the average of the z-scores to create a composite shared identity with the scientist measure. We used this combined measure in the subsequent analyses. We first ran a parallel mediation analysis employing PROCESS Macro Model 4, and 10,000 bootstrap resamples including information condition as the predictor (gender bias in STEM module = 1, control modules = 0), awareness of gender bias in science and shared identity with the scientist as the mediators, and belonging and trust as the outcome variable. Replicating the first three experiments, there was a significant indirect effect of information condition on belonging and trust via shared identity with the scientist, .11, 95% CI[.05, .19], and awareness of gender bias in STEM, -.11, 95% CI[-.19, - .06]. Supporting Hypothesis 2b, identifying with the female scientist protected participants from the detrimental influence of awareness of gender bias in STEM on anticipated belonging and trust in a STEM environment.

We next examined the mechanisms underlying enhanced empathy. In particular, to test Hypothesis 3a, we explored whether, compared to control information, information about gender bias would enhance perceptions that Jane had faced bias, which would in turn would encourage beliefs that Jane had encountered common and similar bias to that of participants, and ultimately would increase feelings of empathic concern. We employed a serial mediation model to test our entire hypothesized model (i.e., gender bias information-> Jane faced gender bias-> Jane encountered similar bias->empathy). We ran this model with Hayes' (2013) PROCESS Macro Model 6 and 10,000 bootstrap resamples and found a significant indirect effect, .08, 95% CI[.04, .15] of gender bias information versus control information on empathy via the serial mediation pathway (gender bias information-> Jane faced gender bias-> Jane encountered similar bias->empathy; see Figure 3a).

As exploratory analyses, we tested this same serial mediation model, replacing empathy as the outcome variable with perceptions that the scientist could take participants' perspective and that the scientist had faced similar situations. Both of these models yielded significant indirect effects via the serial pathway, take perspective: .14, 95% CI[.07, .22]; faced similar situations: 0.27, 95% CI[.14, .43].

Finally, we tested the potential mediators for increased identification. We ran a parallel mediation analysis using Hayes' (2013) PROCESS Macro Model 4 with 10,000 bootstrap resamples; information condition as the predictor; empathic concern, perceptions the scientist had the ability to take participants' perspective, and beliefs the scientist had experienced similar situations as the three mediators; and shared identity with the scientist as the outcome. Supporting Hypothesis 3b, there was a significant indirect effect (i.e., the confidence interval did not cross 0) of information condition on shared identity with the scientist via empathic concern, .16; 95% CI[.08, .25], perceptions the scientist could take participants' perspective, .09; 95% CI[.02, .17], and beliefs the scientist had experienced similar situations, .09; 95% CI[.02, .17]. Participants felt more empathic concern while reading about the woman scientist, perceived the scientist as being able to take their perspective, and believed they had experienced similar situations as the scientist in the gender bias information condition, relative to control information which all, in turn, predicted feeling a sense of shared identity with the woman scientist (see Figure 3a).

Discussion

As anticipated, we found that participants felt more empathic concern while reading about the woman computer scientist in the gender bias information condition, compared to the control information condition, and this enhanced empathy resulted from perceptions that the woman scientist had faced bias and dealt with similar adversity as participants. Our exploratory analyses also revealed that, compared to those in the control information condition, participants in the gender bias information condition were more likely to believe the scientist could take their perspective and had experienced similar situations. Moreover, increased empathy and beliefs that the scientist could take participants' perspective and had experienced similar situations correlated with increased identification with the woman computer scientist, and acted as significant mediators. These findings suggest that there are multiple potential pathways that lead to identification with a woman scientist after learning about gender bias. Nevertheless, supporting our proposed model, empathy emerged as a significant mediator above and beyond the effects of the other two mediators. (We replicated these results with the gender bias and panda informational control modules in an additional experiment, which is available in Supplemental Materials online at http.) Of note, we also provided evidence that our results were not simply due to gender bias information increasing the salience of participants' gender identity. Relative to control information, gender bias in STEM information did not increase participants' identification with their gender. Moreover, the gender identity control module did not increase identification with the woman scientist, relative to the panda control module.

Finally, we found that the gender bias in STEM information encouraged participants to believe that the woman scientist was an example that women could be successful, despite facing gender bias, but these beliefs did not correlate to feeling a sense of belonging in a STEM environment. Rather, in line with the previous experiments, participants did not report decreased belonging and trust in STEM after learning about gender bias because they identified more strongly with the woman scientist.

Experiment 3

All previous experiments relied on participants recruited via MTurk. From a practical standpoint, encouraging women from the general population with potentially established careers to identify with women scientists may not help the lack of gender parity in STEM. To address this practical shortcoming, in the final experiment, we explored whether information about gender bias in STEM would increase female college students' identification with a woman researcher and professor in computer science, who ostensibly works at their university. We explored whether gender bias in STEM information helped participants identify with a woman computer science professor. And we tested whether this information would also enhance participants' interest in taking classes with the professor and getting involved in the professor's research. In Experiment 2, the gender identity control module did not enhance identification with the female scientist, relative to the panda control module. Therefore, we only employed the panda control information in the current experiment.

Method

Participants. We recruited 103 female participants from a large Midwestern university in exchange for one credit for their introduction to psychology class. All participants were able to correctly answer the easy article attention check question, and two participants (1.9%) were excluded for failing to answer at least two of the easy module memory attention check questions. This left a final sample of 101 female participants with the following ages: $M = 21.8$, $SD = 7.5$, range = 18-62. Participants had the following characteristics: 54 were in their first year at the university (53.5%); 22 were in their second year (21.8%); 13 were in their third year (12.9%); 7 were in their fourth year (6.9%); and 5 were in their fifth year or above (6.9%); 74 White (73.3%), 5 African American (5%); 12 Latina (11.9%); 4 Asian (4%); 6 Other (5.9%). Ninety-eight percent (99) of the participants reported having a major, but none of our participants were computer science majors. However, 12.9% (13) were STEM majors (based on NSF [2017] classifications such as biology, mathematics, neuroscience).

Procedure. As in the previous experiments, we advertised Experiment 3 as an online study in which the researchers were interested in how students react to informational modules and articles. Participants were randomly assigned to view the gender bias in STEM module or panda control module. Participants then completed three module attention check questions (average correct = 96%). Participants next read an article about a woman computer scientist. This article was identical to the one used in Experiment 2. However, the computer scientist was described as being a professor at the same university as participants, and conducting her research at this university (in reality this information was all fictional). Moreover, instead of referring to the scientist as “Jane,” the scientist was described as “Dr. Evans” throughout the article. Following the article, participants completed the article attention check question. Thus, we used a 2 condition (gender bias versus control information) design.

