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Ethnic Variation in Gender-STEM Stereotypes and STEM Participation: An Intersectional Approach

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Stereotypes associating men and masculine traits with science, technology, engineering, and mathematics (STEM) fields are ubiquitous, but the relative strength of these stereotypes varies considerably across cultures. The present research applies an intersectional approach to understanding ethnic variation in gender-STEM stereotypes and STEM participation within an American university context. African American college women participated in STEM majors at higher rates than European American college women (Study 1, Study 2, and Study 4). Furthermore, African American women had weaker implicit gender-STEM stereotypes than European American women (Studies 2–4), and ethnic differences in implicit gender-STEM stereotypes partially mediated ethnic differences in STEM participation (Study 2 and Study 4). Although African American men had weaker implicit gender-STEM stereotypes than European American men (Study 4), ethnic differences between men in STEM participation were generally small (Study 1) or nonsignificant (Study 4). We discuss the implications of an intersectional approach for understanding the relationship between gender and STEM participation.

Keywords: gender stereotypes, STEM, intersectionality

In the United States, women are less likely than men to participate in fields related to science, technology, engineering, and mathematics (STEM; Ceci & Williams, 2007; Hill, Corbett, & St. Rose, 2010). There are many different ways to index STEM participation including initial choice of STEM as a college major, obtaining a bachelor's degree in a STEM field, choosing to attend graduate school in a STEM field, obtaining an advanced STEM degree, and holding an occupation in a STEM field. At almost every step in the so-called STEM pipeline, women are underrepresented relative to men; moreover, these gaps tend to be larger at more elite levels of STEM participation (e.g., Hill et al., 2010). Increasing gender diversity in STEM fields is a key goal of the National Science Foundation (NSF), and research on factors that contribute to the lack of gender diversity in STEM has increased dramatically in recent years (e.g., Cheryan, Plaut, Davies, & Steele, 2009; Diekman, Clark, Johnston, Brown, & Steinberg, 2011; Kiefer & Sekaquaptewa, 2007a; Murphy, Steele, & Gross, 2007; Nosek, Banaji, & Greenwald, 2002; Stout, Dasgupta, Hunsinger, & McManus, 2011).

Stereotypes that associate STEM with men and masculinity are one of the key culprits that contribute to the gender disparity in STEM participation (e.g., Kiefer & Sekaquaptewa, 2007b; Nosek et al., 2002; Nosek & Smyth, 2011). Stereotypes associating men and masculine traits, such as independence, with STEM fields are ubiquitous, exist at both explicit and implicit levels, and contribute to the gender gap in STEM outcomes through multiple pathways (e.g., Cheryan et al., 2009; Diekman, Clark, et al., 2011; Nosek et al., 2009; Schmader, Johns, & Barquissau, 2004). For example, gender-STEM stereotypes can affect evaluations of students, such that faculty are more likely to offer mentoring and job recommendations to men than to women (Moss-Racusin, Dovidio, Brescoll, & Graham, 2012). In addition, gender-STEM stereotypes can artificially decrease women's performance on STEM tests due to stereotype threat (e.g., Spencer, Steele, & Quinn, 1999) and artificially inflate men's performance on STEM tests due to stereotype lift (Walton & Cohen, 2003). Furthermore, gender-STEM stereotypes can decrease expectations of success and valuing of STEM among girls and women, while increasing expectations of success

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and valuing of STEM among boys and men (Eccles, 2007). Moreover, gender-STEM stereotypes can alter people's goals and interest in pursuing STEM careers (Cheryan et al., 2009; Diekman, Brown, Johnston, & Clark, 2010; Diekman et al., 2011). In sum, because there are so many potential mechanisms through which gender-STEM stereotypes affect STEM outcomes, stereotypes have far-ranging effects and become self-reinforcing as they shape the career goals, performance, and interests of women and men in ways that are consistent with the stereotypes (Nosek & Smyth, 2011).

Gender-STEM stereotypes are widespread; however, they may not be monolithic. Although cultural, regional, and ethnic variation in gender-STEM stereotypes has not been widely studied to date, some recent evidence suggests that gender-STEM stereotypes vary in strength across settings (Nosek et al., 2007; Nosek et al., 2009). Likewise, evidence suggests that the gender gap in STEM participation and performance may vary across nations (e.g., Nosek et al., 2009). The goal of the present research is to use an intersectional approach to examine African American and European American college women's gender-STEM stereotypes, participation in STEM majors, and the potential role of gender-STEM stereotypes in predicting ethnic differences in STEM participation.

An intersectional approach to the study of gender and ethnicity emphasizes that the dynamics of gender play out differently across different ethnic groups (e.g., Cole, 2009; Galinsky, Hall, & Cuddy, 2013; Purdie-Vaughns, & Eibach, 2008). Stereotypes that associate STEM with "masculine" characteristics, such as independence and agency, may contribute to ethnic variation in gendered constructions of STEM (Diekman et al., 2010; Diekman et al., 2011).[1] A growing body of work in psychology examines ethnic variation in the social constructions of gender and suggests that gendered conceptions of independence and agency as "masculine" are stronger among European Americans than African Americans (e.g., Binion, 1990; Black & Peacock, 2011; Goff, Thomas, & Jackson, 2008; Kane, 2000; Landrine, 1985; Livingston, Rosette, & Washington, 2012; Robinson, 1983). For example, although conventional gender stereotypes portray women as dependent, passive, and emotional, racialized variations of gender stereotypes portray European American women as more dependent, passive, and emotional than African American women (Landrine, 1985; see also Galinsky et al., 2013). Similarly, observers note that African Americans value independence and self-reliance in women to a greater extent than European Americans (Black & Peacock, 2011; Kane, 2000; Robinson, 1983). These different social constructions of gender among African Americans and European Americans may have important implications for both stereotypes associating STEM with men and for the underrepresentation of women in STEM.

The Intersectionality Hypothesis

We propose that the participation of women in college STEM majors may vary across African Americans and European Americans due to ethnic variation in constructions of gender—an idea we refer to as the intersectionality hypothesis. Compared with European Americans, the association between STEM and men may be weaker among African Americans because the traits stereotypically associated with STEM (e.g., independence) are not considered highly masculine in African American culture. The first prediction derived from the intersectionality hypothesis is that implicit gender-STEM stereotypes will be weaker among African Americans than among European Americans. Furthermore, an intersectional approach suggests that ethnic variation in gender-STEM stereotypes will contribute to ethnic variation in women's STEM outcomes. Thus, the second prediction derived from the intersectionality hypothesis is that African American women will be more interested in participating in STEM than European American women. Finally, the third prediction derived from the intersectionality hypothesis is that ethnic variation in implicit gender-STEM stereotypes will mediate differences between African American and European American women in STEM participation.

