Reducing Stereotyping of Women in STEM:

Do Personal Relevance and Efficacy of Messages Boost Persuasion?

Amy L. Hillard[1], Tamera R. Schneider[2], and Sarah M. Jackson[3]

[1] Northwest Missouri State University

[2] City University of New York

[3] Wright State University

Author Note

Amy L. Hillard https://orcid.org/0000-0003-4491-2434

Tamera R. Schneider https://orcid.org/0000-0001-8082-8163

Sarah M. Jackson https://orcid.org/0000-0003-0528-5159

Abstract

Women are underrepresented in science, technology, engineering, and mathematics (STEM) in part because of gender stereotyping, and real-world interventions are needed to address this problem. Building on theory and research on persuasion, this quasi-experimental field study compared the effects of standard messages (i.e., fact-based, stereotype-disconfirming) versus experimental messages (i.e., the same messages enhanced with personal relevance and efficacy) on reducing gender stereotyping toward women in STEM. Faculty completed measures of feelings, perceptions of local norms, and stereotype endorsement toward women in STEM before (N = 146) and after (N = 113) a six-week persuasion campaign (including posters, brochures, and flyers) intended to reduce stereotyping toward women in STEM. Compared to the standard messages, the experimental messages evoked more negative feelings toward women in STEM and increased stereotyping of women in STEM. This unexpected finding is further examined across diverse identities and is discussed in terms of alternative hypotheses or explanations.

Keywords: gender, STEM, faculty, persuasion, stereotypes

Reducing Stereotyping of Women in STEM:

Do Personal Relevance and Efficacy of Messages Boost Persuasion?

Women still are underrepresented in science, technology, engineering, and mathematics (STEM), and growth in women's participation in these fields has slowed over the last decade; even though women comprise over half of the college-educated workforce, the overall share of women in science and engineering fields grew meagerly from 26% in 2003 to 29% in 2017 (National Science Board, 2020). Most social scientists attribute these gaps to pervasive cultural influences, such as stereotypes associating men but not women with STEM (Nosek et al., 2002). Gender stereotypes influence hiring, salary, and promotion decisions made by both men and women STEM faculty (Moss-Racusin et al., 2012) and so present an obstacle for women's recruitment, advancement, and retention in STEM. However, research suggests that cultural barriers related to gender stereotyping in STEM, including bias, chilly climates, and underrepresentation, can be challenged by individuals (e.g., Dickter et al., 2019; Shea et al., 2019) and organizations (e.g., Dasgupta & Asgari, 2004; Walton et al., 2015) to support institutional transformation. The present study examined the effects of a persuasion campaign aimed at reducing gender stereotyping and improving attitudes toward women in the academy.

To reduce bias and increase women's representation, advancement, and retention in STEM, our approach focuses on persuading more positive attitudes toward STEM colleagues. Extensive research on bias reduction has been conducted in the laboratory but more translational research on anti-prejudice persuasive messages is needed in the field. Interventions grounded in theory improve outcomes, but most real-world persuasive campaigns are not evidence-informed (Vrij & Smith, 1999; Vrij et al., 2003; Walton, 2014). According to persuasion theory and research (e.g., Schneider et al., 2009), messages that are personally relevant to the recipient and

foster self-efficacy (i.e., the belief that the recipient can accomplish the task at hand; in this case, avoiding bias) are likely to improve attitudes toward and reduce stereotypes about women in STEM. We review the literature on anti-prejudice messages but note that the most effective message approach for STEM fields remains unclear, along with how such messages might affect people differently based on identity and/or status. Based on existing research, we designed a quasi-experimental study of effects of anti-prejudice messages differing in personal relevance and efficacy in the context of women in STEM.

Anti-Prejudice Messages as Persuasion

A persuasion campaign uses media to inform the public to influence attitudes, beliefs, and/or behaviors. Persuasion campaigns, including communication programs, advertising, and public service announcements initiated by governments, have aimed to reduce prejudice and discrimination, but such campaigns are more successful when informed by social psychological evidence and theory (Vrij & Smith, 1999). For example, a two-week mass media campaign that included television, radio, and press advertising reduced stereotypical beliefs about Aboriginal workers (Donovan & Leivers, 1993). These nuances of persuasion have been well studied, including the findings that persuasion can occur through conscious (i.e., central) and unconscious (i.e., peripheral) routes (e.g., Petty & Cacioppo, 1986), and that persuasive messages increase arousal through personal relevance but also increase efficacy by providing recommendations for action (Folkman et al., 1986; Schneider et al., 2009). The ways in which persuasion can reduce prejudice have also been examined. For example, positive media exposure (Dasgupta, 2013) and messages that focus on similarities in a positive context (Vrij et al., 2003) reduce bias. Specific to STEM, an educational program that introduced notable women engineers to high school science teachers reduced stereotypic gender beliefs in students (Hoh, 2009), and an experiment

that altered the salient stereotypes about computer scientists and engineers so that exemplars shared more similarities with participants increased women undergraduates' interests in computer sciences and engineering (Cheryan et al., 2015). Bias literacy education can also increase awareness of and knowledge about gender bias (Pietri et al., 2017). However, educational interventions are often more successful in changing stereotypical beliefs than attitudes or norms (Donovan & Leivers, 1993; Hill & Augoustinos, 2001), which also have a strong influence on behavior and social climate (e.g., Murrar et al., 2020).

To develop an intervention to shift stereotypic beliefs, attitudes, and norms, the present quasi-experimental study designed messages based on theories about persuasion and reducing prejudice. We aimed to conduct translational research by applying previous evidence and theory to a new domain (i.e., women in STEM). Broadly, research on reducing prejudice relies on self-regulation to promote diversity, equity, and inclusion (DEI; i.e., an approach orientation) or prevent bias (i.e., an avoidance orientation). Both strategies reduce implicit prejudice, depending on the context (Phills et al., 2011). Prejudice reduction strategies are more effective when the context has a positive (v. negative) valence and when individuals have a promotion focus (e.g., increasing DEI) rather than a prevention focus (e.g., preventing bias; Higgins, 2005). Existing messages about women in STEM are often associated with a positive domain (e.g., education or the workplace) and have a promotion focus (e.g., equity; National Academy of Sciences, 2007). Thus, we adopted an approach strategy for promoting positive attitudes about women in STEM.

We used the biobehavioral model of persuasion, which has been shown to promote behaviors in real-world contexts, to develop messages that foster attitude and behavior change (Schneider et al., 2009). According to this model, "challenge messages" are more personally relevant and increase self-efficacy (e.g., by offering appropriate actions to take); this

combination of personal relevance and self-efficacy in challenge messages results in a promotion orientation, which increases message processing and produces favorable attitudes. Based on other applications of this model of persuasion (e.g., Schneider et al., 2009; Schneider et al., 2011), we expected that challenge messages about the underrepresentation of women in STEM (i.e., featuring more personal relevance and efficacy) would produce greater message acceptance while avoiding a threat response (i.e., because efficacy is present) and disengagement from the message (i.e., because it is personally relevant). Informed by this theory and evidence, we aimed to boost persuasion using challenge messages, which have more personal relevance and efficacy. Both variables have been examined in persuasion literature and in the context of STEM gender stereotyping. For example, an experiential activity demonstrating how bias accumulates in the workplace increased self-efficacy to avoid gender bias (Zawadzki et al., 2012).

Effective persuasive messages should also result in positive changes in attitudes. One study measured the effect of an educational intervention about subtle workplace bias and focused on reducing faculty's implicit associations and explicit bias toward women in STEM (Jackson et al., 2014). Faculty in STEM attended a presentation that provided information about women in STEM at that college (i.e., providing personal relevance), research demonstrating bias in decisions that impact women in STEM, and steps that faculty could take to reduce gender bias (i.e., providing self-efficacy). Compared to a control condition (i.e., attending a faculty meeting of the same length in which bias was not discussed), the presentation reduced men’s implicit bias and increased their personalized associations of women with STEM.

Rather than an educational intervention, the present study used messages relevant to gender stereotyping in STEM while varying personal relevance and efficacy. Based on previous persuasion theory and research, we hypothesized that messages with more personal relevance

and efficacy would produce more positive feelings, attitudes, and norms toward women in STEM compared to standard messages (i.e., fact-based, stereotype-disconfirming messages). Messages might also have differential impacts among social identities such as gender, race/ethnicity, and rank; it is therefore necessary to use an intersectional lens to understand the range of reactions in response to a persuasion campaign.