Immediately after reading the article, participants completed a measure assessing their interest in interacting with the scientist. Participants indicated their level of agreement (1 = *strongly disagree*, 5 = *strongly agree*) with 7 statements assessing their desire to take classes with the professor (e.g., "I would be excited to take a class with Jane."); their perceptions of having Jane as a mentor (e.g., "I would enjoy having Jane as my mentor or advisor"); and their interest in getting involved in Jane's research (e.g., "I would be excited to work as a research assistant in Jane's lab"; $M = 3.75$, $SD = .58$, $\alpha=.84$). Although we referred the scientist as Dr. Evans throughout the article, we referred to the scientist as "Jane" in our questions about interacting with the professor, which was an oversight. These questions referred to Jane's research, laboratory, and classes and, hence, we believe that it was still evident that Jane was a professor.

As in Experiment 2, participants completed measures assessing empathic concern ($M = 3.70$, $SD = 1.52$, $\alpha = .92$), perceptions the scientist had faced bias ($M = 3.77$, $SD = .69$, $\alpha = .90$) and had encountered similar bias and unfair treatment ($M = 3.61$, $SD = 1.38$, $\alpha = .93$), identification with the scientist ($M = 3.27$, $SD = .53$, $\alpha=.81$), and self-other overlap with the scientist ($M = 2.69$, $SD = 1.36$, $\alpha = .96$). Participants also completed the same indices from Experiments 2, examining the extent to which they believed the scientist could take their perspective ($M = 4.53$, $SD = 1.02$, $\alpha = .63$), and had faced similar situations ($M = 3.46$, $SD = 1.34$, $r = .80$). In addition, participants completed the measure assessing their beliefs that the scientist was an example that women can be successful despite gender bias ($M = 4.23$, $SD = .65$, $\alpha = .94$), and their awareness of gender bias in science ($M = 3.50$, $SD = .64$, $\alpha = .84$).

In contrast to the previous experiments, we did not present participants with a fictional company. Rather, participants indicated their level of belonging and trust in computer science. We specifically instructed participants to answer the questions based on how they feel when working in computer science (e.g., in a computer science class, working on a computer science research project; $M = 2.61$, $SD = 0.68$, $\alpha = .90$). Although participants were not computer science majors, the majority of students at the university participants attended were required to take an introductory computer science course for their major.

Results

For all the analyses, we ran between-groups independent-samples *t*-tests. The means and standard deviations across conditions are available in Table 3 and the correlations between outcome variables are presented in Table 4. We found that, as expected, gender bias information resulted in significantly higher awareness of gender bias in science than control information, $t(99) = 2.63$, $p = .010$, $d = .53$. Demonstrating the practical benefits of gender bias information, relative to the control information, participants in the gender bias information condition expressed greater interest in interacting with the woman computer science professor (e.g., taking a class with the scientist, getting involved in the scientists' research), $t(99) = 2.51$, $p = .014$, $d = .51$. Of note, interest in working with the scientist significantly correlated with identification with the scientist (see Table 4). Relative to participants in the control information condition, participants in the gender bias information condition reported more empathic concern while reading about the scientist, $t(99) = 2.16$, $p = .033$, $d = .43$; higher perceptions that the scientist has faced bias, $t(99) = 4.16$, $p<.001$, $d = .84$ and had encountered similar bias and unfair treatment, $t(99) = 2.59$, $p = .011$, $d = .52$; marginally stronger identification with the scientist, $t(99) = 1.87$, $p = .064$, $d = .38$; and more self-other overlap with the scientist, $t(99) = 2.21$, $p = .028$, $d = .44$. In addition, compared to participants in the control information condition, participants in the gender bias information condition reported higher perceptions that the scientist could take their perspective, $t(99) = 2.61$, $p = .011$, $d = .53$; and that the scientist has experienced similar past situations, $t(99) = 1.98$, $p = .050$, $d = .40$. Participants were also more likely to believe that the scientist was an example that women could be successful in STEM, despite facing gender bias, $t(99) = 3.13$, $p<.001$, $d = .63$, in the gender bias information condition than in the control information condition. However, replicating Experiment 2, believing that the scientist was an example that women could be successful in STEM, despite facing gender bias, had no relation with belonging and trust, $r(310) = -.15$, $p = .132$. Finally, there was no effect of information condition on belonging and trust in computer science, $t(99) = 1.03$, $p = .304$, $d = 0.21$.

Mediation analyses. Similar to Experiment 2, the identification and self-other overlap with the scientist were strongly correlated (see Table 4) and, as a result, we created the composite shared identity with the scientist measure for the subsequent mediational analyses. We first ran a parallel mediation analysis employing PROCESS Macro Model 4 and 10,000 bootstrap resamples including information condition as the predictor (gender bias in STEM information = 1, control information = 0), awareness of gender bias in science and shared identity with the scientist as the mediators, and belonging and trust as the outcome variable. There was a significant indirect effect (i.e., the confidence interval did not cross 0) of information condition on belonging and trust via shared identity with the scientist, .07, 95% CI[.01, .18]) and awareness of gender bias in science, -.15, 95% CI[-.35, - .04]. Thus, identifying with the scientist protected participants from the harmful influence of awareness of gender bias in STEM on belonging and trust in computer science environments.

We next ran the same serial mediation model from Experiment 2, predicting empathy (gender bias information-> scientist faced gender bias-> scientist encountered similar bias->empathy; see Figure 3b). Employing Hayes' (2013) PROCESS Macro Model 6 and 10,000 bootstrap resamples, we found a significant indirect effect, .20, 95% CI[.07, .44], of gender bias versus control information via the proposed serial mediation pathway (gender bias information->

scientist faced gender bias-> scientist encountered similar bias->empathy). We again tested this serial mediation model with perceptions that the scientist could take participants' perspective and that the scientist had faced similar situations, respectively, as the outcome variables. The indirect effects via the serial mediation pathway was significant in both of these models (take perspective: .12, 95% CI[.04, .26]; experienced similar situations: .38, 95% CI[.17, .68]).