Research examining variation in implicit gender-STEM stereotypes across international respondents provides preliminary support for the first prediction of the intersectionality hypothesis. Harvard's Project Implicit Web site includes an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) that measures the relative strength of implicit tendencies to associate STEM with men versus with women. Respondents who identified as Black held weaker implicit gender-STEM stereotypes compared with respondents who identified as White (Nosek et al., 2007). Data from the National Education Longitudinal Study (NELS) provides support for the second prediction of the intersectionality hypothesis regarding ethnic variation in women's STEM outcomes. African American college women were more likely than European American college women to expect to complete a degree in science by age 30 and were more likely to plan a career in science (Hanson, 2006). In addition, African American women were more likely than European American women to initially choose STEM majors, especially after statistically accounting for group differences in academic preparation (Riegle-Crumb & King, 2010).

Finally, in line with the third prediction derived from the intersectionality hypothesis, there is reason to believe that differences between African Americans and European Americans in implicit gender-STEM stereotypes may contribute to ethnic variation in women's interest in STEM. For example, national variation in the strength of implicit gender-STEM stereotypes is related to national variation in the gendered nature of STEM outcomes (Nosek et al., 2009). Using the IAT, Nosek et al. (2009) measured implicit gender-STEM stereotypes in 34 countries. Although the tendency to implicitly associate STEM with men was evident across national settings, the average effect size varied widely, from $d = .26$ in Jordan to $d = .65$ in Tunisia ($d = .38$ in the United States). Furthermore, cross-national variation in implicit associations between STEM and men (i.e., gender-STEM stereotypes) predicted variation in the magnitude of gender differences in math and science achievement. That is, countries with large average gender-STEM stereotypes also had large gender differences in 8th-grade math and science achievement, favoring boys over girls.

Overview

In the present research, we examine ethnic variation in gender-STEM stereotypes and STEM participation among African American and European American college students. The present re-

[1] For other sources of variation in gendered constructions of STEM, see Eisenhart and Holland (1992).

search builds upon past research in important ways. First, the present work extends a growing body of work on intersectionality (e.g., Cole, 2009; Purdie-Vaughns & Eibach, 2008) by applying an intersectional perspective to research on gender, gender-STEM stereotypes, and STEM outcomes. With a few exceptions (e.g., Gonzales, Blanton, & Williams, 2002; Shih, Pittinsky, & Ambady, 1999), past research on gender, gender-STEM stereotypes, and STEM outcomes has not considered how women from ethnic minority groups are affected by gender-STEM stereotypes. By focusing on ethnic variation in gender-STEM stereotypes within the U.S., we extend past research on group differences in gender-STEM stereotypes (e.g., Nosek et al., 2009).

In Study 1, we sought to examine participation in STEM majors versus other majors as a function of gender and ethnicity. We obtained data from a large, publically available, national data set that surveyed college freshman at institutions across the country over a 10-year period. We predicted that, compared with European American women, African American would be more likely to be STEM majors. In Study 2, we administered measures to African American and European American university women to test for ethnic variation in women's gender-STEM stereotypes and STEM participation. We predicted that African American women would have weaker gender-STEM stereotypes and be more likely to be STEM majors as compared with European American women and that the ethnic differences in gender-STEM stereotypes would mediate ethnic differences in women's STEM participation. In Study 3, we examined ethnic differences in gender-STEM stereotypes among a sample comprised only of STEM majors. Women majoring in STEM fields tend to have weaker gender-STEM stereotypes than women who are not majoring in STEM fields (Nosek & Smyth, 2011). Thus, obtaining evidence of an ethnic difference in gender-STEM stereotypes among a sample of women STEM majors would provide a stronger test of our hypothesis. We predicted that, even among STEM majors, African American women would have weaker gender-STEM stereotypes than European American women. Finally, in Study 4, we expanded our research by examining gender-STEM stereotypes and STEM participation among a larger sample that included both women and men. Although the analyses with men were largely exploratory, we predicted that African American women would once again have weaker gender-STEM stereotypes and be more likely to be STEM majors as compared with European American women and that differences in gender-STEM stereotypes would mediate differences in STEM participation.

Study 1

In Study 1, we examined data from the annual Cooperative Institute Research Program (CIRP) Freshman Survey conducted by the Higher Education Research Institute. Each year, the CIRP Freshman Survey gathers information on student background characteristics, attitudes, values, and educational goals from colleges and universities across the United States. We examined participants' choice of college major in order to test for ethnic variation in STEM participation among women and men. We predicted that the percentage of African American women majoring in STEM would be significantly larger than the percentage of European American women majoring in STEM.

Predictions for ethnic differences in STEM participation among men, however, were more exploratory. Whereas gender-STEM stereotypes are negatively associated with STEM participation for women, gender-STEM stereotypes are positively associated with STEM participation for men (e.g., Nosek & Smyth, 2011). If African American men have weaker gender-STEM stereotypes than European American men, then they might also have lower rates of participation in STEM. However, the magnitude of the relationship between gender-STEM stereotypes and STEM outcomes is weaker for men than for women (Gilbert, O'Brien, Marx, & Garcia, 2014; Nosek & Smyth, 2011; Ramsey & Sekaquaptewa, 2011; Walton & Cohen, 2003). Moreover, some past research has found that African American men are actually more likely than European American men to initially choose STEM majors (Riegle-Crumb & King, 2010). Thus, we made no a priori predictions regarding ethnic differences in STEM participation among men.

Method

Participants. Participants were 1,772,133 individuals[2] (55.8% female; 7.6% Black) who completed the annual Cooperative Institute Research Program (CIRP) Freshman Survey between 1990 and 1999. Although the vast majority (96.9%) of participants were between 18- to 20-years-old, 2.1% of participants were under 18, .4% were 21 years or older, and .5% did not provide their age.

Procedure. The present data were drawn from the CIRP Freshman Survey, which is designed and administered by the Higher Education Research Institute at the University of California Los Angeles. All data that is over 10-years-old is publically available for download from the CIRP data archives on HERI's Web site.