Intersectionality and Women in STEM

Despite the well-established impact of gender bias on equity in STEM fields, not all women experience these effects equally. Women who also belong to other underrepresented groups (e.g., race/ethnicity, disability status, and sexual orientation) face unique challenges arising from the synergistic effect of intersecting systems of oppression. Although recent years have seen more bachelor's, master's, and doctorate degrees earned by people of color (NCSES, 2021) and more people of color and women hold doctoral level academic positions, the proportions still fall considerably short of their share in the population (Gumpertz et al, 2017; NCSES, 2021). Once in the academy, women of color are less likely to get tenure than any other group, despite equal productivity and teaching records and being saddled with greater service demands (O'Meara et al., 2019; Sheridan et al., 2017). Often the sole member of their social group, women from underrepresented groups face discrimination in overt and covert ways (Armstrong & Jovanovic, 2015; Settles et al., 2006), creating a chilly workplace climate, feelings of isolation, and increasing attrition and turnover (Armstrong & Jovanovic, 2015; Griffith & Dasgupta, 2018; Gumpertz et al., 2017). The intersection of gender and race/ethnicity creates a distinct experience that is more than the sum of its parts. People who experience marginalization often develop a keen awareness of prejudice and discrimination, and women (regardless of race/ethnicity) in STEM departments are more likely to perceive gender and racial bias than men

(Griffith & Dasgupta, 2018). But even when there is evidence of gender bias, women from overrepresented ethnic groups (e.g., White and Asian) perceive STEM as fair more often than women from underrepresented ethnic groups (Doerr et al., 2021; O'Brien et al, 2015), perhaps because system justifying beliefs reduce psychological threat aroused by evidence of systematic disparities (Jost et al., 2004). In complex ways, intersecting identities may influence responses to persuasive messages aimed at improving attitudes toward women in STEM.

Faculty rank and discipline also could impact the relationships among gender, experiences, and attitudes toward women in STEM. The percentage of women faculty has increased in recent decades, in part due to more part-time or non-tenured positions being held by women (Colby & Fowler, 2020). Women are still less likely to be in full-time, tenure-track positions than men and are more likely to leave the academy prior to promotion (Armstrong & Jovanovic, 2015; Gumpertz et al., 2017). Even within disciplines where the percentage of women is closer to the percentage of men (e.g., social, biological, and medical sciences), women are more likely to occupy part-time or non-tenure positions (Lautenberger & Dandar, 2020; Li & Koedel, 2017). Compared to men in STEM fields and faculty in non-STEM fields, women faculty in STEM are more likely to perceive the tenure process as unfair or unclear (Lisnic et al., 2020). Also, faculty in physical sciences, engineering, and math report lower satisfaction with the tenure and promotion process than faculty in the humanities and social sciences (Durodoye et al., 2019; Jackson et al., 2017). For some who have achieved higher ranks or who have benefited from the status quo, anti-prejudice messages might make systematic disparities explicitly salient, resulting in a psychological threat response that justifies the system (Doerr et al., 2021; Jost et al., 2004). Thus, gender, race/ethnicity, and rank are demographic factors that may influence how anti-prejudice messages are received in STEM.

Present Research

Persuasion theory and research suggest that messages with more personal relevance and efficacy may enhance persuasion and reduce prejudice, but it is unclear if the same will be found in the STEM academy. We examined the effects of a persuasion campaign with enhanced personal relevance and efficacy on STEM faculty designed to promote DEI and prevent bias. We aimed to create a fact-based, stereotype-disconfirming standard condition and compare its effect to an experimental condition in which messages were framed to include more personal relevance and efficacy. Based on persuasion theory and research, both the standard and experimental conditions were expected to result in more positive outcomes (i.e., more positive feelings and norms and less stereotyping) toward women in STEM from pre- to post-test, but the experimental condition was expected to result in more positive outcomes compared to the standard condition. Thus, this quasi-experimental field study examined the effect of experimental messages with enhanced personal relevance and efficacy vs. standard messages in an anti-prejudice campaign on faculty feelings, perceptions of norms, and stereotyping toward women in STEM. Given the importance of intersectionality, exploratory analyses also examined faculty demographic variables (e.g., gender, race/ethnicity, and rank) in the context of the study.

Method

Participants

Full-time, tenured or tenure-track faculty members from 25 STEM departments across two U.S., midwestern universities were invited to participate (N = 276). The universities were selected because of their involvement in a National Science Foundation (NSF) ADVANCE grant (i.e., an institutional transformation project geared toward reducing gender disparities in STEM disciplines). Both are research universities located in the same city. One is a relatively larger,

public university, whereas the other is a medium-sized, private university. Before and after a persuasion campaign, faculty were invited via email and surveys placed in their campus mailboxes to participate in a survey examining thoughts about people in STEM—one of the specific aims of this particular NSF ADVANCE grant. Participants were entered in a raffle for one of two $50 gift cards. Up to three reminders were sent at each time point to faculty who had not yet returned surveys. In total, 183 faculty members (132 men, 40 women, and 11 who did not specify) participated in at least one time point, and 76 participants had complete data that could be matched across time points. For both partial and complete responders, approximately 73% were men. Table 1 provides additional demographic information on participants.

Table 1

Demographic Information on Participants by Time Point

	Pre-campaign (n = 146)	Post-campaign (n = 113)	Matched Participants (n = 76)
Field of primary/sole department			
Engineering	47 (25.7%)	34 (18.6%)	24 (31.6%)
Physical Sci (Chemistry, Physics, etc.)	14 (7.7%)	12 (6.6%)	6 (7.9%)
Biological/Agricultural Sciences	37 (20.2%)	20 (10.9%)	15 (19.7%)
Earth, Atmosphere, Ocean Sciences	6 (3.3%)	6 (3.3%)	3 (3.9%)
Mathematics	14 (7.7%)	17 (9.3%)	8 (10.5%)
Computer Science	11 (6.0%)	8 (4.4%)	8 (10.5%)
Social Science & Other	14 (7.7%)	16 (8.7%)	11 (14.5%)
Rank			
Assistant	34 (18.6%)	20 (10.9%)	17 (22.4%)
Associate	51 (27.9%)	42 (23.0%)	29 (38.2%)
Full	57 (31.1%)	45 (24.6%)	30 (39.5%)
Gender			
Men	99 (54.1%)	87 (47.5%)	54 (71.1%)
Women	38 (20.8%)	24 (13.1%)	20 (26.3%)

Tenured faculty	107 (58.5%)	90 (49.2%)	58 (76.3%)
Ethnicity: White	109 (59.6%)	80 (43.7%)	55 (72.4%)

Note. Percentage is for total participants within each time point, including participants who opted not to report demographic item(s).

Procedure

Because of the field setting, the study used a quasi-experimental, pre-post design with two comparison groups. Using a matched groups procedure, departments were matched across universities (i.e., based on field and number of faculty) and then randomly assigned to standard or experimental message conditions, as described below. Participants completed the pre-test, after which the six-week persuasion campaign using one of two message conditions began. At the conclusion of the campaign, participants were again invited to complete a survey, including the measures below.

The campaign included posters displayed in public areas and mailings delivered to faculty mailboxes. Posters were hung in public spaces near department offices and/or mailrooms. Posters were designed as a series with similar formatting and graphics but covered three topics in STEM: women's representation, diversity increasing global competitiveness, and bias. Brochures and flyers were delivered every other week to all faculty mailboxes in participating departments. There were four mailings across six weeks, each of which had a different focus within STEM: women's representation, mentorship, women's history, and issues of bias. Surveys were provided in mailboxes as well, to increase the likelihood that responders saw the messages.

Across the posters and mailings, the standard condition included general messages about STEM, taken in part from National Academy of Sciences (2007). We developed the standard

condition and then altered its content for the experimental condition. All messages contained factual statements intended to disconfirm stereotypes and increase awareness of the issues related to women in STEM. Compared to the standard condition, however, the messages in the experimental condition also emphasized personal relevance (e.g., specific to the discipline and/or department) and efficacy (e.g., detailed methods to address problems related to underrepresentation of women in STEM). Past research has shown that it is necessary to increase both personal relevance and efficacy to create a challenge response (i.e., approach orientation). Messages that fail to increase efficacy in addition to relevance are more likely to result in a threat response (i.e., avoidance or reactance; Schneider et al., 2009). Therefore, experimental messages were designed to create challenge and thus a promotion (i.e., positive, supportive) orientation toward women in STEM.