Finally, we ran a parallel mediation analysis using Hayes' (2013) PROCESS Macro Model 4 with 10,000 bootstrap resamples, with information condition as the predictor; empathic concern, perceptions the scientist could take participants' perspective, and beliefs the scientist had experienced similar situations as the three mediators; and shared identity with the scientist as the outcome. Replicating Experiment 2, there was a significant indirect effect of information condition on shared identity with the scientist via empathic concern, .07; 95% CI[.01, .20]; perceptions the scientist could take participants' perspective, .12; 95% CI[.03, .27]; and beliefs the scientist had experienced similar situations, .17; 95% CI[.01, .40]. Participants who learned about gender bias felt empathic concern while reading about the computer science professor, perceived that this professor was able to take their perspective, and believed they had experienced similar situations as the professor, more than participants in the control information condition; and these beliefs all, in turn, predicted feeling a sense of shared identity with the woman computer science professor (see Figure 4b).

Discussion

In Experiment 3, we replicated the previous experiments with a sample of female college students, which demonstrated that these results were not unique to MTurk participants. Compared to control information participants, after learning about gender bias in STEM, students reported an increased sense of shared identity with a woman computer scientist, who ostensibly worked at their university. Moreover, the effect of gender bias information on identification with the scientist was again mediated by empathy, perceptions the scientist could take their perspective, and beliefs the scientist had faced similar situations. Finally, in Experiment 3, we demonstrated that information about gender bias in STEM has the potential to be inspiring for female students when paired with an article about a successful woman scientist. The students reported a greater interest in taking classes with, and working on research with, the woman computer science professor in the gender bias information than in the control information condition.

General Discussion

In the current research, we aimed to test a new intervention for enhancing women's identification with women scientists, including those who are "highly stereotypical" and lacking warmth (see Table 5 for summary of results). Across five experiments, we found that, relative to control information, teaching women about the pervasive sexism in STEM fields increased their identification with both a woman biomedical scientist (Experiments 1a, 1b, and 1c) and a woman computer scientist (Experiments 2 and 3). Of importance, in Experiments 1a and 1c, information about gender bias in STEM increased identification with a woman scientist but not with a man scientist (even when the male scientist was relatable). Moreover, in Experiments 1b and 1c, learning about gender bias helped female participants relate to the "highly stereotypical" woman scientist who fit the masculine scientist stereotype (e.g., the scientist said she did not care about her appearance, had no hobbies, and only enjoyed research and watching Mystery Science Theater). Indeed, in Experiment 1b, we found that the "mildly stereotypical" scientist was perceived as warmer and more relatable than the "highly stereotypical" scientist; however, information about gender bias in STEM still encouraged identification with the “highly stereotypical” scientist.

In Experiments 2 and 3, we identified multiple potential mechanisms underlying the effect of gender bias information on identification with the woman scientist. In particular, feelings of empathic concern, and beliefs that the scientist could take participants’ perspective and faced similar situations, all predicted increased identification with the woman computer scientist and functioned as significant mediators. Although multiple processes were important for enhanced identification, supporting our initial model and hypotheses, empathy emerged as a significant mediator, even while controlling for the other two mediators in the model. We did not directly test how participants’ feelings of empathic concern affected trait perceptions of the women scientists; however, it is possible that increased empathy also lead participants to perceive the women scientists as warmer in Experiment 1b. In Experiment 2, we found that information about the benefits of gender identification and female affinity groups did not encourage feelings of similarity with a female scientist. Finally, in Experiment 3, we found that compared to control information, female college students who learned about gender bias in STEM felt a stronger sense of shared identity with a woman computer science professor who supposedly worked at their university. Particularly relevant to promoting women’s attraction to STEM fields, compared to those in the control condition, participants in the gender bias information condition also reported higher interest in taking classes with the computer science professor, having the professor as a mentor, and working in the professor’s laboratory.

Across all of the current experiments, we also explored how learning about gender bias in STEM influenced participants’ anticipated belonging and trust in a STEM environment. As expected, in Experiments 1a and 1c, when participants were presented with a man scientist, information about gender bias in STEM resulted in lower anticipated belonging and trust at a STEM company than participants in the control information condition. However, identifying with a successful woman scientist protected participants from this harmful effect of gender bias information. In fields where the majority of professors are men (e.g., computer science, engineering; NSF, 2017), there may be few woman scientists or professors to protect female students from the harmful influence of gender bias information. Thus, in these fields, it will be important to incorporate information and articles featuring women scientists when teaching about sexism in STEM. In the current research, a brief article describing a woman scientist was sufficient to protect female participants' belonging and trust in STEM from the negative affect of gender bias information.

Practice Implications

Because of the lack of gender parity in STEM fields (NSF, 2017), it is critical to address the factors undermining women's interest in these domains. In particular, female scientists are stereotyped as masculine and socially awkward, which may make it difficult for women to identify with female scientists and may discourage their pursuit of STEM majors and careers (Banchefsky et al., 2016; Cheryan et al., 2013, Cheryan et al., 2011). The current research suggests that teaching women about gender bias in STEM may be one way to enhance the relatability of female scientists. For example, after female students learn about the sexism that is pervasive in STEM fields, they may find it easier to identify with female scientists from their everyday lives (e.g., female professors, graduate students, or senior undergraduate students) or with female scientists, who are portrayed in popular media as somewhat awkward and nerdy (Weitekamp, 2017). In addition, the results from Experiment 3 suggest that learning about gender bias may encourage students to take classes with STEM professors or approach these professors about research opportunities in their laboratories.

Beyond women's interest in pursuing a STEM career, detrimental and often subtle biases also impede women's advancement in these fields (Milkman et al., 2014; Moss-Racusin et al., 2012). To address these biases, it is important to first raise awareness of their damaging influence on women's careers in STEM (Carnes et al., 2012; Sevo & Chubin, 2008). Various successful interventions that reduce sexism are effective because they increase recognition of the powerful and damaging influence of sexism (e.g., Becker & Swim, 2011; Carnes et al., 2014; Cundiff, Zawadzki, Danube, & Shields, 2014; Pietri et al., 2017, Zawadzki, Danube, & Shields, 2012). Results from our first two experiments suggested that teaching women about gender bias in STEM can decrease their sense of belonging in these fields. As a result, when conducting studies to validate new diversity training and workshops to reduce gender bias in STEM, researchers may want to explore whether these interventions also make women question their belonging and trust in STEM. Likewise, college faculty who teach about gender bias in the sciences and enhance awareness of this issue might examine how class content affects women's feelings of belonging across STEM majors (Good & Moss-Racusin, 2010). Exploring this possible consequence will be particularly important when male professors are teaching courses that cover sexism because these professors will not act as protective role models for their female students. Of note, the current research also provides a solution to the problem—integrating information about successful women scientists into diversity trainings and classes on gender bias.

