Subtle Barriers and Bias in STEM:

How Stereotypes Constrain Women's STEM Participation and Career Progress

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Women have made substantial progress in the workplace over the past 50 years, including impressive gains in historically male-dominated professions, such as business, law, medicine, and even some areas of science such as biology and psychology. Yet, women's progress has been slower in other fields, particularly in math-intensive areas of the physical sciences, technology, engineering, and math (STEM), where women make up less than one-quarter of workers and bachelor's degree earners (National Science Foundation, 2016a, 2016b). The gender gap in STEM participation is costly for STEM fields that are losing out on an untapped workforce that could help meet growing job demands and contribute to technological innovation. But beyond the critical loss to STEM fields, the gender gap in STEM is also an issue of gender equity. Because STEM jobs offer higher salaries than non-STEM jobs (Langdon, McKittrick, Beede, Khan, & Doms, 2011), gender imbalance in STEM perpetuates the gender wage gap. Gender equity cannot be fully achieved without addressing gender disparities in high-paying occupations such as STEM careers.

Several explanations have been offered to explain why women remain underrepresented in STEM, including theories about gender differences in STEM ability; however, research evidence fails to support the conclusion that intrinsic gender differences in STEM ability are a major cause of gender disparities in STEM participation (Ceci, Ginther, Kahn, & Williams, 2014; Ceci, Williams, & Barnett, 2009; Else-Quest, Hyde, & Linn, 2010; Halpern et al., 2007; Spelke, 2005). A second explanation is that women are just not interested in STEM careers and are freely choosing non-STEM careers. However, in this chapter I review evidence that women's choices and opportunities – rather than freely chosen – are powerfully constrained by gender stereotypes that create visible as well as invisible barriers to women's entry and progress in STEM. Various other social and cultural factors, such as gender socialization, overt discrimination, and work norms and structures, also contribute to gender disparities in STEM (for reviews, see: Blickenstaff, 2005; Ceci et al., 2014; Ceci & Williams, 2007; Cheryan, Ziegler, Montoya, & Jiang, 2016; Halpern et al., 2007; Hill, Corbett, & St. Rose, 2010; Kossek, Su, & Wu, 2016; Ong, Wright, Espinosa, & Orfield, 2011; Wang & Degol, 2016); my focus on gender stereotyping does not diminish the role of these other factors. Rather, my goal is to review the vast and growing literature that demonstrates the powerful influence of stereotypes on our self-concepts and behaviors, and examine how these stereotypes may, sometimes covertly and unintentionally, prevent women from entering and persisting in STEM.

Stereotypes are widely known, culturally shared, and oversimplified images or ideas about social groups or things (Nelson, 2016). This chapter focuses on two categories of stereotypes – stereotypes about STEM fields and stereotypes about women's STEM abilities – and examines the barriers that these stereotypes impose on the recruitment, retention, and advancement of women in STEM. I begin by considering stereotypes about STEM fields and how these stereotypes make STEM fields unappealing to girls and women. I then consider negative stereotypes about women's STEM abilities and how these stereotypes negatively impact women's subjective and objective experiences in STEM settings. The chapter concludes by offering recommendations for lifting the constraints of stereotypes and promoting gender equity in STEM.

Stereotypes about STEM Fields

Although girls and women clearly demonstrate the ability to pursue math-intensive STEM careers (Hyde & Mertz, 2009; Lindberg, Hyde, Petersen, & Linn, 2010), they report less interest in these careers (Hill, Corbett, & Rose, 2010). Even among mathematically gifted individuals, women are less likely than men to pursue careers in STEM (Lubinsky & Benbow, 2006). One explanation is that mathematically capable women are more likely than men to also have high verbal abilities, affording them greater choice in career options (Wang, Eccles, & Kenny, 2013). But why are highly capable women choosing to pursue non-STEM careers over STEM careers? Even when women enter STEM careers, they choose less math-intensive fields such as biology and chemistry but opt out of math-intensive engineering, computer science, and physics (National Science Foundation, 2016a, 2016b).

Women seem to be freely choosing to opt out of math-intensive STEM careers. However, research suggests that these choices are not freely chosen (Bargh, 1997, 2008), but instead are powerfully constrained by stereotypes about math-intensive STEM fields, and in particular, beliefs about the types of people in STEM (Cheryan, Master, & Meltzoff, 2015) and beliefs about the work involved and value afforded by STEM careers (Diekman, Steinberg, Brown, Belanger, & Clark, 2016). These beliefs provide a narrow, and often inaccurate, representation of STEM that clashes with the way that many girls and women see themselves, thus making math-intensive STEM fields seem unappealing and undesirable.

Stereotypes about the people in STEM

When people think of STEM, they more often think of men than women (Nosek et al., 2007). Stereotypes of people who work in STEM as male emerge early in development: children as young as five and six years old endorse stereotypes of science as male-dominated (Andre, Whigham, Hendrickson, & Chambers, 1999; Liben & Bigler, 2002), draw scientists as male far more often than female (Chambers, 1983; Barman, 1997; Fralick, Kearn, Thompson, & Lyons, 2009), and implicitly, or automatically, associate science with men more than women (Cvencek, Meltzoff, & Greenwald, 2011). These STEM-male stereotypes are pervasive and continue through adolescence and adulthood (Nosek et al., 2007; Thomas, Henley, & Snell, 2006).

Stereotypes about people in STEM consist of not only information about their typical gender, but also information about their personality traits, interests, and appearance. In U.S. culture, scientists are generally stereotyped as having inborn brilliance, as well as being socially isolated, unattractive with glasses and pale skin, and lacking social skills (Chambers, 1983; Thomas et al., 2006; Welch & Huffman, 2011). In addition to these general stereotypes, stereotypes vary across STEM fields in ways that correspond with gender disparities, such that the most male-dominated fields are also the fields that are most stereotyped as having qualities typically more valued in men than women (Carli, Alawa, Lee, Zhao, & Kim, 2016; Cheryan et al., 2016; Leslie, Cimpian, Meyer, & Freeland, 2015). For instance, in addition to general stereotypes of scientists, computer scientists are also stereotyped as interested in science fiction and video games and singularly focused on technology (Cheryan, Plaut, Davies, & Steele, 2009; Cheryan, Plaut, Handron, & Hudson, 2013). Engineers are stereotyped as using tools and manual labor to fix and build things such as cars (Capobianco, Diefes-Dux, Mena, & Weller, 2011; Fralick et al., 2009; Knight & Cunningham, 2004). These stereotypes provide an unrealistic and narrow profile of what people in STEM are like. The lack of perceived diversity of STEM people is likely to deter many students – not just women but also some men – who feel they do not fit the narrow mold.