Campaign Communication Strategy. The specific aims of the campaign messages were to create more positive feelings toward women in STEM and reduce endorsement of stereotypes. Both types of messages had factually equivalent information but differed in framing such that experimental messages enhanced personal relevance and efficacy. Message development was based on social psychological and persuasion theories as well as recommendations from past research on anti-prejudice campaigns (e.g., Pederson et al., 2005), and we followed these guidelines for all messages, regardless of condition. First, all messages were to be positive rather than negative (Vrji et al., 2003). For example, we used gain framing (i.e., focusing on the advantages or benefits of diversity) rather than loss framing (i.e., disadvantages or costs of lack of diversity). A flier titled “Scholar + [Your] Mentorship = Strong STEM Future” (with the bracketed inclusion representing the experimental condition) focused on the benefits of mentorship in both conditions rather than the costs of not being a mentor.

Second, all messages focused on changing behavior (Guerin, 2005; Pederson et al., 2005) and/or information-based beliefs through emphasizing gender similarity (Pederson et al., 2005; Vrij et al., 2003). We also used consensus information in an effort to shift norms (Pederson et al., 2005). Rather than simply changing attitudes, we often suggested behaviors that could increase equity. More specific behavior changes were suggested in the experimental condition to increase self-efficacy. A flier that was titled "STEM + Diversity = Innovation" advocated behavioral change in both conditions, but the experimental condition provided more specific recommendations. The experimental condition featured personalized language (using "you" and referencing the specific university and specific academic field) and more specific recommendations. For example, the standard condition flier read, "Be inclusive to strengthen STEM," but the experimental condition flier read, "Every day you can take small steps to be inclusive and strengthen [field] at [university] as a mentor and collaborator." Similarly, a message in the mentorship flier in the standard condition read, "Shape the future of STEM by being a mentor to young scholars." but more personalized language and specific recommendations were included in the experimental condition: "You can shape the future of STEM by being a mentor to a young [field: scientist, mathematician, etc.] at [university] through collaboration on research, teaching, and/or service."

Third, we also considered dual-process persuasion theories to increase the effectiveness of all messages (e.g., Petty & Cacioppo, 1986). Although we aimed to inspire greater engagement and deeper thinking (i.e., central processing) with all messages, we also considered peripheral routes to persuasion. For example, we worked with a graphic designer to ensure attractive designs (see Figure 1 for an example). We provided citations to increase credibility (Vrij et al, 2003). We also used notable women to address misperceptions (Hoh, 2009). For

example, to prevent participants from explaining away an individual woman as atypical and to encourage generalization (Vrij et al., 2003), we highlighted four women's contributions to STEM during women's history month.

Figure 1

Example Posters for the Standard and Experimental Conditions

Note. Compared to the standard condition (left), the experimental condition (right) has higher personal relevance (e.g., the specific field of STEM, "you," and use of questions: "Did you know?") and efficacy (i.e., specific recommendation).

Campaign Message Development. Given the importance of pretesting of campaigns (Whittingham et al., 2008), we checked our manipulation on 77 STEM undergraduates (39 women, 38 men). Participants read a one page, tri-fold brochure, which contained messages from the National Academy of Sciences (2007) that were adapted as either standard or experimental messages. Participants completed four items measuring their efficacy concerning issues facing women in STEM (e.g., "The message presented ways that I can reduce gender discrimination;" α = .83) on 5-point, Likert-type agreement scales. As expected, an independent samples *t*-test revealed that experimental messages evoked more efficacy (M = 3.47, SD = 0.70) than the standard messages (M = 3.11, SD = 0.83), $t(75) = 2.05$, $p = .04$.

Along with the messages used in the preliminary study, we developed additional messages for this campaign. The research team brainstormed messages, identified messages that best met our goals, and solicited feedback on the messages from three experts (i.e., psychological researchers with expertise in gender issues in STEM). After using this feedback, the best 10 messages were pre-tested with a small sample of STEM postdoctoral fellows (N = 13). Postdocs received five messages from each condition in a split-half design. These participants indicated their efficacy based on each message as well as qualitative feedback. This information was used to continue to hone the messages and minimize negative effects (e.g., reactance) in the campaign, which included the best messages from this pre-test.

Measures

Participants completed three attitude measures before and after the persuasion campaign. First, participants indicated their feelings toward women in STEM using feeling thermometers (with endpoints of 0 = cold, 100 = warm) for four groups of women (i.e., female scientists, female engineers, women in STEM, and women). A mean was created from these items to use in

subsequent analyses, and the scale was reliable (pre-campaign α = .93; post-campaign α = .92). Higher scores indicated warmer (i.e., more positive) feelings toward women in STEM.

Second, participants completed six items about their perception of stereotypical local norms about women on campus using the question stem: "My peers at my university think women in STEM are..." Participants responded using a 5-point semantic differential with endpoints of: analytical vs. emotional; competent vs. incompetent; intellectual vs. nonintellectual; logical vs. illogical; favorable vs. unfavorable; and committed vs. not committed. A mean was created from these items, and the scale was reliable (pre-campaign α = .92; post-campaign α = .91). Higher scores indicated that the participant perceived more stereotypical local norms about women in STEM.

Third, participants completed a measure of stereotype endorsement (modified from Schmader et al. (2004) by replacing "math" with "STEM"). Participants rated their agreement with three items (e.g., "In general, men may be better than women at STEM") on 7-point Likert-type scales with endpoints of Strongly Disagree (1) and Strongly Agree (7). A mean was created, and the scale was reliable (pre-campaign α = .67; post-campaign α = .73). Higher scores indicated more agreement with stereotypes about women in STEM.

At the end of the survey, participants had the option to provide demographic information, including academic field, rank, tenure status, gender, and race/ethnicity.

Results

Table 2 shows the univariate statistics by time and condition for all participants who responded at either time point (N = 146 pre-campaign; N = 113 post-campaign), and participants with complete data matched across time points (N = 76). Generally, participants had positive feelings toward women in STEM on the composite feeling thermometer measure, as

demonstrated by mean ratings; however, perceived local norms and stereotype endorsement were just below the mid-point of the scales. The pattern of means is similar for the overall sample and subsample with complete data, but the latter is included in subsequent analyses.

Table 2

Mean (SD) for DVs by Condition.

	All Participants (N = 183)			
	Standard condition		Experimental condition	
	Pre (n = 66)	Post (n = 55)	Pre (n = 75)	Post (n = 54)
Feeling thermometers	81.41 (17.55)	85.52 (13.51)	83.33 (19.10)	80.98 (17.45)
Perceived local norms	2.60 (0.87)	2.37 (0.72)	2.51 (0.73)	2.57 (0.73)
Stereotype endorsement	2.77 (1.36)	2.45 (1.41)	2.47 (1.42)	2.50 (1.34)
	Participants with Complete Data (N = 76)			
	Standard condition		Experimental condition	
	Pre (n = 35)	Post (n = 35)	Pre (n = 41)	Post (n = 41)
Feeling thermometers	82.54 (16.11)†	87.29 (12.68)†	84.97 (15.47)*	80.45 (17.35)*
Perceived local norms	2.27 (0.83)	2.16 (0.69)	2.33 (0.63)*	2.65 (0.69)*
Stereotype endorsement	2.55 (1.33)	2.38 (1.34)	2.35 (1.43)†	2.67 (1.42)†

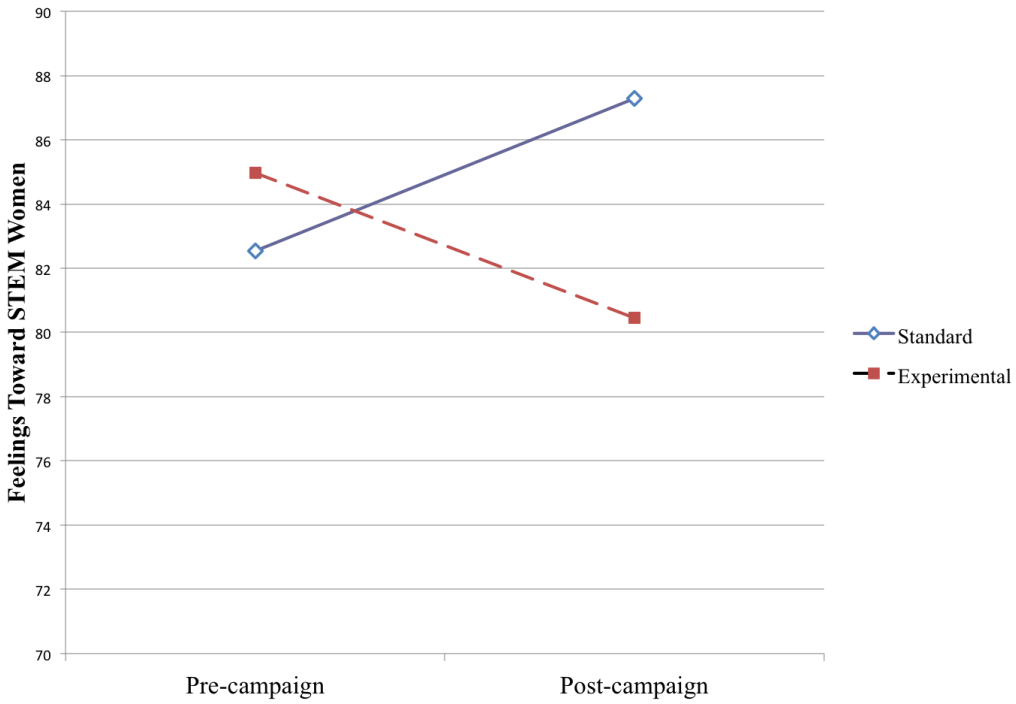
Note. Within each measure and each condition, differential means over time are marked in adjacent columns: *$p < .05$, †$p < .08$.