The current research also has implications for understanding how empathy may enhance one's sense of shared identity with another person. Previous work has found that explicitly instructing participants to take the perspective of an individual or telling participants about an individual's specific hardships can encourage empathy and self-other overlap with the individual (Batson, Early, & Salvarani, 1997; Cialdini et al., 1997; Galinsky & Moskowitz, 2000; Davis, Conklin, Smith, & Luce, 1996; Galinsky, Ku, & Wang, 2005). However, the current experiments did not require a perspective-taking manipulation or a detailed description of the particular unfair treatment the female scientist had encountered, to increase empathic concern and identification with the female scientist. Moreover, necessitating a perspective-taking manipulation, or specific instances of bias, limits an intervention to enhancing the relatability of a single female scientist at a time (i.e., participants would need to take the perspective of a certain person or learn about a person's personal struggle with bias). In contrast, increasing awareness of gender bias in STEM (e.g., via the gender bias informational module) has the potential to stimulate perceptions that multiple scientists across different contexts have faced bias, and this might promote identification with many scientists simultaneously. Research also demonstrates that people are generally disliked and seen as complainers when they claim to have encountered bias and discrimination (Kaiser, Dyrenforth, & Hagiwara, 2006). Thus, having a female scientist describe her experiences with unfair treatment in STEM (rather than providing outside information about gender bias) may harm a female scientist's relatability. Moreover, if a female scientist points out that gender bias is an issue in STEM generally, she may not be trusted or believed (Abel & Meltzer, 2007). Individuals may be more inclined to believe evidence of sexism when it comes from a man or a gender-neutral source. However, because researchers have also found that women tend to be more aware of gender bias than men (Luzzo & McWhirter, 2001; Pietri et al., 2017), it is possible that women may trust a woman scientist presenting information about gender bias and, in turn, identify more strongly with the scientist. In the current work, we always employed a gender-neutral source to present gender bias information and, hence, this will be an important question to explore in future research.

Limitations and Future Directions

Based on the current findings, we do not know whether these results are limited to increasing identification with scientists who share a common identity (i.e., participants were women and learned about how gender bias affects women scientists). Given that feeling empathic concern was one important mediator for increased identification, it is possible that as long as external information increases women's empathic concern for a scientist, this information would also enhance women's felt similarity with the scientist regardless of group identity. For example, gender stereotypes can be constraining for men, and men are disliked and punished when they act counterstereotypically modest, or value fatherhood over their career (Brescoll & Uhlmann, 2005; Moss-Racusin, Phelan, & Rudman, 2010). Learning about the harmful influence of stereotypes on men scientists may encourage women to feel empathy and to identify with men scientists. This is an important possibility to explore in future research because it may further demonstrate the importance of empathy as a mechanism for enhanced identification. In addition, men dominate many STEM fields (NSF, 2017) and, as a result, it would be beneficial to increase women's identification with both men and women scientists in order to increase their interest in STEM careers.

Future work also might explore whether learning about gender bias in STEM helps women of color identify with women scientists, particularly those who share a different ethnicity. One limitation of the current experiments is that the majority of participants across our samples were White women, and the woman scientist was always White. Recent work suggested that Black women might struggle to relate with White female scientists; researchers found that Black women identified more strongly with a Black woman scientist and a Black man scientist than with a White woman scientist (Pietri, Johnson, & Ozgumus, in press). This finding aligns with the current research because Black women tend to be more aware of racism than sexism (King, 2003; Levin, Sinclair, Veniegas & Taylor, 2002). The Black female participants may have presumed the Black scientists had faced more bias than the White woman scientist and, hence, identified more strongly with the Black scientists. Information about the insidious nature of sexism in STEM may serve as an effective intervention to encourage Black women to identify with White women scientists. However, this question should be directly tested in future research, and future work should continue to explore the how the intersection of racism and sexism harms men and women of color's interest and engagement in STEM.

Given that the gender bias module was brief, it is possible that participants may forget this information and our effects may not persist. However, many established interventions have a lasting influence on awareness of gender bias (see Becker & Swim, 2011; Carnes et al., 2014; Cundiff, et al., 2014), and thus future longitudinal research might explore whether these interventions encourage an enduring change in women's impressions of multiple women scientists. Future work might also test the research questions we examined with women already established in STEM fields. It is possible that women scientists may strongly identify with other scientists and, as a result, gender bias information would do little to further increase their felt similarity with another woman scientist. However, women in STEM fields also may easily take the perspective of a successful woman scientist and imagine the obstacles she encountered with sexism. Women working in STEM fields may feel more empathic concern for, and may identify more strongly with, women scientists after learning about gender bias, compared to women employed in other disciplines (Cialdini et al., 1997; Maner et al., 2002). Future research exploring these questions with STEM professionals, STEM majors, or college students generally, should ensure that woman scientist is referred to as Dr. or Professor and not by her first name in the survey questions, which was a limitation of Experiment 3.

Finally, STEM fields are not the only domain in which women are negatively stereotyped and face bias. Women in leadership positions are often seen as less competent and less likable than their male counterparts (Lyness & Heilman, 2006; Rudman, Moss-Racusin, Phelan, & Nauts, 2012). Furthermore, women leaders and politicians are stereotyped as lacking warmth (Fiske, Xu, Cuddy, & Glick, 1999) and, as a result, women may struggle to relate to them. Future research might explore whether teaching women about the biases women leaders and politicians encounter would increase women's identification with, and support for, leaders.

Conclusions

Although there are many opportunities for future research, the current research represents a critical first step. This work demonstrates that teaching women about gender bias in STEM encourages their identification with a woman scientist and that identifying with the woman scientist protects women from the harmful consequences (i.e., decreased belonging and trust) associated with learning about gender bias in STEM. Thus, teaching women about gender bias in STEM may act as a powerful intervention for enhancing women's identification with all women scientists and encouraging women's interest in STEM.

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Table 1

The Means and Standard Deviations Across Information Condition and Scientist Condition in Experiments 1a, 1b, and 1c.