Measure. Participants selected their intended college major from a list of possible majors. The majors were categorized as either STEM (e.g., physics, mathematics, mechanical engineering) or non-STEM (e.g., sociology, english, philosophy). These categorizations were based on the list of STEM degree programs designated by the U.S. Department of Homeland Security. Any major that was not on the list of STEM degree programs was designated as non-STEM.[3]

Results

We conducted a binary logistic regression with ethnicity, gender, and their interaction terms as predictors of participants' in-

[2] Between 1990 and 1999, 2,275,911 individuals completed the annual CIRP Freshman Survey. The present sample consists of the 1,772,133 individuals who self-identified as White or Black, who self-identified as male or female, and who completed the dependent measure. In order to avoid mischaracterizing the data, we use the same terminology for ethnic groups as used in the original survey (e.g., "Black" instead of "African American").

[3] The one difference between our categorization of STEM majors and the DHS's categorization of STEM majors is that we categorized psychology majors as non-STEM. The reason for this decision is that the vast majority of psychology majors are women and the goal of the present article is to understand why women are underrepresented in traditional STEM fields. Psychology was not added to the DHS list of STEM-designated majors until 2011. We also categorized "undecided" and "other" as non-STEM (results do not differ when these majors are excluded from the analyses). For a list of the DHS STEM-designated degree programs (see http://www.ice.gov/doclib/sevis/pdf/stem-list.pdf).

tended college major (0 = non-STEM, 1 = STEM). The interaction between ethnicity and gender was significant, $\beta = -.33$, $SE = .01$, Wald = 653.70, $p < .001$, Exp(β) = .72. Whereas 23.4% of Black women intended to major in STEM (19,794 STEM majors vs. 64,732 non-STEM majors), 16.4% of White women (148,528 STEM majors vs. 755,337 non-STEM majors) intended to major in STEM, $\beta = .44$, $SE = .01$, Wald = 2,633.35, $p < .001$, Exp(β) = 1.56. In addition, although ethnic variation in STEM participation was less pronounced among men, 36.5% Black men (18,520 STEM majors vs. 32,208 non-STEM majors) intended to major in STEM whereas 33.9% of White men (248,730 STEM majors vs. 484,284 non-STEM majors) intended to major in STEM, $\beta = .11$, $SE = .01$, Wald = 139.97, $p < .001$, Exp(β) = 1.12.

Discussion

Study 1 provided support for our prediction regarding ethnic differences in STEM participation among women. In a sample of over one million incoming college freshmen between 1990 and 1999, African American women were significantly more likely to indicate that they intended to major in STEM than European American women. We also assessed ethnic differences in STEM participation among men. Because gendered stereotypes about STEM tend to have a weaker impact on men as compared to women (e.g., Gilbert, O'Brien, Marx, & Garcia, 2014; Nosek & Smyth, 2011; Ramsey & Sekaquaptewa, 2011; Walton & Cohen, 2003), we did not make predictions about ethnic differences in STEM participation among men. We found a small but significant ethnic difference in STEM participation, such that African American men were more likely to indicate that they intend to major in STEM than European American men. It is important to keep in mind that, due to the large sample size in the present study, even small differences between groups are likely to be statistically significant. Nonetheless, this finding replicates past research by Riegle-Crumb and King (2010) demonstrating higher rates of STEM participation among African American men than European American men. We return to the issue of ethnic differences in STEM participation among men in Study 4.

There are some limitations of Study 1. First, because the data were from the 1990s, they may be dated and the patterns of STEM participation may have changed over time. More recent tables published in reports by the NSF summarizing the results of the CIRP study suggests that first-year African American college women continue to be more likely than first-year European American college women to express intentions to major in STEM, but that the pattern has reversed among men such that first year European American college men are now more likely to intend to major in STEM than African American college men (National Science Foundation, 2009, 2013). However, these tables lack important information that would aid in a clear interpretation of the percentages reported such as sample size and researcher definitions regarding which majors should be categorized as STEM. Thus, there is need for additional research on intentions to major in STEM.

A second limitation of Study 1 is that we were unable to examine the mechanisms that contribute to ethnic difference in intentions to major in STEM. We propose that this ethnic difference in STEM participation among women is due, at least in part, to ethnic differences in implicit gender-STEM stereotypes. We were unable, however, to assess the role of stereotypes in the ethnic gap in STEM participation in the present study. We will assess the prediction that ethnic differences in implicit gender-STEM stereotypes contribute to ethnic differences in STEM participation among women in Study 2 and Study 4.

Study 2

We recruited a sample of African American and European American women to examine potential ethnic differences in gender-STEM stereotypes and their role in ethnic differences STEM participation in Study 2. We decided to focus on women both because gender-STEM stereotypes have a stronger impact on women than men (e.g., Ramsey & Sekaquaptewa, 2011) and because our key predictions derived from the intersectionality hypothesis concern women's STEM outcomes. We used the IAT to measure gender-STEM stereotypes because research suggests that implicit measures of gender-STEM stereotypes are more strongly correlated with STEM outcomes than explicit measures of gender-STEM stereotypes (e.g., Kiefer & Sekaquaptewa, 2007a; Kiefer & Sekaquaptewa, 2007b; Nosek & Smyth, 2011; Nosek et al., 2009). We also included an exploratory measure of the perceived gendering of STEM fields. This explicit measure assessed the extent to which individuals perceive that "people in general" consider STEM fields to be masculine relative to liberal arts fields. One possibility is that European American women perceive STEM fields to be more gendered at a societal level than African American women. Alternatively, it is also possible that African American and European American women are equally likely to perceive STEM fields as gendered, but that European American women are more likely to internalize gender-STEM stereotypes at an implicit level. Finally, we examined participation in STEM majors.

Method

Participants. Participants were 153 women (43 African Americans, 110 European Americans; age range 18 to 29 years, $M = 19.58$, $SD = 2.19$) attending college at one of two private universities in the Southern region of the United States. European American participants were recruited from a private, primarily White institution (PWI). African American participants were recruited from both a PWI ($N = 8$) and a private, historically Black college/university (HBCU, $N = 35$).[4] Due to our focus on ethnic variation in gender-STEM stereotypes and STEM participation within American culture, we excluded data from four participants (two who identified as Black/African American and two who identified as White/European American) who indicated that they were born outside the United States. Participants either received extra credit in their psychology courses or a monetary payment in exchange for their participation. Degrees of freedom vary slightly across analyses due to missing data.