Stereotypes of STEM as male-oriented emerge from repeated exposure to social environments that consistently pair STEM with men more than women. Because there are more men than women in STEM careers (NSF, 2016b), for instance, we more often see men than women in STEM roles. Indeed, the prevalence of STEM-male stereotyping corresponds with national patterns of gender disparities, with the strongest STEM-male stereotyping appearing in nations with the largest gender gaps in STEM participation (Miller, Eagly, & Linn, 2015). STEM-male stereotypes are also transmitted via narrow media representations of scientists and engineers in books, magazines, television, and film that pair STEM success with male protagonists (Long et al., 2010; Previs, 2016; Rawson & McCool, 2014) and with traits that are valued more in men than women (Fara, 2013). For instance, CBS's popular television show *The Big Bang Theory* depicts physicists and engineers who embody the stereotypes of inborn intelligence, singular focus on technology, and social awkwardness (Bednarek, 2012). Likewise, in a less widely known television show, *Better Off Ted*, scientists are depicted as "geeky" men in lab coats. Notably, when women are depicted in STEM roles, they tend to be portrayed as "weird" women who eschew feminine characteristics (Fara, 2013) and, in some cases, violate female gender role norms by acting cold, calculating, and domineering (e.g., Bernadette in *The Big Bang Theory* and Veronica in *Better Off Ted*). These stereotypic media representations are troubling given that students report that they get most of their knowledge about what a scientist is like from media sources (Steinke et al., 2007).

The stereotype that scientists are "geeky" lone men who are socially inept, unattractive, and obsessed with science and technology is incompatible with the way that many women, as well as some men, see themselves or wish to be perceived by others. As a result, when these stereotypes are salient, or activated, students who do not fit into this narrow mold report less belonging and interest in STEM. These stereotypes can be activated either by chronic implicit beliefs that unconsciously and automatically associate STEM with male, or by situational cues that signal the presence of STEM-male stereotypes in the immediate social context. I discuss the influence of implicit stereotypes and situationally-activated stereotypes below.

Influence of implicit stereotypes. Over time, repeated exposure to STEM-male pairings can become ingrained in our unconscious such that we automatically associate STEM with male, even outside of our conscious awareness (Greenwald & Banaji, 1995). Research evidence suggests that automatic, or implicit, associations between STEM and male are consequential and differentially predict STEM interests and aspirations among women and men. Whereas stronger implicit STEM-male associations predict positive STEM engagement for men (e.g., more positive STEM attitudes, stronger identification with STEM, and greater likelihood of majoring in STEM), these associations predict negative STEM engagement for women (Nosek & Smyth, 2011; Smyth & Nosek, 2015), especially among those who strongly identify with their gender group (Lane, Goh, & Driver-Linn, 2012; Nosek, Banaji, & Greenwald, 2002). Even among undergraduate women majoring in STEM, stronger implicit STEM-male associations predict weaker STEM identification and weaker intentions to pursue graduate study in STEM (Cundiff, Vescio, Loken, & Lo, 2013; Kiefer & Sekaquaptewa, 2007). Likewise, women who have opted out of STEM careers have stronger implicit STEM-male associations than women who have opted into STEM careers (Smyth & Nosek, 2015).

It is important to note that women's explicit, or consciously endorsed, STEM-male stereotypes do not consistently predict negative consequences for women's engagement in STEM (Cundiff et al., 2013; Delisle, Guay, Senecal, & Larose, 2009; Nosek et al., 2002; Nosek & Smyth, 2011). Rather, it is women's *implicit* STEM-male stereotypes, which operate automatically and outside of conscious awareness, that negatively predict women's STEM interests and aspirations. That is, stereotypes do not need to be consciously endorsed for them to influence the attitudes and behaviors involved in making career choices.

Influence of situationally-activated stereotypes. Stereotypes of STEM as male-oriented, even if not chronically active, can be situationally activated by cues in the immediate social context. Environmental cues, such as objects in STEM settings or interactions with people who embody STEM stereotypes, can signal to women that they have little in common with the people in STEM and that they will not fit in and do not belong in those fields (Cheryan et al., 2015).

Evidence across multiple studies demonstrates that physical objects in academic environments can broadcast stereotypes about the people associated with those environments and serve as a cue of who belongs there. In one study, undergraduate students were brought to one of two computer science classrooms (Cheryan et al., 2009). One classroom was decorated with objects stereotypically associated with computer science majors, such as Star Trek memorabilia, soda cans, computer parts, and science fiction books. The other classroom was decorated with objects that were non-stereotypic, such as plants, art posters, water bottles, and a coffee maker. As predicted, women in the stereotypic classroom felt a lower sense of belonging, and consequently reported less interest in computer science, than women in the non-stereotypic classroom. Men's sense of belonging and interest did not differ between the two classrooms. These results have been replicated using virtual classrooms (Cheryan, Meltzoff, & Kim, 2011) and with high school students (Master, Cheryan, & Meltzoff, 2016). When environments match current male-oriented stereotypes, women who do not see themselves as fitting those stereotypes feel a mismatch and are discouraged from entering.