	Experiment 1a			
	Female scientist		Male scientist	
	Gender bias (*n* = 121)	Control (*n* = 118)	Gender bias (*n* = 122)	Control (*n* = 127)
Measure	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Awareness of gender bias in science	4.04 (0.68)	3.41 (0.88)	4.05 (0.72)	3.56 (0.76)
Perception the scientist faced gender bias	3.93 (0.61)	3.34 (0.80)	2.05 (0.86)	2.15 (0.76)
Identification with Scientist	3.60 (0.69)	3.27 (0.72)	3.23 (0.66)	3.27 (0.73)
Belonging and trust	3.36 (0.68)	3.40 (0.74)	3.12 (0.68)	3.37 (0.77)
	Experiment 1b			
	"Mildly stereotypical" female scientist		"Highly stereotypical" female scientist	
	Gender bias (*n* = 52)	Control (*n* = 59)	Gender bias (*n* = 52)	Control (*n* = 51)
Measure	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Awareness of gender bias in science	4.19 (0.62)	3.46 (0.73)	3.98 (0.65)	3.69 (0.73)
Perception the scientist faced gender bias	3.84 (0.66)	3.25 (1.01)	3.86 (0.65)	3.23 (0.83)
Identification with scientist	3.83 (0.60)	3.57 (0.75)	3.49 (0.78)	3.31 (0.83)
Belonging and Trust	3.36 (0.68)	3.44 (0.74)	3.09 (0.77)	3.19 (0.76)
Scientist warmth	4.23 (0.73)	3.95 (0.87)	3.72 (0.71)	3.51 (1.01)
Scientist competence	4.67 (0.62)	4.59 (0.59)	4.72 (0.46)	4.75 (0.48)
Scientist success	4.73 (0.49)	4.66 (0.51)	4.72 (0.45)	4.80 (0.45)
	Experiment 1c			
	"Highly stereotypical" female scientist		"Relatable" male scientist	
	Gender bias (*n* = 127)	Control (*n* = 127)	Gender bias (*n* = 125)	Control (*n* = 136)
Measure	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Awareness of gender bias in science	3.99 (0.67)	3.45 (0.87)	4.07 (0.64)	3.46 (0.88)
Perception the scientist faced gender bias	3.88 (0.68)	3.33 (0.87)	2.14 (0.84)	2.18 (0.82)
Identification with Scientist	3.41 (0.77)	3.15 (0.81)	3.31(0.71)	3.33 (0.77)
Belonging and Trust	2.70 (1.00)	3.12 (1.08)	2.60 (1.01)	3.21 (1.01)

Table 2

Correlation Matrix for Experiments 1a-1c.

Experiment 1a and 1b correlations							
Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Awareness of gender bias in science		.51***	.15***	- .23***	-.02	.21***	.19**
2. Scientist faced gender bias	.06		.18***	- .12+	.05	.14*	.13+
3. Identification with scientist	.10*	.24***		.50***	.51***	.16*	.19**
4. Belonging and Trust	-.28***	.13**	.42***		.39***	.07	.07
5. Scientist warmth	-	-	-	-		.17*	.24***
6. Scientist competence	-	-	-	-	-		.72***
7. Scientist success	-	-	-	-	-	-	

Experiment 1c				
Measure	*1*	*2*	*3*	*4*
1. Awareness of gender bias in science		-	-	-
2. Scientist faced gender bias	.11*		-	-
3. Identification with scientist	.09*	.17***		-
4. Belonging and Trust	-.27***	.06	.27***	

Note: Experiment 1a values are presented above the diagonal and Experiment 1b values are presented below the diagonal in top table. Experiment 1c is presented in the bottom table.
$^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 3

The Means and Standard Deviations Across Information Condition in Experiments 2 and 3.

Experiment 2			
	Gender bias information (n = 107)	Gender identity information (n = 101)	Panda information (n = 104)
Measure	*M (SD)*	*M (SD)*	*M (SD)*
Awareness of gender bias in science	4.07 (0.66)	3.60 (0.71)	3.63 (0.79)
Empathy	4.66 (1.21)	4.11 (1.29)	3.93 (1.47)
Perception the scientist faced gender bias	4.01 (0.85)	3.63 (0.91)	3.58 (0.93)
Identification with scientist	3.67 (0.67)	3.48 (0.69)	3.38 (0.74)
Self-other overlap with scientist	3.92 (1.50)	3.49 (1.33)	3.26 (1.38)
Can take perspective	4.88 (1.16)	4.73 (1.10)	4.38 (1.21)
Similar past situations	4.04 (1.48)	3.56 (1.32)	3.69 (1.39)
Similar past unfair treatment	4.14 (1.55)	3.82 (1.37)	3.87 (1.35)
Example of women being successful	4.43 (0.72)	4.20 (.73)	4.21 (.73)
Belonging and Trust at STEM company	3.00 (0.70)	3.20 (0.74)	3.09 (0.70)
Gender solidarity	4.00 (0.85)	3.87 (0.83)	3.95 (0.92)
Gender satisfaction	4.18 (0.68)	4.18 (0.65)	4.22 (0.70)
Gender centrality	3.91 (0.80)	3.91 (0.82)	4.01 (0.86)
Gender self-stereotyping	3.76 (0.95)	3.80 (0.84)	3.81 (0.98)

Experiment 3		
	Gender Bias Information (n = 54)	Control Panda Information (n = 47)
Measure	*M (SD)*	*M (SD)*
Awareness of gender bias in science	3.65 (0.67)	3.33 (.56)
Interest in interacting with scientist	3.88 (0.61)	3.60 (.50)
Empathy	3.99 (1.49)	4.35 (1.50)
Perception the scientist faced gender bias	4.02 (.62)	3.49 (0.66)
Identification with scientist	3.37 (0.57)	3.17 (.46)
Self-Other Overlap with scientist	2.97 (1.49)	2.38 (1.14)
Can take perspective	4.77 (1.14)	4.25 (0.78)
Similar past situations	3.71 (1.34)	3.18 (1.31)
Similar past unfair treatment	3.93 (1.30)	3.24 (1.39)
Example of women being successful	4.41 (0.66)	4.02 (0.58)
Belonging and trust in computer science	2.55 (0.66)	2.69 (0.70)

Table 4

Correlation Matrix for Experiments 2 and 3.