Procedure. Participants completed all measures on a computer using MediaLab software in a campus laboratory. We coun-

[4] There were no significant differences between African American women as a function of university setting on any of the study measures. Conclusions of analyses that we report here did not change when we excluded African American women from the PWI.

terbalanced the order of measures across participants. At the PWI, the experimenters were European American. At the HBCU, the experimenters were African American. The experimenters' only interaction with the participant was to explain consent forms at the beginning of the study and to debrief the participant at the end of the study. Otherwise, participants sat alone in a cubicle and completed the measures on a computer for the duration of the session.

Measures.

Gender-STEM stereotypes. To measure the extent to which participants held implicit associations between STEM and male (i.e., implicit gender-STEM stereotypes), we used a version of the IAT (Greenwald et al., 1998) with stimuli that came from the Project Implicit Web site (http://projectimplicit.harvard.edu; see also Nosek et al., 2009). The words for the STEM category included *astronomy, biology, chemistry, engineering, geology, math,* and *physics*. The words for the liberal arts (LA) category included *arts, english, history, humanities, literature, music,* and *philosophy*. The words for the male category included *boy, father, grandpa, husband, male, man, son,* and *uncle*. The words for the female included *aunt, daughter, female, girl, grandma, mother, wife,* and *woman*. We presented the IAT in five blocks of trials in two order conditions: one with the STEM/male combination first, and one with the STEM/female combination first. We computed IAT scores as a difference between the mean response latencies of the STEM-male/LA-female block and the STEM-female/LA-male block, using the *D*-measure algorithm (Greenwald, Nosek, & Banaji, 2003). Larger scores indicate greater implicit masculinization of STEM relative to liberal arts.

Perceived gendering of STEM. To measure explicit beliefs about the extent to which "people in general" perceive STEM fields to be masculine relative to liberal arts fields, we asked participants to indicate how masculine or feminine *people in general* believe each of the 14 fields of study from the IAT to be. Thus, we sought to measure participants' perceptions of the extent to which STEM fields are gendered at a societal level, as opposed to personal endorsement of the stereotypes (Zou et al., 2009). Participants rated the relative masculinity or femininity of each domain on a 7-point Likert scale (1 = *Feminine,* 4 = *Neutral,* 7 = *Masculine*). Higher scores indicated greater ratings of domain masculinization. We then computed a difference score between mean masculinization ratings of STEM domains ($\alpha = .66$) and liberal arts domains ($\alpha = .60$). Higher scores indicate greater perceived masculinization of STEM relative to liberal arts.

STEM major. As an indicator of STEM participation, we asked participants to report their current college major. College majors were categorized as STEM or non-STEM using the same method as Study 1.

Results

Gender-STEM stereotypes. Consistent with the intersectionality hypothesis, African American women ($M = .36$, $SD = .56$) held weaker implicit gender-STEM stereotypes than European American women ($M = .64$, $SD = .48$), $F(1, 145) = 9.84$, $p < .01$, $d = -.54$.

Perceived gendering of STEM. African American women ($M = 1.87$, $SD = .98$) and European American women ($M = 1.76$, $SD = .90$) did not differ in their perceptions of the gendered nature of STEM fields, $F < 1$. The positive mean levels of perceived gendering of STEM, however, indicate that both groups of women perceived that STEM is considered masculine relative to liberal arts.

STEM participation. Consistent with the intersectionality hypothesis, African American women were more likely than European American women to indicate that they were majoring in a STEM field, B = 1.93, $SE = .41$, Wald = 22.80, $p < .001$, $Exp(B) = 6.91$. Whereas 55.8% of African American women (24 STEM majors vs. 19 non-STEM majors) were majoring in STEM, 15.5% of European American women (17 STEM majors vs. 93 non-STEM majors) were majoring in a STEM field.

Test of mediation. In order to assess whether ethnic differences in implicit gender-STEM stereotypes could account for ethnic differences in the tendency to major in STEM, we conducted a test of mediation using a bootstrapping procedure (Preacher & Hayes, 2008) with 1,000 bootstrap resamples. In order to implement the procedure, we used the Indirect macro from Hayes's Web site (http://afhayes.com/spss-sas-and-mplus-macros-and-code.html). Because there were no ethnic differences in the perceived gendering of STEM fields, we did not conduct mediational analyses using this measure.

The total effect of ethnicity (European American vs. African American) on the tendency to major in STEM was significant, B = 1.93, Wald = 22.29, $p < .001$. In addition, ethnicity had a significant effect on implicit gender-STEM stereotypes, B = −.29, $p < .01$ and implicit gender-STEM stereotypes had a significant effect on STEM major, B = −1.00, Wald = 5.34, $p < .05$. More important, results provide evidence of partial mediation. The indirect effect of ethnicity on the tendency to major in STEM through implicit STEM stereotypes was significant, B = .30 with a 95% bias corrected confidence interval of .03 to .82. The direct effect of ethnicity on tendency to major in STEM was also significant, B = 1.74, Wald = 16.92, $p < .001$ $p < .001$, indicating that implicit STEM stereotypes partially mediated the effect of ethnicity on the tendency to major in STEM (see Figure 1).

Discussion

Study 2 provided support for the three predictions derived from the intersectionality hypothesis. Compared with European Amer-

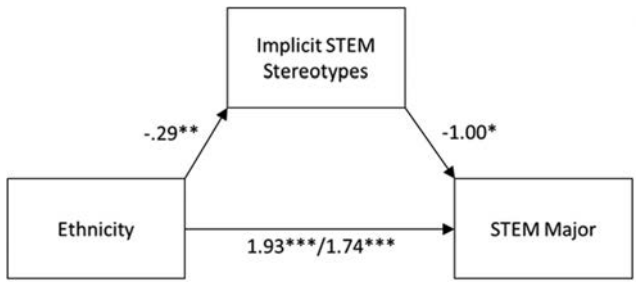

Figure 1. Study 2: Relationship between ethnicity, implicit gender-STEM stereotypes and STEM major. * $p < .05$. ** $p < .01$. *** $p < .001$. For relationship between ethnicity and STEM major, value on left indicates relationship before implicit gender-STEM stereotypes included in the model and value on right indicates relationship after implicit gender-STEM stereotypes included in model. Ethnicity was coded such that 0 = European American and 1 = African American. All values reported in the figure are unstandardized.

ican women, African American women held weaker implicit gender-STEM stereotypes and were more likely to major in STEM. In addition, ethnic variation in implicit gender-STEM stereotypes partially mediated the difference between African American and European American women in the tendency to major in STEM. The fact that the direct effect of ethnicity on major remained significant even after controlling for implicit gender-STEM stereotypes suggests that additional factors beyond implicit gender-STEM stereotypes that contribute to the ethnic difference in choice of major.