If stereotypic physical environments can deter women from STEM fields, can encounters with stereotypic STEM students also deter women? To test this idea, researchers had undergraduate women who were not majoring in computer science interact with a peer role model who was majoring in computer science (Cheryan, Drury, & Vichayapai, 2013; Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). The role model either embodied current stereotypes of computer scientists (e.g., reported interests in video games and science fiction and wore a t-shirt that read “I code therefore I am”) or did not (e.g., reported interest in hanging out with friends and wore a solid colored t-shirt). Women who interacted with the stereotypic role model reported lower belonging and less interest in computer science (Cheryan, Drury et al., 2013) and were less confident in their ability to succeed in the major (Cheryan, Siy et al., 2011), compared to women who interacted with the non-stereotypic role model. Again, no effects were found for men who interacted with the role models. Interestingly, the gender of the role model had no effect on women’s interest in computer science: women were equally put off by the stereotypic female role model as they were the stereotypic male role model. These findings suggest that when recruiting women into STEM fields, what may matter most is not the gender of role models, but whether the role model matches current male-oriented stereotypes (Drury, Siy, & Cheryan, 2011).

Stereotypes about the people in STEM can deter women from STEM when those stereotypes do not match how women view themselves. But these are not the only stereotypes that inform perceptions of STEM fields. There are also stereotypes about the type of work that is done in STEM and whether that work matches one’s values and goals.

Stereotypes about the work involved in STEM

Math-intensive STEM fields, particularly physics, engineering, and computer science, are perceived as involving work that is done alone and focused on things and objects rather than work that is collaborative and/or focused on helping others (Diekman, Brown, Johnston, & Clark, 2010; Morgan, Isaac, & Sansone, 2001; Masnick, Valenti, Cox, & Osman, 2010; National

Academy of Engineering, 2008). In other words, STEM fields are (mis)perceived as unlikely to fulfill communal goals of working with or helping others.

This view, of course, is inaccurate. STEM work is highly collaborative (Lee & Bozeman, 2005; Sonnenwald, 2007) and often focused on solving problems that will help improve people's lives (Burke, Bergman, & Asimov, 1985; Understanding Science, 2013). For instance, mathematicians help plot safe trajectories for fireworks on the Fourth of July to ensure public safety and satisfaction. Physicists help determine how to stabilize power grids and prevent blackouts. Computer scientists create technology that enables quality education to be accessed in locations that were previously underserved. Engineers design cost-effective methods to bring clean water to impoverished communities.

Unfortunately, students are not getting the message that math-intensive STEM careers involve collaboration and can positively benefit society and help others; instead, students view math-intensive STEM careers as less likely to fulfill communal goals than other careers (Diekman et al., 2010; Masnick et al., 2009; Morgan et al., 2001). (Mis)perceptions that math-intensive STEM fields are incongruent with communal goals are concerning because they are likely to deter communally-oriented individuals (Diekman & Steinberg, 2013; Diekman et al., 2016; Diekman, Weisgram, & Belanger, 2015).

Communal goals are highly valued by both women and men (Diekman, Clark, Johnston, Brown, & Steinberg, 2011; Hayes & Bigler, 2013) and reflect a basic human motive to care for and affiliate with others (Baumeister & Leary, 1995). However, women are particularly likely to be communally-oriented (Diekman et al., 2010, 2011; Weisgram, Bigler, & Liben, 2010). Social role theory (Eagly, 1987; Eagly, Wood, & Diekman, 2000) suggests that this gender difference emerges from the distribution of women and men into different social roles. Because women have traditionally occupied caretaking roles, the female gender role is associated with traits and goals that are communal and focused on others, such as being nurturing, warm, and helpful. By contrast, because men have traditionally occupied provider and leadership roles, the male gender role is associated with traits and goals that are agentic and self-focused, such as being competitive, independent, and focused on achieving status and recognition. Through a process of socialization, women and men come to enact these prescribed gender roles and to pursue goals congruent with these gender roles (Diekman & Eagly, 2008).

People are motivated to pursue careers that will help them achieve their goals and values, and they avoid careers that don't fit their goals and values. Perceiving math-intensive STEM careers as impeding communal goals thus deters communally-oriented individuals, regardless of gender. But because women value communal goals more than men do, women more so than men are deterred by perceptions of STEM as uncommunal (Diekman et al., 2015, 2016; Diekman & Steinberg, 2013). Indeed, correlational data suggest that communal goal endorsement partially accounts for the gender difference in STEM interest (Diekman et al., 2010). In addition, experimental evidence shows that when communal goals are temporarily activated, students report less interest in STEM careers (Diekman et al., 2011).

The reason that communal goal endorsement negatively predicts STEM interest is because STEM careers are viewed as incongruent with communal goals. People who believe more strongly that STEM careers provide opportunities for working with and helping others report greater interest in STEM careers compared to their peers (Brown, Thoman, Smith, & Diekman, 2015; Weisgram & Bigler, 2006). Likewise, portraying STEM careers as affording communal goals increases STEM interest (Brown, Smith, Thoman, Allen, & Muragishi, 2015; Diekman et al., 2011). In one study, undergraduate women reported greater positivity toward

STEM careers after reading about a scientist whose daily activities were highly collaborative versus highly independent (Diekman et al., 2011, Study 3). The gender of the scientist role model did not moderate results; what mattered most in changing perceptions and attitudes toward STEM was whether the scientist engaged in communal activities, not whether the scientist was male or female (Clark, Fuesting, & Diekman, 2016). These results suggest that female *and* male scientists can both inspire greater positivity toward STEM careers when they emphasize the communal aspects of their work.

Importantly, beliefs about communal goal affordances uniquely predict gender distributions across traditionally male-dominated careers. Math-intensive STEM careers are perceived as less communal than other traditionally male-dominated careers such as law and medicine, which may help explain why law and medicine have experienced greater increases in women's participation than math-intensive STEM careers. A related perspective is that STEM careers are perceived as requiring long hours and devotion to work at the expense of family goals. Some evidence suggests that women opt out of math-intensive careers because they prefer work that allows them to achieve family goals (e.g., Ceci et al., 2009; Ferriman, Lubinski, & Benbow, 2009; Frome, Alfeld, Eccles, & Barber, 2006; Williams & Ceci, 2012). However, other traditionally male-dominated careers such as medicine and law also require long hours and work devotion, yet those fields have experienced an increase in women's participation. Women may be more interested in entering medicine and law despite long hours because those fields are perceived as fulfilling other communal goals of working with and helping others (Cheryan, 2012). Long hours and work-devotion norms certainly contribute to gender disparities in the workplace (Williams, Blair-Loy, & Berdahl, 2013), but these factors seem to contribute to gender disparities across many fields, not just STEM fields specifically (Cheryan et al., 2016).