We conducted 2 (Time: pre- vs. post-campaign) × 2 (Condition: standard vs. experimental) mixed ANOVAs (with repeated measures on the first factor) for feelings toward women, perceived local norms, and stereotype endorsement to examine the effects of message condition on each dependent variable (DV) over time. There were no significant main effects of Time or Condition for any DV, all *p*s > .10.[1] However, there were significant Time × Condition interactions for feelings toward women in STEM, $F(1, 71) = 8.33$, $p = .005$, $\eta_p^2 = .105$; perception of local stereotypical norms, $F(1, 58) = 7.03$, $p = .01$, $\eta_p^2 = .108$; and stereotype endorsement, $F(1, 75) = 4.12$, $p = .046$, $\eta_p^2 = .052$. As shown in Figure 2, planned comparisons indicated that participants in the standard condition had marginally more positive feelings toward women in STEM after, compared to before the campaign, $t(34) = 1.99$, $p = .05$, Cohen's $d = .34$. In contrast, participants in the experimental condition had more negative feelings toward women after, compared to before the campaign, $t(37) = 2.09$, $p = .04$, $d = .34$.

[1] Complete non-significant results for 2 (Time: pre- vs. post-campaign) × 2 (Condition: standard vs. experimental) mixed ANOVAs are as follows: For feelings toward women, there was no main effect of Time, $F(1, 71) = 0.005$, $p = .944$, $\eta_p^2 < .001$, or Condition, $F(1, 71) = 0.46$, $p = .502$, $\eta_p^2 = .006$. For perception of local norms, there was no main effect of Time, $F(1, 58) = 1.59$, $p = .21$, $\eta_p^2 < .027$, or Condition, $F(1, 58) = 2.82$, $p = .10$, $\eta_p^2 = .046$. For stereotype endorsement, there was no main effect of Time, $F(1, 75) = 0.43$, $p = .52$, $\eta_p^2 < .006$, or Condition, $F(1, 75) = 0.03$, $p = .87$, $\eta_p^2 < .001$.

Figure 2

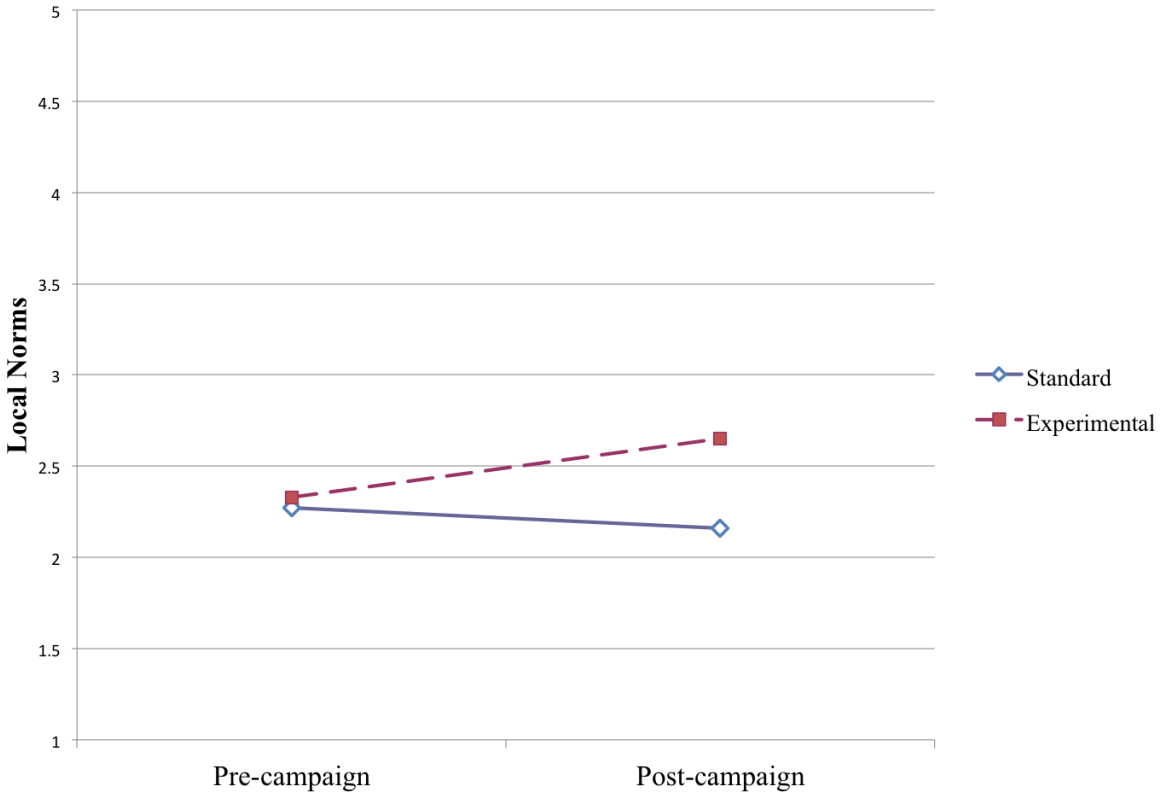
Faculty Feelings Toward Women in STEM Over Time and by Message Condition



As shown in Figure 3, planned comparisons indicated that participants in the standard condition had a similar perception of local norms before and after the campaign, $t(34) = 0.08$, $p = .41$, $d = .16$. Participants in the experimental condition perceived more stereotypical local norms after, compared to before the campaign, $t(31) = 3.30$, $p = .002$, $d = .58$.

Figure 3

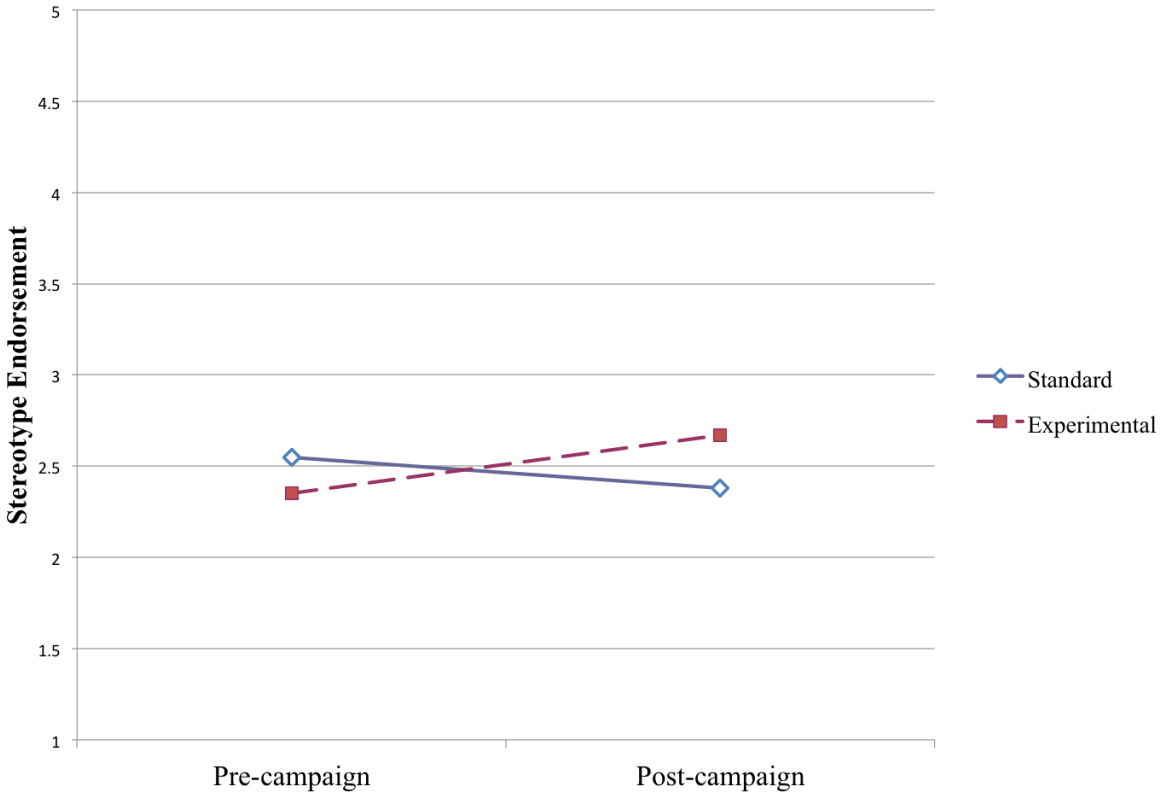
Faculty Perception of Local Norms Toward Women in STEM By Time and Message Condition



As shown in Figure 4, planned contrasts indicated that participants in the standard condition had similar endorsement of stereotypes before and after the campaign, $t(35) = 1.06$, $p = .29$, $d = .18$. However, participants in the experimental condition endorsed stereotypes about women in STEM marginally more after, compared to before the campaign, $t(40) = 1.81$, $p = .08$, $d = .28$.