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1. Interest in interacting with scientist		.16	.29**	.30**	.39***	.56***	.47***	.32**	0.37***	.25*	.24*	-	-	-	-
2. Awareness of gender bias in science	-		.13	.33**	.23*	.04	0.10	.13	.00	.35***	-.44***	-	-	-	-
3. Empathy	-	.07		.16	.39***	.39***	.51***	.30***	.45***	.32**	- .05	-	-	-	-
4. Scientist faced gender bias	-	.47***	.19**		.46***	.25*	.28**	.22*	.24*	.42***	- .17^{+}	-	-	-	-
5. Similar past unfair treatment	-	.38***	.29***	.51***		.50***	.64***	.38***	.81***	.33**	- .04	-	-	-	-
6. Identification with scientist	-	.17**	.50***	.26***	.52***		.70***	.48***	.57***	.37***	.28**	-	-	-	-
7. Self-other overlap with scientist	-	.11*	.56***	.21***	.49***	.73***		.49***	.67***	.28**	.10	-	-	-	-
8. Can take perspective	-	.24***	.36***	.26***	.51***	.63***	.56***		.41***	.25*	- .02	-	-	-	-
9. Similar past situations	-	.21***	.28***	.36***	.81***	.57***	.55***	.51***		.2^{6*}	.13	-	-	-	-
10. Example of women being successful	-	.38***	.17**	.38***	.28***	.20***	.20***	.21***	.22***		-.15	-	-	-	-
11. Belonging and Trust	-	-.28***	.24***	-.10^{+}	.11*	.35***	.28***	.24***	.22***	-.04		-	-	-	-
12. Gender solidarity	-	.22***	.36***	.22***	.28***	.33***	.35***	.33***	.26***	.29***	.13*		-	-	-
13. Gender satisfaction	-	.08	.24***	.06	.06	.20***	18**	.24***	.07	.24***	.18**	.66***		-	-
14. Gender centrality	-	.11^{+}	.36***	.12*	.19***	.27***	.30***	.23***	.20***	.16**	.09	.66***	.70***		-
15. Gender self-stereotyping	-	-.02	.26***	.01	.06	.13*	.12*	.22***	.14*	.10^{+}	.16**	.63***	.54***	.58***	

Note. Experiment 2 values are presented above the diagonal and Experiment 3 values are presented below the diagonal.

$^{+}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 5
Summary of Results Across the Experiments.

Experiment	Participants	Control comparison module	Design	Gender bias information influence on identification	Gender bias information influence on belonging
1a	Female Mturk workers	Endangered pandas	(Gender bias information versus control information) × (male versus female scientist)	Increased identification with a female biomedical scientist *but not a* male biomedical scientist	Decreased belonging in the male scientist condition and *did not harm* belonging in the female scientist condition
1b	Female Mturk workers	Endangered pandas	(Gender bias information versus control information) × (typical versus stereotypical female scientist)	Increased identification with a “typical” female biomedical scientist *and* a “stereotypical” female biomedical scientist	Did not influence belonging
1c	Female Mturk workers	Endangered pandas	(Gender bias information versus control information) × (male versus female scientist)	Increased identification with a “stereotypical” female biomedical scientist *but not a* “relatable” male biomedical scientist	Decreased belonging in the male scientist condition and *did not harm* belonging in the female scientist condition
2	Female Mturk workers	Endangered pandas & gender identity	Gender bias information versus control information	Increased identification with a female computer scientist.	Did not influence belonging
3	Female college students	Endangered pandas	Gender bias information versus control information	Increased identification with a female computer professor scientist.	Did not influence belonging

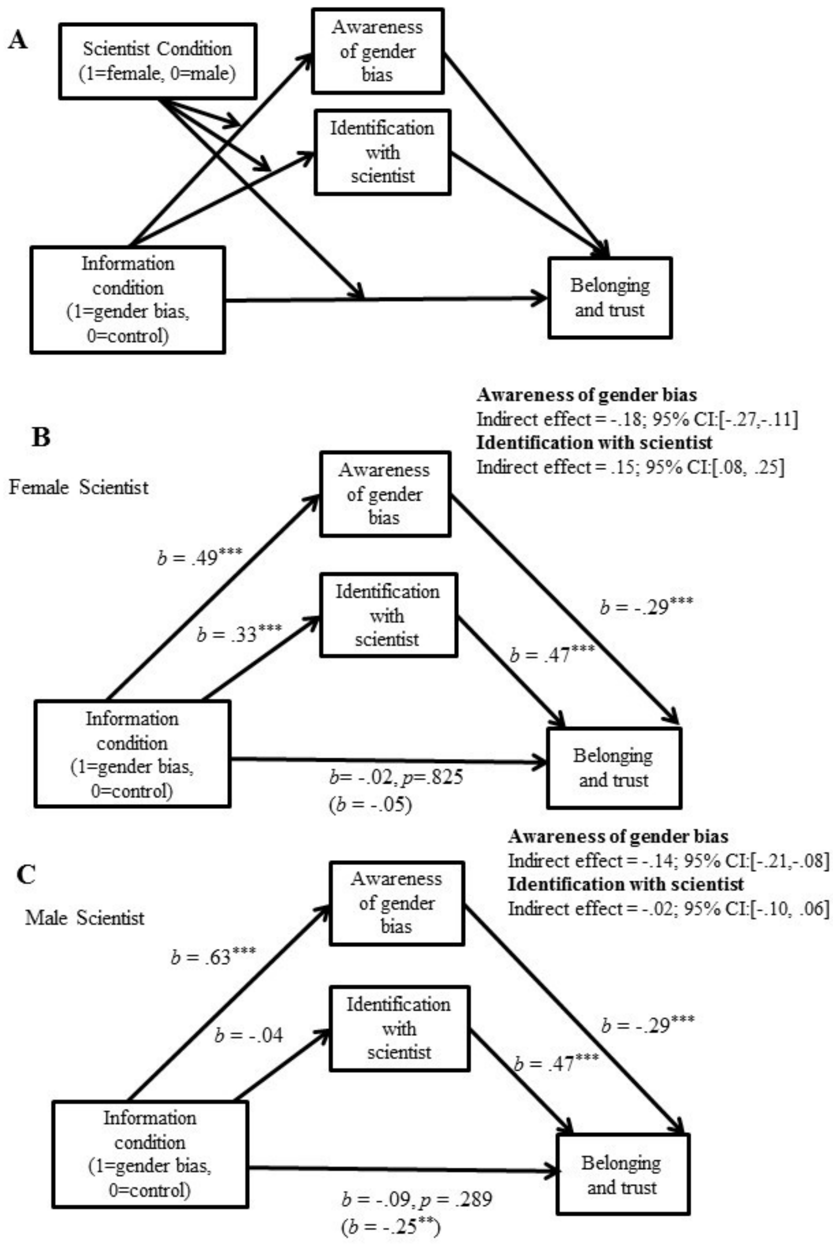

Figure 1. The moderated parallel mediation model testing whether there are indirect effects of information condition on belonging and trust at the STEM company via awareness of gender and identification with the scientist in the male and female scientist condition in Experiment 1a. Figure 1a demonstrates the conceptual model. Figure 1b shows the mediational model in the female scientist condition, and Figure 1c presents the mediational model in the male scientist condition. The total effects are shown with parenthesis, and the direct effects (i.e., controlling for awareness of gender bias and scientist relatability) are shown without parenthesis. *b* indicates the unstandardized regression coefficient. $^{+} = p < .1$, $^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$.