Thus far the chapter has discussed stereotypes about STEM fields and how those stereotypes can make STEM fields unattractive to women and girls. Yet even when women and girls *are* attracted to STEM fields, other stereotypes can impede their progress. The next section focuses on negative stereotypes about women's STEM abilities and how those stereotypes can create obstacles that constrain women's potential and opportunities in STEM.

Stereotypes about women's STEM ability

Women are perceived as possessing fewer of the qualities associated with STEM success than are men. Successful scientists are stereotyped as having agentic qualities, such as being ambitious, analytic, dominant, competitive, intelligent, and confident – qualities that are more closely associated with men than women (Carli et al., 2016). The result is that women are negatively stereotyped as lacking the traits and abilities needed to succeed in STEM roles. Unfortunately, the stereotyping climate is stronger in fields where women are more severely underrepresented (Hewlett et al., 2008; Kanter, 1977; Leslie et al., 2015; Loken, Cundiff, Vescio, & Lo, 2017; Robnett, 2016; Smith, Brown, Thoman, & Deemer, 2015; Steele, James, & Barnett, 2002). These negative stereotypes can have deleterious effects by eroding women's self-efficacy, by creating threatening environments that impair women's achievement and motivation, and by biasing evaluations and allocation of valued resources.

Negative stereotypes can erode women's self-efficacy

Stereotypes that women are less capable in STEM than men can cause women to doubt their own STEM abilities. For example, the more that girls experience stereotypic comments about girls' STEM abilities, the less competent they feel in their own STEM abilities (Brown & Leaper, 2010). By the time they enter high school, girls are well aware of negative stereotypes about women's STEM ability, and they rate their math competence lower than similarly performing boys (Correll, 2001; Sainz & Eccles, 2012). The pattern continues in college where, despite having similar GPAs, women engineering students report lower confidence in their engineering abilities compared with their male peers (Hein et al., 2012; Heylen et al., 2012). Undergraduate women also tend to underestimate their performance on math tasks (Reuben, Sapienza, & Zingales, 2014), are more likely than men to attribute failure on a math test to lack of math ability (Kiefer & Shih, 2006), and are unwilling to take the credit they deserve for successful performance on male-typed tasks when working with male collaborators (Haynes & Heilman, 2013).

Importantly, female students show lower self-assessments only for those tasks on which women are stereotypically perceived as less competent. For tasks where women are stereotyped as having an advantage, such as verbal tasks, the opposite pattern emerges: female students rate their verbal competence *higher* than similarly performing male students (Correll, 2001; Frome & Eccles, 1998; see also Beyer, 1998, 2002). Self-assessments are thus biased in the direction of gender stereotypes.

Stereotypes bias self-assessments because they influence the standard used to decide whether one's own performance indicates sufficient ability. For example, when students were led to believe that men tend to outperform women on a bogus task, women rated their own task ability lower than men and held themselves to a higher standard than men (e.g., reported needing a higher score than what men reported to be convinced they possessed high levels of task ability); by contrast, when led to believe there were no gender differences on the task, women and men reported similar standards and similar self-assessments of task ability (Correll, 2004). These findings provide evidence that, even in the absence of actual gender differences, *beliefs* about gender differences can powerfully influence self-assessments.

Self-assessments of ability are important because they predict career aspirations (Bandura, Barbaranelli, Caprara, & Pastorelli,; Eccles, 1994; Lent, Brown, & Hackett, 1994). Individuals must believe they have the ability to succeed in a given career to be motivated to pursue that career. If girls/women do not believe they have the ability to succeed in STEM roles, they will likely opt for careers in other fields where they feel more confident (Buse, Bilimoria, & Perelli, 2013; Cech, Rubineau, Silbey, & Seron, 2011; Lent et al., 2005; Moakler & Kim, 2014; Sainz & Eccles, 2012; Singh et al., 2013). For example, in Correll's (2004) study described above, when led to believe that men outperform women on the task, women felt less confident in their task ability than men and, as a result, were less interested in pursuing careers that required high task ability. Stereotypes can thus dampen interest in stereotype-relevant careers by depressing self-assessments and confidence in one's ability to succeed (Eccles, Jacobs, & Harold, 1990; Gunderson, Ramirez, Levine, & Beilock, 2012; Jacobs & Weisz, 1994; Schmader, Johns, & Barquisau, 2004; Smith, Brown et al., 2015).

Negative stereotypes can create threatening environments

Even when women reject stereotypes about male superiority in STEM, merely being aware that others may endorse the stereotype can pose a "threat in the air" for women that arouses concerns about being devalued, marginalized, or treated unfairly simply because of their gender (Crocker, Major, & Steele, 1998; Major & O'Brien, 2005; Steele, 1997). These concerns create an extra psychological burden that undermines women's achievement and motivation through a process known as *social identity threat* (Cohen & Garcia, 2008; Steele, Spencer, & Aronson, 2002; Thoman, Smith, Brown, Chase, & Lee, 2013). Indeed, stronger feelings of identity threat among undergraduate STEM students predict weaker intentions to persist in STEM careers (Beasley & Fischer, 2012; Woodcock, Hernandez, Estrada, & Schultz, 2012).

Social identity threat is easily triggered in stereotype-relevant contexts, such as STEM settings, where individuals are aware of negative stereotypes about their group (McKown & Weinstein, 2003; Murphy, Steele, & Gross, 2007; Nguyen & Ryan, 2008; Spencer, Steele, & Quinn, 1999; Walton & Spencer, 2009). For example, simply being in a situation where one can potentially confirm a negative stereotype – such as a woman taking a math exam – can create added pressure to prove oneself, which can elicit physiological stress responses that interfere with cognitive processing and ultimately undermine performance (Beilock, Rydell, & McConnell, 2007; Inzlicht & Schmader, 2012; O'Brien & Crandall, 2003; Schmader, Johns, & Forbes, 2008).