In contrast to the ethnic variation in implicit gender-STEM stereotypes, there were no differences between African American and European American women in the perceptions that people in general consider STEM fields to be masculine relative to liberal arts fields. Both African American and European American women perceived that STEM is considered masculine relative to liberal arts. The present discrepancy between implicit gender-STEM stereotypes and explicit perceptions of STEM gendering are perhaps unsurprising in light of research demonstrating that implicit stereotypes do not necessarily correspond to a person's explicit perceptions of others' beliefs (Chiu et al., 2010; Zou et al., 2009). Furthermore, it is possible that this lack of ethnic variation occurred because participants responded to explicit questions about the perceived masculinity of STEM in American culture as a whole, rather than the perceived masculinity of STEM within their respective ethnic groups.

Although the results of Study 2 provided support for the intersectionality hypothesis, we were unable rule out the possibility that sampling bias explained the observed ethnic differences in gender-STEM stereotypes. A disproportionate number of African American women in the Study 2 sample were STEM majors. Given that women who major in STEM have weaker implicit gender-STEM stereotypes than women who are not STEM majors (Nosek & Smyth, 2011), it is possible that the difference between African American women and European American women in gender-STEM stereotypes is merely a reflection of their different majors as opposed to a reflection of ethnic differences in the gendered nature of STEM. The small sample size in Study 2 prevented us from conducting additional analyses that would allow us to rule out this potential sampling bias explanation; we conducted a third study to address this sampling bias explanation.

Study 3

Study 3 examined a sample of first-year college women majoring in STEM fields. If the differences in implicit gender STEM stereotypes between African American and European American women observed in Study 2 reflect cultural differences associated with their ethnicity (as opposed to merely reflecting differences between STEM and non-STEM majors), then these ethnic differences should emerge even among a sample of women who are STEM majors.

Method

Participants. Participants were 123 women (58 African American, 67 European American; age range 18 to 19 years, $M = 18.09$, $SD = 0.29$) majoring in a STEM field and in their first year of college at one of three universities in the United States: a private PWI in the South ($n = 39$; 7.7% African American), a private HBCU in the South ($n = 54$, 98.1% African American), and a public PWI in the Midwest ($n = 32$; 6.3% African American). We excluded data from two participants (both of whom identified as White/European American) who indicated that they were not born in the United States.

Procedure. Participants completed the gender-STEM IAT as part of a pretest for an unrelated study. Participants were recruited through several strategies including university rosters of STEM majors and STEM courses. All participants took a short demographic questionnaire to determine if they qualified for the study. Qualification criteria were that participants had to be female, in their first year of college, and majoring in one of the STEM fields as defined in previous studies. Participants received monetary payment in exchange for participation.

Measures. We assessed implicit gender-STEM stereotypes using the same IAT procedure as in Study 2.

Results

African American women had weaker implicit gender-STEM stereotypes ($M = .05$, $SD = .42$) as compared with European American women ($M = .35$, $SD = .37$), $F(1, 122) = 18.06$, $p < .001$, $d = .75$.

Discussion

By demonstrating that African American women had weaker implicit gender-STEM stereotypes than European American women, Study 3 replicated an important finding from Study 2. Furthermore, addressing a potential shortcoming of Study 2, the ethnic differences in gender-STEM stereotypes observed in the present study cannot be explained by oversampling of African American STEM majors as all participants included in Study 3 were STEM majors. A potential limitation of Studies 2 and 3 are that a large proportion of the African Americans were students at an HBCU. Thus, it is unclear whether the differences in gender-STEM stereotypes that emerged between African American and European American women in these studies were due to the fact that a large number of African American women attended an HBCU or if these differences would also be observed among African American women attending other types of institutions. Finally, the exclusive focus on women is another limitation of Studies 2 and 3. We conducted a fourth and final study to address these limitations.

Study 4

Study 4 extends our investigation in several important ways. First, we attempted to replicate the findings from Study 2 in a sample of participants from a broader set of universities in different regions of the United States. As in Study 2, we expected to find that African American women would have weaker implicit gender-STEM stereotypes and be more likely to major in STEM as compared with European American women. Furthermore, we predicted that ethnic differences in implicit gender-STEM stereotypes would mediate ethnic differences in women's STEM participation.

Second, we examined potential ethnic differences in gender-STEM stereotypes and STEM participation among African Amer-

ican and European American men as a point of comparison with women. Within a particular culture, gender stereotypes tend to be consensual in that men and women tend to hold similar gender stereotypes (Glick et al., 2000). Thus, we expected that the ethnic differences in implicit gender-STEM stereotypes observed among women in Studies 2 and 3 would also be observed among men. In Study 1, we found that African American men were more likely to major in STEM than European American men, although this ethnic difference among men was much smaller than the ethnic difference among women. Recent summary tables published in reports by the NSF suggest that European American college men may now be more likely to intend to major in STEM than African American men (National Science Foundation, 2013); however, these summary tables lack both inferential statistics and information regarding which majors were categorized as STEM. Thus, we were uncertain whether we would obtain ethnic differences in choice of STEM major among male participants. We did not expect implicit gender-STEM stereotypes to mediate any potential ethnic differences in STEM participation among men since men are much less affected by implicit gender-STEM stereotypes as compared to women (e.g., Nosek & Smyth, 2011).

Third, we sought to recruit a larger sample than Studies 2 and 3 so that we could conduct additional analyses to rule out a sampling bias explanation for ethnic differences in gender-STEM stereotypes, as we did in Study 3. We predicted that we would replicate the findings of Study 3 by demonstrating ethnic differences in gender-STEM stereotypes among STEM majors. Furthermore, we predicted that we would also find ethnic differences in gender-STEM stereotypes among non-STEM majors.

Finally, because we recruited participants from a broader set of universities in different regions of the United States, we were able to compare African American women attending an HBCU with African American women attending other types of institutions. In addition to having a strong emphasis on African American cultural traditions, HBCUs also tend to have a strong focus on STEM (Gasman, 2011; Hurtado et al., 2011). Either of these features of HBCUs could account for the observed differences among African American and European American women in Studies 2 and 3.