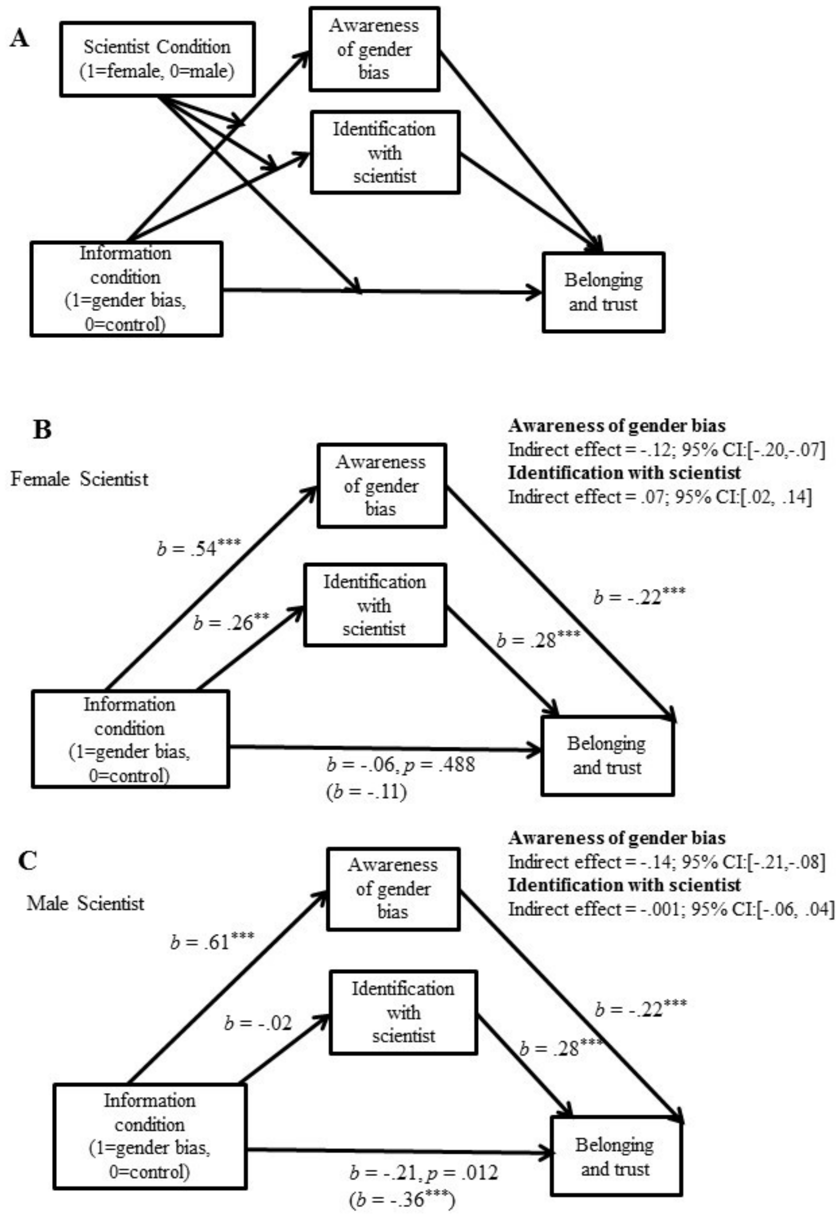

Figure 2. The moderated parallel mediation model testing whether there are indirect effects of information condition on belonging and trust at the STEM company via awareness of gender and identification with the scientist in the male and female scientist condition in Experiment 1c. Figure 2a demonstrates the conceptual model. Figure 2b shows the mediational model in the female scientist condition, and Figure 1c presents the mediational model in the male scientist condition. The total effects are shown with parenthesis, and the direct effects (i.e., controlling for awareness of gender bias and scientist relatability) are shown without parenthesis. *b* indicates the unstandardized regression coefficient. $^{+} = p < .1$, $^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$.