However, not all STEM settings are equally threatening, and cues in the immediate social context can make some STEM settings more threatening than others (Emerson & Murphy, 2014; Murphy & Taylor, 2012; Wout, Shih, Jackson, & Sellers, 2009). What sorts of situational cues activate stereotypes and trigger identity concerns? I focus here on two cues that have received considerable support in the literature: numerical representation and others' behavior.

Numerical representation. Seeing that one's social group is underrepresented can raise the specter of stereotypes and concerns about whether one belongs and will be valued in the setting (Dasgupta, 2011). In one study, women STEM majors watched a video advertising a summer STEM conference (Murphy et al., 2007). The video showed either gender-imbalance (with women making up only 25% of conference-goers) or gender-balance at the conference. Women who watched the gender-imbalanced video experienced greater physiological stress responses, anticipated belonging less at the conference, and were less interested in attending the conference compared to women who watched the gender-balanced video. The lack of female peers in the video served as a threatening cue that dampened women's desire to participate in

STEM opportunities, despite the fact that these women were highly identified with STEM and demonstrated high math ability and confidence.

Other studies show that women's performance suffers in contexts where they are outnumbered by men, especially when negative stereotypes are relevant to the task at hand (Thompson & Sekaquaptewa, 2002). For instance, undergraduate women performed worse on a math exam when they completed the exam in a room with two men compared to a room with two other women (Inzlicht & Ben-Zeev, 2003). Women's performance on a verbal exam, by contrast, was unaffected by the gender composition of the room (Inzlicht & Ben-Zeev, 2000; see also Sekaquaptewa &Thompson, 2003). Even the imagined presence of a male majority can suppress performance: undergraduate women performed worse on a math exam after reading a news article highlighting that women remain underrepresented, compared to equally represented, in STEM fields (Shaffer, Marx, & Prislin, 2012). These results suggest that a seemingly innocuous cue – the number of men within a setting – can create a threatening environment that interferes with the ability to perform as well as might otherwise be possible.

Importantly, being in the gender minority does not have the same negative effects on men. Men perform just as well on math exams when surrounded by women as when surrounded by other men (Inzlicht & Ben-Zeev, 2000; Sekaquaptewa & Thompson, 2003; Shaffer et al., 2012; Thompson & Sekaquaptewa, 2002). The key difference is that men do not contend with negative stereotypes about their math ability. Minority situations are most threatening to those for whom negative stereotypes apply. In addition, women and men have historically experienced different outcomes when they are the minority. Women in male-dominated occupations tend to experience negative outcomes, such as sexual harassment, social isolation, marginalization, and exclusion (Kanter, 1977; King, Hebl, George, & Matusik, 2010; Konrad, Winter, & Gutek, 1992;

Spangler, Gordon, & Pipkin, 1978; Yoder, 2002). Men in female-dominated occupations, by contrast, tend to experience positive outcomes, such as comfort with co-workers and preferential treatment that propels men into leadership positions (Cross & Bagilhole, 2002; Simpson, 2004; Williams, 1992). These different histories make the cue of numeric representation more meaningful for women than men and therefore signals to women, but not men, the possibility of devaluation and marginalization.

Others' behavior. Identity threat can also be triggered by other people's behavior. Women in STEM report experiencing micro-inequities – minor slights, exclusions, or negative treatment rooted in gender stereotyping (Rowe, 1990) – in their daily interactions with STEM colleagues (Erickson, 2012; Faulkner, 2009a; Hewlett et al., 2008; Settles, Cortina, Malley, & Stewart, 2006; Steele, James et al., 2002). A recent survey of female students in STEM revealed that 61% had experienced sexist treatment in the past year, such as being ignored, excluded, or insulted based on their gender; students in math-intensive STEM fields were more likely to experience these negative behaviors than students in other STEM fields (Robnett, 2016). Similarly, a survey of women STEM professionals (Hewlett et al., 2008) found that 63% had experienced sexual harassment at work, including predatory behavior, vulgarities, and sexual humor. The survey also found that 43% of women in engineering and 37% in technology reported working with men who avoid women and act condescendingly and arrogantly toward women.

Negative behaviors and micro-inequities, even when subtle and seemingly minor, accumulate to create a "chilly climate" in STEM that leaves women discouraged, dissatisfied, and questioning whether they can and want to fit in STEM professions (Amelink & Creamer, 2010; Faulkner, 2009b; Good, Rattan, & Dweck, 2012; Hayes & Bigler, 2013; Seron, Silbey, Cech, & Rubineau, 2016; Settles, Cortina, Buchanan, & Miner; Settles et al., 2006; Xu, 2008; Yoshida, Peach, Zanna, & Spencer, 2012). In a survey of over 5,500 women engineers (Fouad, Singh, Fitzpatrick, & Liu, 2012), women who reported being treated in a condescending and patronizing manner at work were more likely to think about leaving engineering than women who did not report these experiences. Of women who had left the profession, 30% reported that the negative workplace climate was a major factor in their decision to leave. Likewise, a daily diary study (Hall, Schmader, & Croft, 2015) found that the more that female engineers experienced negative conversations with male colleagues – conversations that made women feel incompetent and devalued – the more that women were concerned about being viewed in terms of their gender and felt mentally exhausted and disengaged at work. Negative conversations with men thus triggered identity threat, which in turn predicted psychological burnout.