Figure 4

Faculty Endorsement of Stereotypes Toward Women in STEM By Time and Message Condition



In summary, participants in the standard message condition reported similar stereotypical norms and stereotype endorsement before and after the campaign; there was limited support for the hypothesis in that recipients of the standard messages reported marginally more positive feelings after the campaign. There was no support for the expectation that messages enhanced with personal relevance and efficacy would result in more positive feelings, attitudes, and norms compared to standard messages. Instead, participants in the experimental, enhanced message condition reported more negative feelings toward women in STEM, perceived more stereotypical local norms, and endorsed marginally more stereotypes following the campaign.

Demographics, Identity, and Intersectionality

Additional exploratory analyses were conducted to examine the influence of demographic and/or identity factors as well as whether outcomes of the persuasion campaign were qualified by demographic variables included in the study. Table 4 shows the univariate statistics for Time 2 means for men and women by race/ethnicity, institution, and rank. These results should be cautiously interpreted given small sample size, but few gender differences emerged for any DV when comparing men and women within race/ethnicity, institution, and rank.

Table 4

Gender Differences for DVs at Time 2 by Race/Ethnicity, Institution Type, and Rank

	Men		Women		
Feeling Therm.	*M* (*SD*)	*n*	*M* (*SD*)	*n*	Sig.
Race/Ethnicity					
White	82.67 (17.17)	61	84.80 (11.88)	15	.65
People of color	80.22 (15.63)	22	83.42 (16.94)	6	.66
Institution					
Private	80.34 (16.89)	29	79.44 (17.11)	9	.89
Public	83.85 (16.24)	54	88.27 (7.60)	13	.35
Rank					
Assistant	86.64 (10.47)	11	87.03 (11.13)	8	.94
Associate	81.29 (17.58)	32	84.38 (11.26)	10	.61
Full	79.25 (17.52)	35	80.63 (21.05)	4	.88
Local Norms	*M* (*SD*)	*n*	*M* (*SD*)	*n*	Sig.
Race/Ethnicity					
White	2.56 (0.69)	51	2.26 (0.69)	15	.15
People of color	2.49 (0.77)	18	2.33 (0.92)	6	.68
Institution					
Private	2.51 (0.63)	25	2.30 (0.80)	9	.43
Public	2.56 (0.76)	44	2.26 (0.73)	12	.24
Rank					
Assistant	2.26 (0.75)	11	2.60 (0.73)	8	.33
Associate	2.49 (0.77)	26	2.10 (0.76)	10	.18
Full	2.71 (0.60)	28	2.00 (0.58)	3	.06†

Stereotype Endors.	*M* (*SD*)	*n*	*M* (*SD*)	*n*	Sig.
Race/Ethnicity					
White	2.51 (1.46)	63	1.87 (1.09)	15	.11
People of color	3.05 (1.41)	22	1.83 (0.89)	6	.06†
Institution					
Private	2.67 (1.51)	31	2.44 (1.01)	9	.67
Public	2.60 (1.36)	54	1.38 (0.77)	13	<.01**
Rank					
Assistant	2.48 (1.12)	11	1.79 (0.75)	8	.15
Associate	2.65 (1.56)	32	2.10 (1.27)	10	.32
Full	2.94 (1.51)	37	1.17 (0.33)	4	.03*

Note. Sig. indicates two-tailed significance. † $p < .10$. * $p < .05$. ** $p < .01$

Given that men both endorse sexism (Swim et al., 1995) and are critical of evidence of gender bias (Handley et al., 2015) more than women, we examined whether the effects of condition depended on participant gender by conducting 2 (Time) × 2 (Condition) × 2 (Gender: men vs. women) mixed ANOVAs for each DV. Although these effects should be considered cautiously given the small cell size for women (standard $n = 9$, experimental $n = 11$), the only significant main effect of Gender was for stereotype endorsement (but not feelings toward women or local norms, ps > .25), $F(1, 70) = 7.53$, $p < .01$, $\eta_p^2 = .10$. Women endorse stereotypes less (pre-campaign: $M = 1.88$, $SD = 0.99$; post-campaign: $M = 1.78$, $SD = 0.98$) than men (pre-campaign: $M = 2.64$, $SD = 1.48$; post-campaign: $M = 2.84$, $SD = 1.40$). Beyond this main effect, the Time × Condition interactions were still significant when including Gender. There were no significant 3-way interactions between Time, Condition, and Gender for any DV, all ps > .19. Although the analyses of Gender are low in power, Gender appeared to have little influence on the results, beyond the main effect expected from past research. Thus, the findings concerning

the hypothesis (i.e., Time × Condition interactions) apply equally to men and women, although women overall endorse stereotypes less than men.

To further explore whether demographic factors influenced the main finding, we conducted similar analyses for race/ethnicity, via 2 (Time) × 2 (Condition) × 2 (Race/Ethnicity: White or person of color) mixed ANOVAs for each DV. There were no significant main effects or interactions for Race/Ethnicity, all *p*s > .15. The Time x Condition interaction was significant for local norms, $F(1, 51) = 5.50$, $p = .02$, $\eta_p^2 = .10$, but there were no significant main effects or interactions for feelings toward women or stereotype endorsement, all *p*s > .11. These results should be interpreted cautiously given small cell sizes (people of color in the standard condition, $n = 4$, and experimental condition, $n = 11$). At this level of granularity, the analyses are underpowered, making it difficult to detect condition effects even if they exist.

We also examined whether results depended on faculty rank via 2 (Time) × 2 (Condition) × 3 (Rank: Assistant, Associate, Full) mixed ANOVAs for each DV. There were no significant main effects or interactions for Rank, all *p*s > .11. When including Rank, the Time × Condition interactions were still significant for feelings toward women, $F(1, 66) = 6.13$, $p = .02$, $\eta_p^2 = .09$, and local norms, $F(1, 54) = 7.08$, $p = .01$, $\eta_p^2 = .12$. However, the Time x Condition interaction for stereotype endorsement became a marginal effect with the addition of Rank, $F(1, 70) = 3.09$, $p = .08$, $\eta_p^2 = .04$.

Finally, we examined whether results depended on institution type via 2 (Time) × 2 (Condition) × 2 (University: public vs. private) mixed ANOVAs for each DV. There were no significant main effects or interactions for University, all *p*s > .11, except for Time × University for the feelings toward women, $F(1, 69) = 16.89$, $p < .001$, $\eta_p^2 = .20$; however, the Time × Condition interactions were still significant for feelings toward women, $F(1, 69) = 18.45$, $p <$

.001, η_p^2 = .21, local norms, $F(1, 56) = 5.57$, p = .02, η_p^2 = .09, and stereotype endorsement, $F(1, 73) = 5.98$, p = .02, η_p^2 = .08.

Although women overall endorse stereotypes less than men, these exploratory analyses revealed that the findings concerning the hypothesis (i.e., Time × Condition interactions) generally apply across gender, race/ethnicity, faculty rank, and type of university. After exploring the results within the context of gender, race/ethnicity, faculty rank, and type of university, the pattern remained that participants in the standard condition had marginally more positive feelings toward women in STEM after the campaign, whereas participants in the experimental condition had more negative feelings post-campaign.