Method

Participants. Participants were 870 students (212 African American, 658 European American; age range 18 to 56 years, $M = 20.44$, $SD = 3.99$) attending college at one of four universities in the United States: a private PWI in the South ($n = 407$; 80.1% women, 7.1% African American), a private HBCU in the South ($n = 145$; 87.6% women, 98.6% African American), a public PWI in the Midwest ($n = 263$; 50.6% women, 7.6% African American) and an ethnically diverse public university in the West ($n = 55$; 98.2% women, 36.4% African American). We excluded data from 32 participants (13 who identified as Black/African American, 19 who identified as White/European American) who indicated that they were not born in the United States.

Procedure. Participants completed all measures online as part of a pretest for an unrelated study. They received either course credit or a monetary payment in exchange for participation. Due to time constraints, we included a shortened measure of perceived gendering of STEM fields from Study 2.

Measures. We assessed implicit gender-STEM stereotypes using the same IAT procedure as in Studies 2 and 3. Participants completed a measure of perceived gendering of STEM fields similar to the measure used in Study 2; however, participants only rated the fields of physics, biology, and english. We calculated scores in the same manner as Study 2, with higher scores indicating greater perceived masculinization of STEM. As an indicator of STEM participation, participants indicated their college major, which we categorized as STEM or non-STEM in the same manner as the previous studies.

Results

Gender-STEM stereotypes. We conducted a 2 (Gender) $\times$ 2 (Ethnicity) ANOVA examining implicit gender-STEM stereotypes. A main effect of ethnicity emerged such that implicit gender-STEM stereotypes were weaker among African American participants ($M = .29$, $SD = .39$) than European American participants ($M = .49$, $SD = .36$), $F(1, 866) = 27.88$, $p < .001$, $d = -.53$. The main effect of gender and the interaction were not significant, Fs < 1.

Perceived gendering of STEM. For participants' perceptions about the gendering of STEM fields, the effects of ethnicity, $F(1, 865) = 2.78$, $p = .10$, and gender, $F(1, 865) = 2.53$, $p = .11$, were not significant. The interaction between ethnicity and gender, however, was significant, $F(1, 865) = 6.18$, $p < .05$. Simple effects tests revealed that, consistent with Study 2, African American women ($M = 1.84$, $SD = 1.45$) and European American women ($M = 1.73$, $SD = 1.21$) did not differ on this measure, $F < 1$. However, parallel to observed differences for implicit gender-STEM stereotypes, African American men ($M = 1.33$, $SD = 1.47$) reported lower perceived gendering of STEM fields than did European American men ($M = 1.84$, $SD = 1.10$), $F(1, 865) = 5.42$, $p < .05$, $d = -.43$. This divergent pattern of ethnic difference for men and women is an unanticipated pattern that, if reliable, constitutes an interesting topic for future research.

STEM major. We conducted a binary logistic regression with gender, ethnicity, and their interaction term as predictors of participants' tendency to major in STEM. The interaction was significant, B $= -1.01$, $SE = .42$, Wald $= 5.72$, $p < .05$, Exp (B) $= .37$. Replicating Studies 1 and 2, African American women were more likely to major in STEM as compared with European American women, B $= .95$, $SE = .20$, Wald $= 23.47$, $p < .001$, Exp(B) $= 2.59$. Whereas 37.6% of African American women (65 STEM majors vs. 108 non-STEM majors) were STEM majors, 18.8% of European American women (88 STEM majors vs. 379 non-STEM majors) were STEM majors. In contrast, inconsistent with Study 1, African American men were equally likely to major in STEM as compared with European American men, B $= -.05$, $SE = .37$, Wald $= .02$, $p = .88$, Exp(B) $= .95$. More specifically, 33.3% of African American men (13 STEM majors vs. 26 non-STEM majors) and 34.6% of European American men (66 STEM majors vs. 125 non-STEM majors) were STEM majors.

Test of mediation. As in Study 2, we conducted a mediational analysis to assess whether implicit gender-STEM stereotypes could account for observed differences between African American and European American women in the tendency to major in STEM. As in Study 2, we implemented the bootstrapping approach with 1,000 bootstrap resamples. As there were no ethnic differ-

ences in STEM participation among men, we did not conduct mediational analyses with men.

The total effect of ethnicity (European American vs. African American) on women's tendency to major in STEM was significant, B = .95, Wald = 23.47, $p < .001$. In addition, ethnicity had a significant effect on implicit gender-STEM stereotypes, B = −.21, $p < .001$ and implicit gender-STEM stereotypes had a significant effect on STEM major, B = −.95, Wald = 13.79, $p < .001$. Replicating the mediational analysis from Study 2, the indirect effect of ethnicity on women's tendency to major in STEM through implicit STEM stereotypes was significant, B = .20 with a 95% bias corrected confidence interval of .09 to .33. The direct effect of ethnicity on women's tendency to major in STEM remained significant, B = .78, Wald = 14.53, $p < .001$, indicating that implicit gender-STEM stereotypes partially mediated the effect of ethnicity on women's tendency to major in STEM (see Figure 2).

Additional analyses. In the following section, we conducted additional analyses to rule out sampling bias as an alternative explanation for the observed effects. In these additional analyses we focused only on women for two reasons. First, there were no differences between European American and African American men in STEM participation. Thus, differences between men in gender-STEM stereotypes cannot be explained by different base rates of participation in STEM. The second reason we have excluded men from these analyses is more pragmatic. Our sample of men, and African American men in particular, was much smaller than our sample of women and thus we lack sufficient sample size to conduct these more fine-grained analyses.

STEM versus non-STEM majors. As in Study 3, we conducted additional analyses to address a potential alternative explanation of sampling bias—that the differences in implicit gender-STEM stereotypes between African American and European American women occurred because a disproportionate number of African American women were recruited from STEM majors. Among STEM majors, African American women ($M = .20$, $SD = .36$) held weaker implicit gender-STEM stereotypes than European American women ($M = .41$, $SD = .37$), $F(1, 151) = 12.25$, $p < .01$, $d = -.66$. Likewise, among non-STEM majors, African American women ($M = .36$, $SD = .40$) held weaker implicit stereotypes than European American women ($M = .53$, $SD = .36$), $F(1, 485) = 18.49$, $p < .001$, $d = -.46$. This suggests that the ethnic differences in gender-STEM stereotypes are not merely a result of ethnic differences in STEM participation.