Experimental laboratory studies provide causal evidence that others' negative behaviors trigger identity threat and undermine performance and motivation. In one set of experiments (Logel et al., 2009), male confederates were trained to act in either a sexist or non-sexist manner toward their female partners. In the sexist condition, the male confederate displayed dominant and sexually interested behaviors, which mirrored the behaviors of male engineering students who scored high on a measure of sexism. These behaviors included looking often at their partner's body, maintaining a confident facial expression, and sitting close to their partner with an open posture (e.g., shoulders back, knees wide apart). In the non-sexist condition, the male confederate sat further away with a forward lean, knees closed, and tentative facial expression. As predicted, interacting with the sexist confederate triggered identity threat in female engineering students and caused them to underperform on a difficult engineering test, compared to women who interacted with the non-sexist confederate (see also Gervais, Vescio, & Allen, 2011).

Negative treatment can have harmful effects even when it is directed toward other women and not the self. For example, female STEM students who witnessed other women being treated negatively (vs. positively) in science settings subsequently expressed greater gender stereotyping and reported lower intentions to continue in STEM after graduation (LaCosse, Sekaquaptewa, & Bennett, 2016). Even the mere suggestion that an instructor is sexist, in the absence of actual negative treatment, caused women to be less trusting of the instructor and perform worse on a logic test administered by the instructor, compared to women who were not exposed to the suggestion of sexism (Adams, Garcia, Purdie-Vaughns, & Steele, 2006). Being aware of sexist treatment by others, either by witnessing it directly or hearing about it from peers, creates a chilly climate that makes women apprehensive about being the target of prejudice and triggers harmful downstream consequences for women.

Others' behavior does not necessarily need to be perceived as negative to have harmful consequences; seemingly positive behavior can also be consequential. Sexism scholars (Glick & Fiske, 1996, 2001) have distinguished between two forms of sexism: hostile sexism and benevolent sexism. Hostile sexism consists of overtly negative behaviors and antipathy toward women, whereas benevolent sexism involves affectively positive yet patronizing and condescending beliefs that woman are warm and virtuous but incompetent and thus in need of men's protection and help. Because benevolent sexism seems subjectively positive and well intentioned, it is more subtle than hostile sexism and thus more difficult to recognize as potentially harmful (Barreto & Ellemers, 2005; Barreto, Ellemers, Piebinga, & Moya, 2009). Yet, benevolent sexism can be just as harmful as hostile sexism. Being treated in a benevolently sexist manner, such as being praised but denied valued resources (Vescio, Gervais, Snyder, & Hoover, 2005), receiving unsolicited help from a man (Dardenne, Dumont, & Bollier, 2007; Salomon, Burgess, & Bosson, 2015), or being viewed through the lens of positive stereotypes (Dumont, Sarlet, & Dardenne, 2010), triggers threat responses, thoughts of incompetence, and interferes with cognitive processing and performance.

Just as being in the gender minority is less consequential for men than women, being subjected to sexist behavior is also less consequential. Men perform just as well when treated in a sexist manner as when treated in a non-sexist manner (Adams et al., 2006; Gervais et al., 2011; Vescio et al., 2005). Sexist treatment conveys different meanings to women and men because sexist treatment, like other situational cues, operate within broader systems of devaluation and privilege. For men, sexist treatment is limited to the immediate situation and has few implications for one's outcomes outside of the immediate context. For women, by contrast, sexist treatment has more ominous implications and implies a more chronic set of concerns that women are devalued members of the STEM community at large. These concerns elicit threat responses and create an extra psychological burden for women that harms women's potential and motivation in STEM.

Negative stereotypes can bias evaluations and allocation of resources

Stereotypes not only deplete women's psychological resources, but they also deplete women's access to material resources and opportunities by biasing the behaviors and decisions of powerful others. Gender bias does not necessarily result from a conscious desire to impede women's career progress in STEM. Rather, unintended biases stem from pervasive cultural stereotypes (Devine, 1989) that ascribe less competence, expertise, and inborn brilliance to women than men, yet also portray women as warm and as more likeable than men (Eagly &

Mladinic, 1994; Fiske, Cuddy, Glick, & Xu, 2002). These stereotypes are so widespread and deeply ingrained in our society that they are automatically activated for most people (Nosek et al., 2007) and can unconsciously influence the behavior of even the most egalitarian individuals (Devine, 1989; Dovidio & Gaertner, 2004), as well as both women and men to the same extent (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Reuben et al., 2014). In fact, people who believe they are more (vs. less) objective are more likely to engage in bias, in part because they do not feel the need to monitor against subtle biases (Monin & Miller, 2001; Uhlmann & Cohen, 2007). Yet when left unexamined, stereotypes can lead to various patterns of subtle gender bias, including: higher ability standards for women than men, exclusion of women from career-enhancing opportunities, and backlash toward women who demonstrate the masculine traits typically associated with success in STEM.

Higher ability standards. The qualities perceived as necessary for success in STEM overlap with stereotypes of men more than women. These stereotypes make it seem as though women are a bad fit for STEM roles (Carli et al., 2016; Eagly, 2004; Heilman, 1983). As a result, women are held to a higher standard than men to prove their STEM ability and thus require more evidence of competence than men to be seen as equally competent (Eagly & Mladinic, 1994; Foschi, 1996, 2000). Numerous studies have documented these double standards (Biernat & Kobrynowicz, 1997; DesRoches, Zinner, Rao, Iezzoni, & Campbell, 2010; Grunspan et al., 2016; Steinpreis, Andres, & Ritzke, 1999; Wenneras & Wold, 1997), including recent experimental studies in STEM contexts that ask participants to evaluate application materials randomly assigned to either a male or female name. Both women and men tend to rate materials as lower in quality (Knobloch-Westerwick, Glynn, & Huge, 2013), are less likely to hire the applicant (Reuben et al., 2014), and offer the applicant a lower salary and less mentoring (Moss-Racusin et al., 2012) when the applicant is female compared to male, even though the only difference between applicants is their gender. Likewise, mistakes and failures are judged more harshly for women than men, with women needing to make fewer mistakes than men to be judged as incompetent (Biernat, Fuegen, & Kobrynowicz, 2010).