Discussion

Past research has demonstrated that persuasive messages that are simultaneously personally relevant to the recipient and provide means to increase self-efficacy are likely to result in a challenge response that improves attitudes (e.g., Schneider et al., 2009), but such messages had not been previously tested outside the lab and/or in the context of the STEM workplace. After creating and implementing a six-week, evidence-based persuasive campaign featuring three posters and four mailings, we employed a quasi-experimental field study to examine the effects of standard (i.e., fact-based stereotype-disconfirming) and experimental messages (i.e., similar messages designed to evoke greater personal relevance and efficacy) on attitudes, norms, and stereotypes concerning women in STEM. The standard condition marginally increased positive feelings toward women in STEM but did not affect perceived local norms or stereotype endorsement. Contrary to research on persuasion in other applied contexts, the experimental condition *reduced* positive feelings toward women in STEM, increased perceptions of

stereotypical local norms, and marginally increased stereotype endorsement. These effects tended to apply across faculty gender, race/ethnicity, and rank.

We hypothesized that attitudes would improve in both the standard and experimental conditions. Although we found an opposite effect in the experimental condition, we did find that faculty exposed to the standard condition had marginally more positive feelings toward women in STEM, even with an audience that is likely familiar with the topic. Past research suggested that approach-oriented messages would be more effective in positive contexts (Higgins, 2005), and we characterized women in STEM as being a positive context in which individuals are likely to have a promotion (vs. prevention) focus. That the standard condition may have increased positive feelings toward women in STEM provides limited evidence that this approach can be effective. The biobehavioral model of persuasion (Schneider et al., 2009) also draws from research on approach orientation and was the basis for developing the experimental messages with more personal relevance and self-efficacy. However, the experimental condition was unsuccessful in our research, in that it had worse outcomes over time in comparison to the standard condition.

One possible explanation for the finding that messages with greater personal relevance and efficacy backfired is that faculty in our sample experienced “reactance” in response to the experimental message (Whitehead & Witting, 2004). It is possible that the messages in the experimental condition evoked too much personal responsibility relative to the efficacy intended to help solve the problem of underrepresentation of women in STEM, resulting in a threat response rather than the desired challenge response. Among this sample, the topic of underrepresentation might already be highly relevant to their profession, resulting in threat. Consistent with past research on reactance against anti-prejudice messages (Legault et al., 2011;

Maio et al., 2008; Vrij et al., 2003), STEM faculty may have seen the experimental messages with more personal relevance and efficacy as exerting social pressure, causing more negative feelings and perceived norms toward women in STEM after the campaign.

Findings concerning local norms indicated that faculty exposed to the experimental condition later perceived more gender stereotyping within the university community. The perception that others hold stereotypical views of women in STEM may increase stereotyping and discrimination at the individual level (Pederson et al., 2005). On the other hand, perceiving the local norms as more stereotypical may show greater awareness of problems facing women in STEM in the academy and at the university specifically. Recognizing stereotypical norms may be less threatening than recognizing one's own potential bias, which could make awareness of local norms an important first step to reducing stereotyping within that context (Perry et al., 2015). If increased perception of stereotypical norms was not coupled with colder feelings toward women in STEM and marginally higher stereotype endorsement, we would be more optimistic that the experimental condition enhanced awareness of bias in a positive way. Additional research is needed to examine the effects of these perceived norms on attitudes, feelings, and behavior, but recent research in this area has shown promise. Posters and videos communicating pro-diversity local norms increased positive attitudes toward marginalized groups among non-marginalized students, while also increasing belonging, perceptions of fair treatment, and academic performance among marginalized students (Murrar et al., 2020).

Limitations and Future Directions

Although the pre-post design is one of the most commonly used designs for evaluation (Mohr, 1988), it has limitations. Including a pre-test eliminates some alternative explanations for the results in a quasi-experimental study, but it is possible that the observed changes resulted

from something other than the campaign. The present study had comparison groups rather than a true "control" group; future research including a no treatment control group could examine change over time without exposure to anti-prejudice messages. However, the results showed different effects over time between the comparison conditions; this pattern suggests that the messages differently influenced feelings, perceived norms, and stereotypes about women in STEM over time. In addition, departments were matched and randomly assigned to a message condition, which eliminates historical confounds and/or confounds related to a single university.[2] However, individuals are nested within departments, and the sample size was not sufficient to further examine or control for effects of department or discipline. Selection bias is also a concern, as participants were self-selected, though similar patterns were shown across participants who completed only one survey and participants who completed both. When interventions are optional, it is often the case that those who need it the most are least likely to participate. Missing data also may have influenced the results; the limited effects may have been related to participants who completed both surveys being more concerned with issues for women in STEM.

There are other limitations of this study's messaging conditions. The experimental condition aimed to manipulate both personal relevance and efficacy, based on the biobehavioral model. Previous research had fully crossed personal relevance and efficacy and supported the use of "challenge" (i.e., more personal relevance and efficacy) messages in real-world contexts (e.g., Schneider et al., 2009). Although this approach was consistent with past recommendations (Vrij

[2] Although historical events would not explain differences between conditions, the historical context may be a factor in these findings. This study predated social movements related to gender (e.g., #MeToo) and broader diversity initiatives on these campuses. The only exception concerning campus diversity initiatives is training on implicit gender bias, which was delivered to some STEM departments in the year preceding this study (see Jackson et al., 2014).

et al., 2003; Walton, 2014) by being grounded in theory, it is unclear if one component of the campaign and/or manipulation was responsible for the effects. The individual and combined effects of personal relevance and efficacy cannot be examined, although future research could parse the individual effects of these factors. The persuasion campaign also included a variety of messages and topics (e.g., implicit bias, mentoring, collaboration, positive effects of diversity). It is impossible to pinpoint which of the messages or topics were more influential or successful. A laboratory study, focused on the individual messages or topics (e.g., Vrij & Smith, 1999) could elucidate the features that increase or decrease effectiveness. It could also more carefully control for variables such as message length. In our quasi-experimental field study, however, we hoped to maximize the potential of the campaign by using multiple modes of communication (e.g., fliers and posters) and messages. Still, the degree of exposure to these messages and conditions was not measured, though we aimed to increase the likelihood that faculty noticed at least some of the campaign materials by using faculty mailboxes for both mailings and surveys.

Future research could investigate whether reactance and other factors influence the effectiveness of anti-prejudice campaigns. Additional mediators to consider include intergroup threat and self-regulation of bias. Experimental condition messages could have heightened intergroup threat by using “you/your” and including specific disciplines, and the directives meant to increase efficacy could have reduced perceptions of autonomy. Future research comparing individual (e.g., “you/your”) to collective (i.e., “we/us/our”) language could examine whether the latter may increase personal relevance without blaming individuals. Our research highlights the need for self-selected goals to increase the effectiveness of anti-prejudice interventions and provides additional evidence of its importance in the context of women in STEM specifically. Future research is needed to develop interventions to encourage self-selection of diversity

promoting goals, which is a challenge because those most in need of intervention may be least likely to be persuaded by anti-prejudice messages and to voluntarily support diversity initiatives.

Intersectionality should be considered in the development and delivery of anti-prejudice messages, and future research should explore how recipients across intersecting identities respond to persuasive messaging. This study examined the effects of gender across race/ethnicity, rank, and institution. There were few significant findings, with gender differences only appearing for stereotype endorsement among full professors and within the public institution. The sample size suggests caution in interpreting these findings and limited further exploration of intersecting identities. Further, the demographic variables included in this study are not the only intersections of identity that should be examined in the STEM academy.

A great deal of research has focused on the initial hiring and promotion of women faculty in STEM fields, but there is little research that compares the experiences and attitudes of junior and senior faculty. White women unconsciously supporting the systems that allowed them to attain positions in the academy (Doerr et al., 2021), and so women of higher rank might also unconsciously maintain that the advancement process is fair as a means of justifying their own promotion. This possibility needs to be investigated in future studies. There are also differences in the type and amount of service required of women at different ranks (Carrigan et al, 2011; O'Meara et al., 2017), which can affect work-life balance, job satisfaction, and perceptions of fairness. Although there is some evidence that the STEM academic gender pay gap has been closing in recent decades (Tao, 2018), Renzulli et al. (2013) found that the interaction of institution type, discipline, and rank was a better predictor of pay differences in men and women faculty than looking at each of these variables independently, even after controlling for

productivity. Further research is needed to examine the intersection of gender and identity variables and how these interactions affect the experience of women faculty in the academy.

The strength of this study includes examining the longitudinal effects of an intervention aimed at faculty in STEM. It contributes to field research on the effects of anti-prejudice campaigns (e.g., Paluck, 2009) and extends this research by examining attitudes, norms, and stereotypes concerning women in STEM within the academy. This study was translational in that it used theory- and research-based evidence to create a persuasive campaign and tested this campaign in the field and over time. Messages with more personal relevance and efficacy may have created some reactance in our knowledgeable audience, but negative effects were avoided in the standard campaign. Combined with future research, these findings suggest ways we can increase the effectiveness of anti-prejudice campaigns in real-world contexts, thereby increasing women's representation and advancement in STEM and working toward institutional transformation.