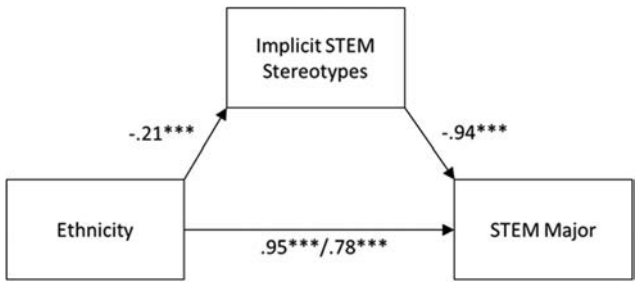

Figure 2. Study 4: Relationship between ethnicity, implicit gender-STEM stereotypes and STEM major among female participants. *** $p < .001$. For relationship between ethnicity and STEM major, value on left indicates relationship before implicit gender-STEM stereotypes included in the model and value on right indicates relationship after implicit gender-STEM stereotypes included in model. Ethnicity was coded such that 0 = European American and 1 = African American. All values reported in the figure are unstandardized.

HBCU versus other institutions. We also conducted additional analyses comparing African American women at an HBCU to African American women at other types of institutions. There was no difference in implicit gender-STEM stereotypes among African American women enrolled at the HBCU ($N = 125$, M = .27, $SD = .37$) and African American women enrolled at non-HBCUs ($N = 48$, $M = .35$, $SD = .44$), $F(1, 171) = 1.49$, $p = .23$. Similarly, there was no difference in the perceived gendering of STEM fields among African American women enrolled at the HBCU (M = 1.99, $SD = 1.51$) and African American women enrolled at non-HBCUs ($M = 1.53$, $SD = 1.55$), $F(1, 171) = 3.13$, $p = .08$. Finally, African American women attending the HBCU (48.0%) were significantly more likely to be STEM majors than those attending other institutions (10.4%), $\chi^2 = 20.89$, $p < .001$.

Discussion

Results of Study 4 are again consistent with the intersectionality hypothesis. African American participants—both women and men—had weaker implicit gender-STEM associations than European American participants. Likewise replicating results of Study 2, this ethnic difference in implicit stereotypes partially mediated the tendency for African American women to participate in STEM at higher rates than European American women. This ethnic difference in implicit gender-STEM stereotypes was not associated with ethnic differences in STEM participation among men. Despite evidence of stronger gender-STEM stereotypes among European American men, the proportion of participants who reported a STEM major in the current study was no greater among European American men than African American men.

Given that gender-STEM stereotypes tend to be positively associated with STEM participation among men, one might expect that stronger implicit gender-STEM associations should translate into greater STEM participation among European American men than among African American men. Previous research has concluded that the beneficial effects of gender-STEM stereotypes on STEM outcomes of men are less consistent than their harmful effects on STEM outcomes of women (Nosek & Smyth, 2011; Walton & Cohen, 2003). The consequences of ethnic differences in gender-STEM stereotypes for ethnic variation in men's STEM participation remain an interesting direction for future research.

The greater diversity of African American participants in Study 4 as compared with Studies 2 and 3 allowed for exploratory analyses comparing African American women as a function of enrollment at the HBCU versus other institutions. These analyses showed that the relatively weak implicit gender-STEM stereotypes we observed among African American women did not differ as a function of institution type. This suggests that ethnic differences in implicit gender-STEM stereotypes were not due to the fact that many African American women in the present study attended an HBCU.

The analyses comparing African American women at an HBCU with African American women at other institutions, however, revealed a difference in STEM participation rates such that African

American women at an HBCU were more likely to participate in STEM. Importantly, the differences in STEM participation of African American women at different types of institutions are not attributable to differences in gender-STEM stereotypes, because African American women at different institutions showed equally weak patterns of implicit gender-STEM associations. Scholars have noted that HBCUs often promote high levels of STEM participation and success for students in general, both for women and men (Gasman, 2011; Hurtado et al., 2011). Although it was beyond the scope of the present study, comparisons of the experiences of African American women majoring in STEM at HBCUs versus other institutions is a promising direction for future research.

General Discussion

The underrepresentation of women in STEM fields in the United States is a persistent social problem. Implicit stereotypes associating men with STEM fields contribute to the unequal representation of men and women through a number of mechanisms. The present research applied an intersectional approach to understanding ethnic variation in gender-STEM stereotypes and STEM participation among European American and African American college students. Across four studies, we tested and found support for predictions derived from the intersectionality hypothesis. First, compared with European American women, African American women were more likely to major in STEM fields (Studies 1, 2, and 4). Second, African Americans had weaker implicit gender-STEM stereotypes than European Americans (Studies 2–4). Third, ethnic differences in implicit gender-STEM stereotypes partially mediated ethnic differences in STEM participation among women (Studies 2 and 4). Among men, African Americans had weaker gender STEM stereotypes than European American men; however, there were no substantive differences between African American and European American men in STEM participation (Studies 1 and 4).

To date, much of the research investigating the underrepresentation of women in STEM fields comes from samples that have primarily included European American women (e.g., Diekman et al., 2011; Kiefer & Sekaquaptewa, 2007a, 2007b; Nosek et al., 2002; although cf. Nosek & Smyth, 2011) or studies that do not describe the ethnic background of participants (e.g., Stout et al., 2011). Frequently, there are not enough women from non-European American ethnic backgrounds to test for ethnic variation in the psychological phenomena that impact STEM participation. Together, these factors raise questions about the extent to which conventional scientific wisdom regarding the underrepresentation of women in STEM accurately describes the experiences of women who are not European American.

An intersectional approach raises questions about the extent to which conventional wisdom in mainstream psychological science is influenced by the settings in which most research occurs (Arnett, 2008; Henrich, Heine, & Norenzayan, 2010). Applied to the present topic, emerging scientific wisdom regarding gender and STEM fields may be influenced by the predominantly White institutions where much scientific research takes place (i.e., where "even the rat was white"; Guthrie, 1976). A growing body of theory and research from a variety of perspectives—including intersectionality theory (e.g., Cole, 2009; Crenshaw, 1991; Purdie-Vaughns & Eibach, 2008; Shields, 2008) and transnational feminisms (Mohanty, 2003)—has proposed that both conventional wisdom and scientific knowledge about gender and gender oppression has its foundation in the experiences of (often upper- or middle-class) White or European American women.