Actual experiences of STEM professionals echo the patterns of bias demonstrated in experimental studies. Roughly two-thirds of women working in STEM report having to repeatedly prove themselves to be seen as equally good as their colleagues (Williams et al., 2014), compared to one-third of men (Williams, Li, Rincon, & Finn, 2016). Women also frequently report having their ideas stolen and their successes discounted and trivialized (Williams et al., 2014, 2016; Fouad et al., 2012; Hewlett et al., 2008; Seron et al., 2016). For instance, successes are more often attributed to external factors such as luck for women than for men, whereas failures are more often attributed to internal factors such as lack of ability (Deaux & Emswiller, 1974; Swim & Sanna, 1996; Tiedemann, 2000).

It is important to note that women who demonstrate exceptionally stellar ability in STEM are sometimes given higher evaluations than similarly stellar men (Williams & Ceci, 2015). This is because people tend to be more impressed with *outstanding* performance by a woman than a man (Biernat & Manis, 1994; Linville & Jones, 1980). Women who are merely high-performing, by contrast, tend to receive much lower evaluations and require more proof to be seen as equally competent as similarly high-performing men. It thus seems that women must achieve stellar status to avoid biased evaluations. However, achieving stellar status can be difficult when gender bias excludes women from career-enhancing opportunities.

Exclusion from career-enhancing opportunities. Women are more often excluded from opportunities that would help advance their careers. For instance, women are assigned more menial and devalued tasks, such as managing projects or taking notes, whereas men are assigned more technical and valued tasks that allow them to practice and showcase their STEM skills (Cech, 2013; Seron et al., 2016; Williams et al., 2014). Women also get fewer high-profile assignments that provide opportunity to showcase leadership skills than their male counterparts; instead, high potential women are assigned tasks that allow them to be seen as tactical doers rather than strategic thinkers and visionary leaders (Williams et al., 2016). Women also report feeling more pressure than men to engage in organizational citizenship behaviors that are stereotypically associated with the female gender role, such as attending company functions and helping others with their work, but are rewarded less than men for doing these behaviors (Allen, 2006). The unequal distribution of work assignments means that women are burdened by work that is unlikely to lead to career advancement, yet are excluded from work that would lead to promotion and raises.

In addition, women working in traditionally male-dominated environments are more likely than men to report feeling isolated and excluded from informal and social gatherings (Hewlett et al., 2008; Zimmerman, Carter-Sowell, & Xu, 2016). For example, interaction rituals used for building work relationships and signaling affection and bonds in engineering, such as handshakes and fraternal labels (e.g., “Hey man!”), are male-oriented and exclude women (Faulkner, 2009a). Exclusion not only contributes to a chilly climate and lower job satisfaction, but also limits women’s access to powerful social networks that are critical for advancing up the career ladder (Hewlett et al., 2008). Early-career women have less access to elite faculty than men do (Milkman, Akinola, & Chugh, 2015; Sheltzer & Smith, 2014) and report difficulty finding sponsors who are willing to support and advocate for their career advancement (Hewlett et al., 2008; Williams et al., 2016). Without sponsors, many women in STEM feel stalled in their careers (Hewlett et al., 2008).

Together, research evidence demonstrates that women have to work harder than men to earn career-enhancing opportunities and prove their competence and worthiness (Heilman, 2012). However, when women demonstrate extreme competence and take on stereotypically masculine roles, they risk facing backlash.

Backlash. Gender stereotypes prescribe that women ought to be warm and communal whereas men ought to be agentic and powerful (Glick & Fiske, 2001; Prentice & Carranza, 2002). When women violate gender role expectations by acting insufficiently feminine or too masculine, they are often met with social disapproval and negative repercussions referred to as *backlash* (Eagly & Karau, 2002; Rudman & Phelan, 2008). This poses a problem for women in STEM because success in STEM is associated with masculine traits. Women who are successful in male gender-typed fields that require agentic traits for success, such as STEM, are viewed as interpersonally hostile, cold, and selfish (Heilman, Wallen, Fuchs, & Tamkins, 2004). Being viewed as cold and hostile is disadvantageous for career advancement by hindering access to social networks (Casciaro & Lobo, 2005), reducing recommendations for salary increases and career opportunities (Heilman et al., 2004; Rudman & Fairchild, 2004), and reducing one's influence (Carli, 2001). Women are thus caught in a double-bind: women must act like men (e.g., be self-promoting, competitive, and aggressive) to demonstrate competence, but when they do, they are disliked and suffer social and economic repercussions that hinder their career advancement (Eagly & Karau, 2002; Heilman, 2012; Rudman & Phelan, 2008).

Summary

Two types of stereotypes – stereotypes about STEM fields and stereotypes about women's STEM ability – create barriers to the recruitment, retention, and advancement of women in STEM, particularly in math-intensive STEM fields of engineering, physics, and computer science. When people consider different career choices, they consider whether they will belong and fit in with others and whether the career will allow them to fulfill their goals and values. Current stereotypes about the people and the work involved in STEM careers provide unrealistically narrow and male-oriented profiles that are incongruent with the traits and values associated with the female gender role. When these stereotypes are present – either chronically or situationally activated – they constrain career choices and lead many women to conclude that STEM fields are not for them.

Women who do choose to enter STEM careers face additional stereotypes about women's STEM ability that impede their career progress. Gender stereotypes harm women's career prospects via internal processes that erode women's self-efficacy and comfort in STEM settings and via external processes that bias other people's behavior toward and evaluations of women in STEM. Negative stereotypes often operate under the radar and outside of conscious awareness, and their effects can seem innocuous and minor. Yet small effects can accumulate over time to create large gender disparities in STEM outcomes (Agars, 2004; Martell et al., 1996). Together, these findings suggest that gender gaps in STEM participation are not due to free choice but instead are covertly shaped by stereotypes that signal to women they do not belong in STEM fields and make it more difficult for women than men to succeed in STEM.