Amy L. Hillard is an Assistant Professor of Psychology at Northwest Missouri State University. Dr. Hillard is a social psychologist who studies prejudice and stereotyping. She received her Ph.D. in Psychology from the University of Nebraska-Lincoln and completed a postdoctoral fellowship through an NSF ADVANCE grant, which examined workplace issues for women in STEM. Her research examines methods to reduce prejudice and stereotyping in everyday interactions (e.g., confronting prejudice) and in organizations (e.g., implicit bias training and educational interventions). Her research has been published in outlets such as Sex Roles, Analyses of Social Issues and Public Policy, and Social Psychology of Education.

Tamera Schneider recently joined The City University of New York as Associate Vice Chancellor for Research. Prior to that she was Social Psychology Program Director then Deputy for the Division of Behavioral and Cognitive Sciences at the National Science Foundation, and Professor of Psychology in the College of Science and Mathematics at Wright State University. She obtained a Ph.D. in Social/Health Psychology from Stony Brook University and was a postdoctoral fellow at Yale University. Her research interests include stress resilience, persuasion for health, emotionally intelligent teams, and parity in STEM.

Sarah M. Jackson is an Adjunct Associate Professor of Psychology at Wright State University and a Psychology Instructor at the Modern College of Design. Having received her Ph.D. in Human Factors and Industrial-Organizational Psychology from Wright State, she has taught research methods, social psychology, and health psychology there for over 10 years. Her research focuses primarily on implicit bias and educational assessments. Dr. Jackson was a graduate research assistant for an NSF ADVANCE grant, focused on advancing women in

STEM, and she also assisted in an assessment of local climate change attitudes to inform a persuasion campaign targeting sustainability practices.

Acknowledgements

This research was part of a larger study supported by NSF ADVANCE HRD 0810989. We would also like to thank Emily Polander (Wright State University) and J. Danny Robinson (University of Dayton) for their contributions to message development, as well as Alex D. Arnett and Aaron D. Fowler for their contributions as research assistants. This work was completed while one of the authors (Schneider) was serving at the National Science Foundation. The views expressed in this manuscript are solely those of the authors and do not necessarily represent those of NSF.

References

Armstrong, M. A., & Jovanovic, J. (2015). Starting at the crossroads: Intersectional approaches to institutionally supporting underrepresented minority women STEM faculty. *Journal of Women and Minorities in Science and Engineering*, *21*(2), 141-157.

Brehm, J. W. (1966). *A theory of psychological reactance.* New York: Academic Press.

Carrigan, C., Quinn, K., & Riskin, E. A. (2011). The gendered division of labor among STEM faculty and the effects of critical mass. *Journal of Diversity in Higher Education*, *4*(3), 131-146. doi:10.1037/a0021831

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology*, *6*(49), 1-8. doi:10.3389/fpsyg.2015.00049

Colby, G. & Fowler, C. (2020). *Data snapshot: IPEDS data on full-time women faculty and faculty of color.* American Association of University Professors. https://www.aaup.org/sites/default/files/Dec-2020_Data_Snapshot_Women_and_Faculty_of_Color.pdf

Dasgupta, N. (2013). Implicit attitude and beliefs adapt to situations: A decade of research on the malleability of implicit prejudice, stereotypes, and self-concept. *Advances in Experimental Social Psychology*, *47*, 233-279. doi:10.1016/B978-0-12-407236-7.00005-X

Dasgupta, N., & Asgari, S. (2004). Seeing is believing: Exposure to counterstereotypic women leaders and its effect on the malleability of automatic gender stereotyping. *Journal of Experimental Social Psychology, 40*, 642-658. doi:10.1016/j.jesp.2004.02.003

Dickter, C., Forestell, C. A., Stevens, J. A., Hunt, P. S., & Porter, C. M. (2019). Implicit gender bias, engagement, and protective factors in STEM faculty. *The ADVANCE Journal, 1*. doi:10.5399/osu/ADVJRNL.1.1.6

Doerr, K., Riegle-Crumb, C., Russo-Tait, T., Takasaki, K., Sassler, S., & Levitte, Y. (2021). Making merit work at the entrance to the engineering workforce: Examining women's experiences and variations by race/ethnicity. *Sex Roles, 85*(7), 422-439. doi:10.1007/s11199-021-01233-6

Donovan, R. J., & Leivers, S. (1993). Using paid advertising to modify racial stereotype beliefs. *Public Opinion Quarterly, 57*, 205-218.

Dover, T. L., Major, B., & Kaiser, C. R. (2014). Diversity initiatives, status, and system-justifying beliefs: When and how diversity efforts de-legitimize discrimination claims. *Group Processes and Intergroup Relations, 17*, 485-493.

Duguid, M. M., & Thomans-Hunt, M. C. (2015). Condoning stereotyping? How awareness of stereotyping prevalence impacts expression of stereotypes. *Journal of Applied Psychology, 100*, 343-339. doi:10.1037/a0037908

Durodoye, R., Gumpertz, M., Wilson, A., Griffith, E., & Ahmad, S. (2020). Tenure and promotion outcomes at four large land grant universities: Examining the role of gender, race, and academic discipline. *Research in Higher Education, 61*(5), 628-651. doi:10.1007/s11162-019-09573-9

Folkman, S., Lazarus, R. S., Gruen, R. J., Rand, J., & DeLongis, A. (1986). Appraisal, coping, health status, and psychological symptoms. *Journal of Personality and Social Psychology, 50*, 571-579.

Griffith, E. E., & Dasgupta, N. (2018). How the demographic composition of academic science and engineering departments influences workplace culture, faculty experience, and retention risk. *Social Sciences, 7*(5), 71-95. doi:10.3390/socsci7050071

Guerin, B. (2005). Combating everyday racial discrimination without assuming racists or racism: New intervention ideas from a contextual analysis. *Behavior and Social Issues, 14*, 46-70.

Gumpertz, M., Durodoye, R., Griffith, E., & Wilson, A. (2017). Retention and promotion of women and underrepresented minority faculty in science and engineering at four large land grant institutions. *PloS one*, *12*(11), 1-17. doi:10.1371/journal.pone.0187285

Handley, I. M., Brown, E. R., Moss-Racusin, C. A., & Smith, J. L. (2015). Quality of evidence revealing subtle gender biases in science is in the eye of the beholder. *Proceedings of the National Academy of Sciences, 112*, 13201-13206, doi:10.1073/pnas.1510649112

Higgins, E. T. (2005). Value from regulatory fit. *Current Directions in Psychological Science, 14*, 209-213.

Hill, M. E., & Augoustinos, M. (2001). Stereotype change and prejudice reduction: Short- and long-term evaluation of a cross-cultural awareness programme. *Journal of Community and Applied Social Psychology, 11*, 243-262.

Hoh, Y. K. (2009). Using notable women in environmental engineering to dispel misperceptions of engineers. *International Journal of Environmental and Science Education, 4*, 117-131.

Hopewell, L., McNeely, C. L., Kuiler, E. W., & Hahm, J. O. (2009). University leaders and the public agenda: Talking about women and diversity in STEM fields. *Review of Policy Research*, *26*(5), 589-607.

Jackson, J. K., Latimer, M., & Stoiko, R. (2017). The dynamic between knowledge production and faculty evaluation: Perceptions of the promotion and tenure process across

disciplines. *Innovative Higher Education, 42*(3), 193-205. doi:10.1007/s10755-016-9378-3

Jackson, S. M., Hillard, A. L., & Schneider, T. S. (2014). Using implicit bias training to improve attitudes toward women in STEM. *Social Psychology of Education, 17*, 419-438. doi:10.1007/s11218-014-9259-5

Jost, J. T., Banaji, M. R., & Nosek, B. A. (2004). A decade of system justification theory: Accumulated evidence of conscious and unconscious bolstering of the status quo. *Political psychology*, *25*(6), 881-919.

Lautenberger, D. M., & Dandar, V. M. (2020). *The state of women in academic medicine 2018-2019: exploring pathways to equity*. Association of American Medical Colleges. https://www.aamc.org/data-reports/data/2018-2019-state-women-academic-medicine-exploring-pathways-equity

Legault, L., Gutsell, J. N., & Inzlicht, M. (2011). Ironic effects of antiprejudice messages: How motivational interventions can reduce (but also increase) prejudice. *Psychological Science, 22*, 1472-1477. doi:10.1177/0956797611427918.