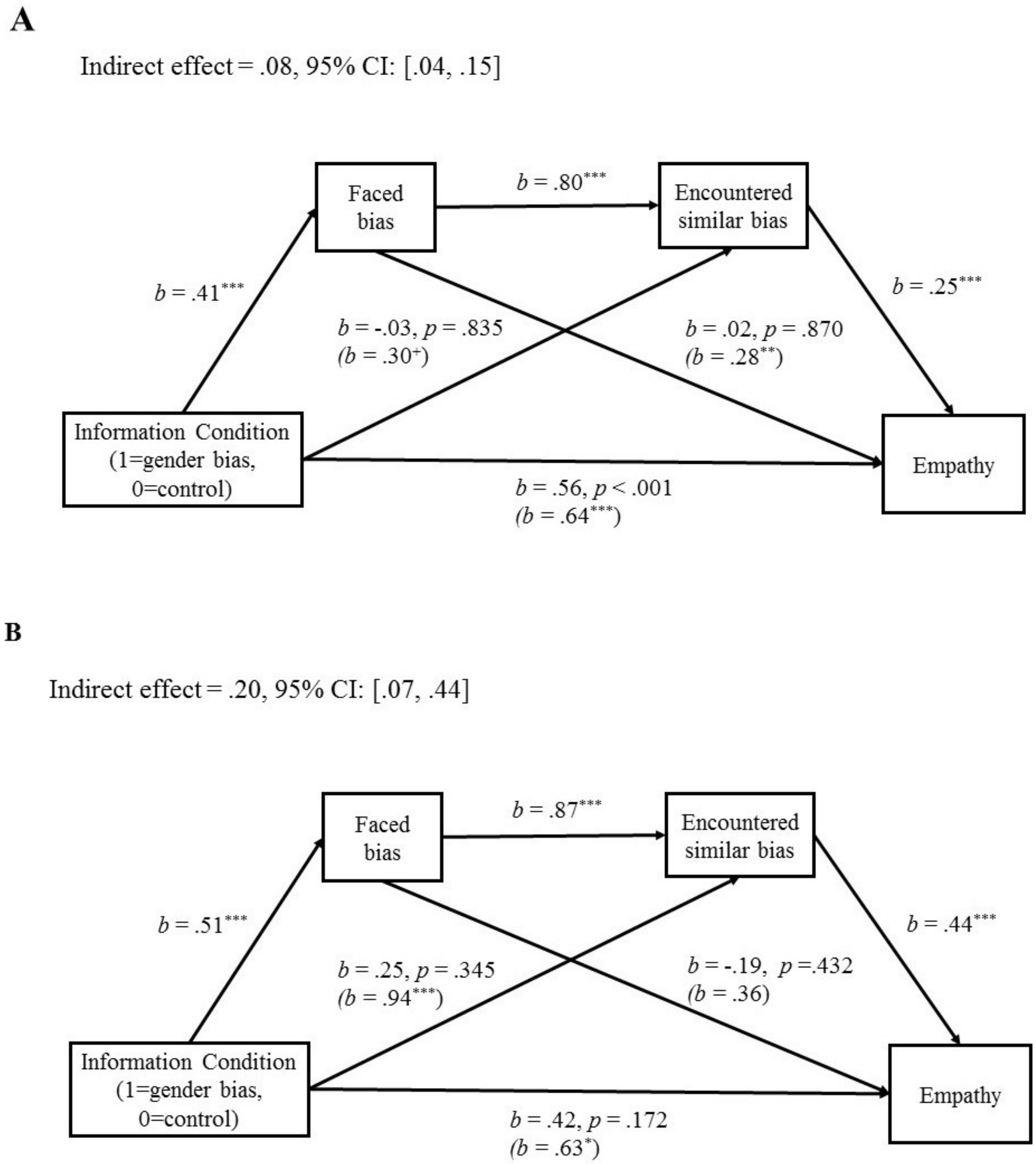

Figure 3. Mediation model testing whether there is an indirect effect of information condition on empathy via perceptions the scientist has faced bias and perceptions the scientist has encountered similar bias as participants in serial. Figure 3A shows this model in Experiment 2 and Figure 3B presents this model in Experiment 3. The total effects are shown with parentheses, and the direct effects (i.e., controlling for previous mediators in the model) are shown without parentheses. *b* indicates the unstandardized regression coefficient. $^{+} = p < .1$, $^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$.

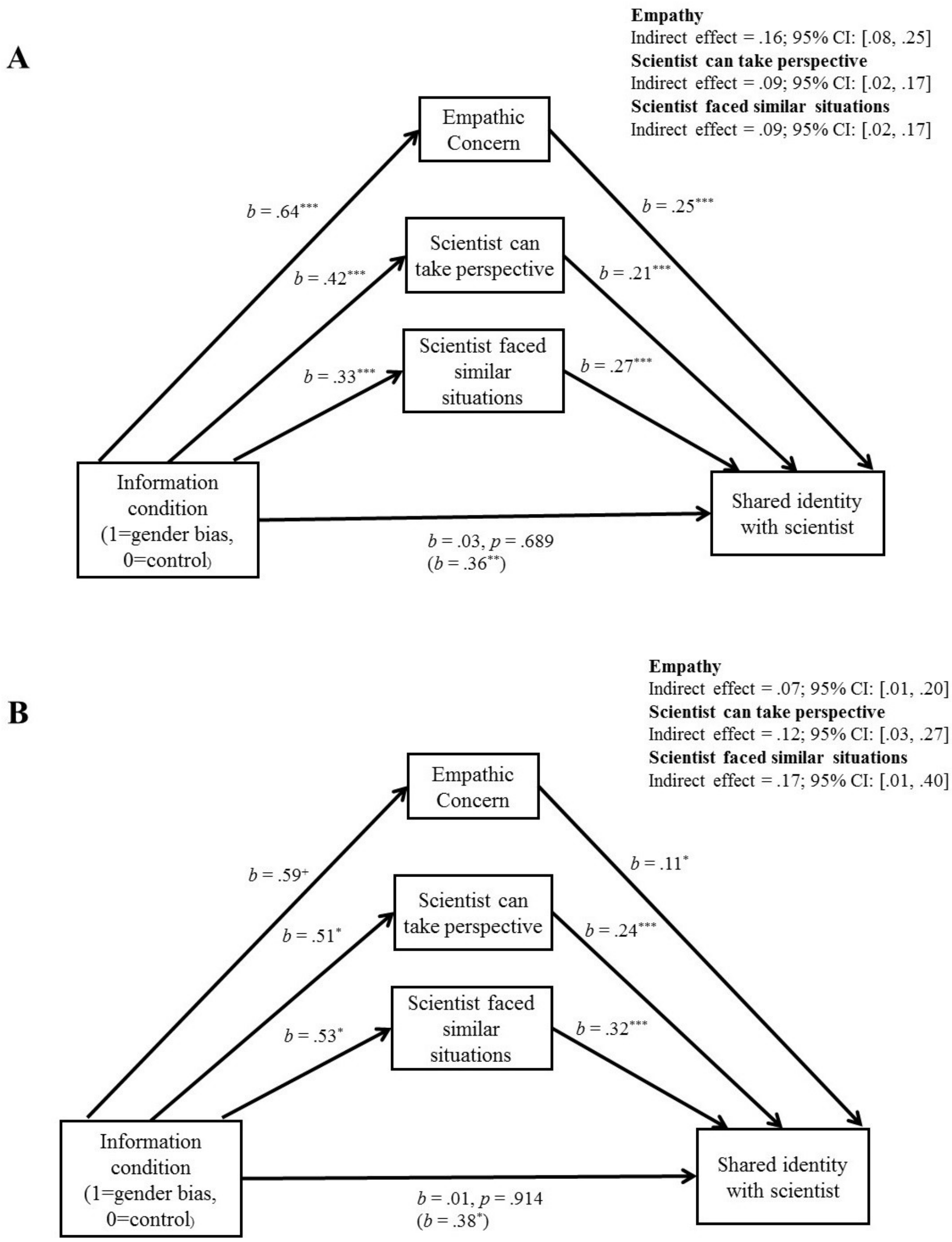

Figure 4. The parallel mediation model testing whether there are indirect effects of information condition on feeling a shared identity with the scientist via empathic concern, perceptions the scientist can take participants' perspective and has faced similar situations. Figure 4a shows the mediation model in Experiment 2, and Figure 4b demonstrates the mediation model in Experiment 3. The total effects are shown with parenthesis, and the direct effects controlling for the mediators (i.e., empathic concern, perceptions the scientist can take participants' perspective and has faced similar situations) are shown without parenthesis. *b* indicates the unstandardized regression coefficient. $^{+} = p < .1$, $^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$.