Because the current state of the literature on gender representation in STEM largely reflects the experiences of European Americans, throughout this article we tend to use language that highlights the contrast between African Americans and the European American "norm" (e.g., Hegarty & Pratto, 2001; Miller, Taylor, & Buck, 1991). For example, we described African American women as having weaker stereotypes than European American women instead of describing European American women as having stronger stereotypes than African American women. We made this framing of group differences consciously in order to highlight the way in which the gendered experiences of European Americans in STEM fields have come to be viewed in the scientific literature as the "standard;" however, we caution readers against viewing the experiences of European Americans as "normal" and the experiences of African Americans as "deviant" (see Hegarty & Pratto, 2001).

Limitations and Future Directions

In the present article, we presented data suggesting that, compared with European American women, African American women are more likely to initially choose STEM majors, and that ethnic differences in implicit gender-STEM stereotypes mediate this difference. One limitation of the present set of studies is that sampling biases may have contributed to some of the observed effects. Fortunately, sampling bias is not a tenable explanation for the ethnic differences that emerged in the first study because Study 1 analyzed data from a nationally representative sample that included over a million participants that covered a 10-year span.

However, because the other studies consist of convenience samples, it is more difficult to rule out sampling bias explanations in these studies. For example, to the extent that we recruited a disproportionate number of African Americans from among STEM majors, the differences between African American and European American women in implicit gender-STEM stereotypes may be explained by the fact that women majoring in STEM, regardless of their race, have weaker implicit gender-STEM stereotypes (e.g., Nosek & Smyth, 2011). In order to address this issue, Study 3 compared implicit gender-STEM stereotypes among a sample of STEM majors and showed that ethnic differences in implicit gender-STEM stereotypes emerged even among STEM majors. In addition, internal analyses conducted in Study 4 showed that ethnic differences in implicit gender-STEM stereotypes emerged both among STEM majors and among non-STEM majors. However, sampling bias cannot be ruled out entirely and may explain why implicit gender-STEM stereotypes only partially mediated the relationship between ethnicity and choice of STEM major among women in Studies 2 and 4.

Future research should investigate whether the relationship between gender, ethnicity, and STEM participation is moderated by factors such as the type of educational institution and the definition of STEM adopted by the researchers. For example, in the present study, we found that African American women attending an HBCU were more likely to participate in STEM than African

American women attending other institutions. Ethnic differences in STEM participation rates among women may vary across different types of educational institutions. Furthermore, in the present article, we adopted a definition of STEM based on designations by the U.S. Department of Homeland Security (with the exception that we did not include psychology as a STEM major). However, it is important to recognize that there are varying definitions of STEM. For example, NSF statistics on STEM majors often include psychology and other social sciences (e.g., anthropology, sociology, etc.) among their definitions of STEM (National Science Foundation, 2013). The participation of women varies across different STEM fields and the conclusions reached in any particular study will almost certainly be influenced by the definition of STEM adopted by the researchers. For example, ethnic differences between African American and European American women in STEM participation may vary across different STEM fields.

The present research provides evidence that African Americans and European American show different patterns of implicit gender-STEM associations. We have argued that these differences in gender-STEM associations originate in the different constructions of gender in African American and European American culture. Because STEM is associated with independence and agency, and independence and agency are viewed as masculine in European American culture to a greater extent than African American culture, European Americans may be more likely to implicitly associate STEM with masculinity. An important direction for future research will be to identify the mechanisms underlying ethnic differences in implicit gender-STEM stereotypes and to directly test the role of gendered conceptions of independence and agency in creating ethnic differences in gender-STEM stereotypes.

Although we have emphasized the impact of stereotypes on STEM participation, ultimately the relationship between stereotypes and STEM participation is reciprocal. In cultural psychological terms, the reciprocal influence of the individual's stereotypes on the environment and the environment on the individual's stereotypes is referred to as mutual constitution (Markus & Kitayama, 2010). Thus, it is likely that women's participation in STEM also shapes implicit gender-STEM stereotypes (Nosek & Smyth, 2011). For example, if African American women are more likely to major in STEM than European American women, this could lead to the development of weaker stereotypes among African American women as compared with European American women.

The present research raises an interesting question that should be addressed in future research. If African American college women hold weaker implicit gender-STEM stereotypes and are more likely to choose STEM majors as compared with European American women, why are African American women underrepresented among STEM bachelor degree recipients (National Science Foundation, 2013)? We contend that there are two factors that may lead to the underrepresentation of African American women among STEM bachelor degree recipients. First, African American women are underrepresented among both STEM and non-STEM bachelor degree recipients relative to their proportion of the population. Thus, even if African American college women are relatively likely to pursue STEM degrees, they may still be underrepresented among STEM degree recipients relative to European American women because they are underrepresented among all degree recipients.

Second, many students who initially choose STEM majors eventually change their major and graduate with a non-STEM degree (Syed, 2010). The data reported in the present studies represent just a snapshot at one point in the STEM pipeline and NSF data on degree completions paints a somewhat different picture. The data on degree completions suggest that, among women graduating with bachelor's degrees in 2010, 10% of European American women, but only 8% of African American women, earned STEM degrees (excluding psychology and social science degrees, National Science Foundation, 2013). If African American women start out more interested in STEM than European American women, but are less likely to complete college with a STEM degrees, this suggests that African American women may face unique barriers to completion of a STEM degree. It will be essential for future researchers to examine the factors that lead women who are initially interested in STEM to opt out of STEM degrees and whether these factors are different for women of different ethnic backgrounds. One possibility is that, relative to European American women, African American women have a high initial interest in STEM, but face unique barriers to completion of STEM degrees, such as negative race-based stereotypes. The ethnic prominence hypothesis suggests that race-based stereotypes, especially on a college campus, may be more salient for African American women than gender-based stereotypes (Levin, Sinclair, Veniegas, & Taylor, 2002). Thus, for African American women, race-based stereotypes may be more likely than gender-based stereotypes to lead to attrition in STEM fields. An important direction for future research is the interplay between race-based and gender-based stereotypes for the experiences of African American women in STEM fields.

Conclusion

In the present article, we argued that an intersectional approach to studying gender-STEM stereotypes and STEM participation has key advantages. First, identification of factors that contribute to ethnic variation in gender-STEM stereotypes and ethnic variation in women's STEM participation is of theoretical and practical importance. For example, if women from some ethnic groups or cultural backgrounds are less likely to hold gender-STEM stereotypes and more likely to show interest in participating in STEM fields as compared with other women, identifying the factors that create these differences may help to inform interventions aimed at increasing women's participation and success in STEM. In addition, an intersectional approach to understanding gender-STEM stereotypes and the participation of women in STEM will help develop a more complete scientific literature that accurately reflects the experiences of people from a variety of ethnic backgrounds.

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