Li, D., & Koedel, C. (2017). Representation and salary gaps by race-ethnicity and gender at selective public universities. *Educational Researcher, 46*(7), 343-354. doi:10.3102/0013189X17726535

Lisnic, R., Zajicek, A., & Kerr, B. (2020). Women faculty in STEM disciplines: Experiences with the tenure process and departmental practices. *Humanity & Society*, 1-26. doi:10.1177/0160597620978773

Maio, G. R., Haddock, G., Watt, S. E., & Hewstone, M. (2008). Implicit measures and applied contexts: An illustrative examination of antiracism advertising. In R. Petty, R. Fazio, &

P. Brinol (Eds.), *Attitudes: Insights from the new wave of implicit measures* (pp. 327-357). New York: Psychology Press.

McNeely, C. L., & Vlaicu, S. (2010). Exploring institutional hiring trends of women in the US STEM professoriate. *Review of Policy Research, 27*(6), 781-793.

Mohr, L. B. (1988*). Impact analysis for program evaluation.* Dorsey: Chicago.

Monteith, M. J. (1993). Self-regulation of prejudiced responses: Implications for progress in prejudice reduction efforts. *Journal of Personality and Social Psychology, 65,* 469-485.

Monteith, M. J., Ashburn-Nardo, L., Voils, C. I., & Czopp, A. M. (2002). Putting the brakes on prejudice: On the development and operation of cues for control. *Journal of Personality and Social Psychology, 83,* 1029-1050.

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the United States of America, 109,* 16474-16479.

Murrar, S., Campbell, M. R., & Brauer, M. (2020). Exposure to peers' pro-diversity attitudes increases inclusion and reduces the achievement gap. *Nature Human Behavior, 4*(9), 889-897. doi:10.1038/s41562-020-0899-5

National Academy of Sciences. (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*, Washington, D.C.: National Academies Press.

National Science Board. (2020). *The state of U.S. science and engineering*. NSB-2020-1. Alexandria, VA: National Science Foundation. Available at https://ncses.nsf.gov/pubs/nsb20201

National Center for Science and Engineering Statistics (NCSES). (2021). *Women, minorities, and persons with disabilities in science and engineering.* NSF 21-321. Alexandria, VA: National Science Foundation. Available at https://ncses.nsf.gov/pubs/nsf21321/

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics, 6,* 101-115.

O'Brien, L. T., Garcia, D. M., Adams, G., Villalobos, J. G., Hammer, E., & Gilbert, P. (2015). The threat of sexism in a STEM educational setting: The moderating impacts of ethnicity and legitimacy beliefs on test performance. *Social Psychology of Education, 18*(4), 667-684. doi:10.1007/s11218-015-9310-1

O'Meara, K., Kuvaeva, A., Nyunt, G., Waugaman, C., & Jackson, R. (2017). Asked more often: Gender differences in faculty workload in research universities and the work interactions that shape them. *American Educational Research Journal, 54*(6), 1154–1186. doi:10.3102/0002831217716767

O'Meara, K., Lennartz, C. J., Kuvaeva, A., Jaeger, A., & Misra, J. (2019). Department conditions and practices associated with faculty workload satisfaction and perceptions of equity. *The Journal of Higher Education*, *90*(5), 744-772. doi:10.1080/00221546.2019.1584025

Paluck, E. L. (2009). Reducing intergroup prejudice and conflict using the media: A field experiment in Rwanda. *Journal of Personality and Social Psychology, 96*, 574-587.

Pedersen, A., Walker, I., & Wise, M. (2005). "Talk does not cook rice": Beyond anti-racism rhetoric to strategies for social action. *Australian Psychologist, 40*(1), 20-30.

Perry, S. P., Murphy, M. C., & Dovidio, J. F. (2015). Modern prejudice: Subtle, but unconscious? The role of bias awareness in Whites' perceptions of personal and others'

biases. *Journal of Experimental Social Psychology, 61,* 64-78. doi:10.1016/j.jesp.2015.06.007

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology, 19,* 123-205. doi:10.1016/S0065-2601(08)60214-2

Petty, R. E., Cacioppo, J. T., & Goldman, R. (1981). Personal involvement as a determinant of argument-based persuasion. *Journal of Personality and Social Psychology, 41*, 847-855.

Phills, C. E., Santelli, Al. G., Kawakami, K., Struthers, C. W., & Higgins, E. T. (2011). Reducing implicit prejudice: Matching approach/avoidance strategies to contextual valence and regulatory focus. *Journal of Experimental Social Psychology, 47,* 968-973. doi:10.1016/j.jesp.2011.03.013

Pietri, E. S., Moss-Racusin, C. A., Dovidio, J. F., Guha, D., Roussos, G., Berscoll, V. L., & Handlesman, J. (2017). Using video to increase gender bias literacy toward women in science. *Psychology of Women Quarterly, 41*, 175-196. doi:10.1177/0361684316674721

Renzulli, L. A., Reynolds, J., Kelly, K., & Grant, L. (2013). Pathways to gender inequality in faculty pay: The impact of institution, academic division, and rank. *Research in Social Stratification and Mobility*, *34,* 58-72. doi:10.1016/j.rssm.2013.08.004

Rosen, B., & Mericle, J. F. (1979). Influence of strong versus weak fair employment policies and applicant's sex on selection decisions and salary recommendations in a management simulation. *Journal of Applied Psychology, 64*, 435-439.

Schmader, T., Johns, M., & Barquissau, M. (2004). The costs of accepting gender differences: The role of stereotype endorsement in women's experience in the math domain. *Sex Roles, 50,* 835-850.

Schneider, T. R., Feufel, M. A., & Berkel, H. J. (2011). Promoting colorectal cancer screening in

public health outreach campaigns. *Human Factors, 53,* 637-646.

Schneider, T. R., Rivers, S. E., & Lyons, J. B. (2009). The biobehavioral model of persuasion: Generating challenge appraisals to promote health. *Journal of Applied Social Psychology, 38*, 1928-1952.

Settles, I. H., Cortina, L. M., Malley, J., & Stewart, A. J. (2006). The climate for women in academic science: The good, the bad, and the changeable. *Psychology of Women Quarterly, 30*(1), 47-58.

Shea, C. M., Young, J. R., Banyard, V., Malone, M. T., Graham, K. J., & Byron, G. (2019). Recognizing and intervening in bias incidents in the academic workplace: A self-categorization theory perspective. *The ADVANCE Journal, 1*. https://doi.org/10.5399/osu/ADVJRNL.1.1.2

Sheridan, J., Savoy, J. N., Kaatz, A., Lee, Y. G., Filut, A., & Carnes, M. (2017). Write more articles, get more grants: the impact of department climate on faculty research productivity. *Journal of Women's Health*, *26*(5), 587-596. DOI: 10.1089/jwh.2016.6022

Swim, J. K., Aikin, K. J., Hall, W. S., & Hunter, B. A. (1995). Sexism and racism: Old-fashioned and modern prejudices. *Journal of Personality and Social Psychology, 68*, 199-214.

Tao, Y. (2018). Earnings of academic scientists and engineers: intersectionality of gender and race/ethnicity effects. *American Behavioral Scientist*, *62*(5), 625-644. doi: 10.1177/0002764218768870

Vrij, A., Akehurst, L., & Smith, B. (2003). Reducing ethnic prejudice: An evaluation of seven recommended principles for incorporation in public campaigns. *Journal of Community and Applied Social Psychology, 13,* 284-299.

Vrij, A., & Smith, B. (1999). Reducing ethnic prejudice by public campaigns: An evaluation of a present and new campaign. *Journal of Community and Applied Social Psychology, 9,* 195-215.

Vrugt, A. (1992). Preferential treatment of women and psychological reactance theory: An experiment. *European Journal of Social Psychology, 22*, 303-307.

Walton, G. W. (2014). The new science of wise psychological interventions. *Current Directions in Psychological Science, 23*, 73-82. doi:10.1177/0963721413512856

Walton, G. W., Logel, C., Peach, J. M., Steven, S. J., & Zanna, M. J. (2015). Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. *Journal of Educational Psychology, 107*, 468-485. doi:10/1037/a0037461

Whitehead, K. A., & Wittig, M. A. (2004). Discursive management of resistance to a multicultural education programme. *Qualitative Research in Psychology, 1*, 267-284.

Whittingham, J., Ruiter, R. A. C., Zimbile, F., & Kok, G. (2008). Experimental pre-testing of public health campaigns: A case study. *Journal of Health Communications, 13*, 216-229. doi:10.1080/10810730701854045.

Zawadzki, M. J., Danube, C. L., & Shields, S. A. (2012). How to talk about gender inequity in the workplace: Using WAGES as an experimental learning tool to reduce reactance and promote self-efficacy. *Sex Roles, 67*, 605-616. doi:10.1007/s11199-012-0181-z