Recommendations

The research reviewed in this chapter demonstrates that stereotypes powerfully constrain women's participation and advancement in STEM fields. Even though these stereotypes sometimes operate unintentionally and outside of conscious awareness, that does not absolve responsibility. Stereotypes and the biases they produce disadvantage women regardless of intent; it is our responsibility to take action and actively interrupt bias, minimize its influence, and create identity-safe environments. Otherwise, by failing to act, we are culprits in sustaining gender inequity. So what can we do? Research evidence and theory point to several areas of intervention. The recommendations that follow below are certainly not exhaustive, but instead aim to provide a useful framework for considering strategies to promote gender equity in STEM.

Broaden the appeal of STEM

Current stereotypes about math-intensive STEM fields provide unrealistically narrow profiles of the types of people and type of work involved in STEM. An effective strategy for diversifying STEM may be to diversify STEM representations so that students do not have to fit a narrow profile to believe they can fit in and be successful in STEM. For example, exposure to STEM role models (Cheryan, Drury et al., 2013), physical environments (Cheryan et al., 2009, Cheryan, Meltzoff et al., 2011; Master et al., 2016), and work activities (Clark et al., 2016; Diekman et al., 2011) that defy (vs. confirm) current stereotypes increases women's sense of belonging and interest in STEM fields. Educators and practitioners should thus carefully consider how STEM fields are portrayed and who is selected to represent STEM fields to ensure variety. If STEM representations are all similar to one another, it sends the message that only one type of person can be successful in STEM. Diverse images, by contrast, signal that many different types of people belong in STEM. Importantly, diversifying the image of STEM will likely increase its appeal not only to women but also to other underrepresented groups, including ethnic minority students (Smith, Cech, Metz, Huntoon, & Moyer, 2014; Thoman, Brown, Mason, Harmsen, & Smith, 2015*)*, first-generation college students (Allen, Muragishi, Smith, Thoman, & Brown, 2015), as well as some men (Cheryan et al., 2015).

There are several concrete ways to integrate diverse images into educational settings. Problem sets and examples used in lecture and homework, for instance, can be reworded so that they reflect diverse experiences and do not assume prior knowledge about stereotypic male topics (McCullough, 2004; Trefil & Swartz, 2011). Course projects can be adapted to be congruent with communal goals of working with and helping others, for example, by having students work together to design products that will positively impact people's lives. Physical spaces can be redesigned to appeal to many students, rather than a subset of students, by including gender-neutral objects and colors. Invited speakers and other role models can be selected that represent a variety of different backgrounds and interests. Likewise, role models can emphasize the aspects of their personality, hobbies, and daily work activities that do not match current stereotypes. The point is not to completely remove current stereotypes, because some students are attracted to those stereotypes, but rather to broaden the image of STEM so that students who do not fit current stereotypes feel like they could belong and succeed in STEM (Cheryan et al., 2015).

Address gender bias

Broadening the appeal of STEM may help inspire more women to enter STEM fields, but women are unlikely to persist and advance if the climate in STEM makes it difficult for women to succeed. To achieve gender parity, it is essential that STEM environments address gender bias. Overtly sexist behavior, such as sexual harassment and derogatory comments, can be reduced by changing features of the organizational context. For example, strong leadership that sets egalitarian norms, establishes clear expectations for respectful behavior, implements antidiscriminatory policies, and sanctions sexist behavior swiftly, justly, and consistently sends the message that discrimination is unacceptable and will not be tolerated. Such contexts tend to have fewer problems with overtly sexist behavior, compared to contexts with lax enforcement and permissive leadership (Cortina, 2008; Feldblum & Lipnic, 2016; Hulin, Fitzgerald, & Drasgow, 1996).

Although effective leadership and policies can help eliminate overt bias, subtle forms of bias that stem from unconscious stereotypes are likely to persist without direct intervention. Most people are unaware of how unconscious stereotypes interfere with their own judgments and behaviors. To address this problem, social scientists have recently begun to develop theory-based interventions aimed at educating individuals so they are better able to detect and address subtle bias (e.g., Carnes et al., 2012, 2015; Moss-Racusin et al., 2016; Smith, Handley, Zale, Rushing, & Potvin, 2015). One example is the Workshop Activity for Gender Equity Simulation (WAGES; Shields, Zawadzki, & Johnson, 2011), which engages participants in a game-like simulation of cumulative subtle gender bias. Experimental studies demonstrate that WAGES effectively decreases sexist attitudes (Zawadzki, Shields, Danube, & Swim, 2014), increases awareness of gender bias (Cundiff, Zawadzki, Danube, & Shields, 2014; Shields et al., 2011; Zawadzki, Danube, & Shields, 2012) and increases detection of and behavior to address bias (Cundiff, Danube, Zawadzki, & Shields, 2017). STEM organizations and institutions could consider implementing educational interventions, such as WAGES, to raise awareness of subtle bias, with the recognition that interventions should incorporate key elements (Moss-Racusin et al., 2014) and likely need to be tailored to specific audiences, outcomes, and contexts.

STEM contexts should also implement *bias interrupters*, which are intentional acts to disrupt the negative influence of unconscious stereotypes (Williams, 2014). One way that bias can be interrupted is by empowering individuals to intervene when they notice micro-inequities (for examples, see Williams & Dempsey, 2014). Bias can also be interrupted by making small tweaks to business practices involved in hiring, promotion, mentoring, and assignments. For example, job advertisements can avoid using stereotypically masculine words, such as *dominant* and *competitive*, which can deter women from applying (Gaucher, Friesen, & Kay, 2011). Hiring committees can commit to a specific set of criteria prior to evaluating candidates (Uhlmann & Cohen, 2005). Devalued tasks such as office housework can be more evenly distributed across employees by establishing a rotation or by assigning them to administrative staff when appropriate (Williams, 2014). Importantly, because bias is most visible in aggregate data rather than single cases (Crosby, Clayton, Alksnis, & Hemker, 1986), it is imperative that organizations continually aggregate and compare the outcomes of women and men on key metrics (e.g., high-profile assignments, office housework, promotion rates, salary) to identify patterns of bias and track improvements (Williams, 2014).

Remove the threat of negative stereotypes

Addressing gender bias in STEM is necessary, but change can be slow and stereotypes can be persistent (Valian, 1999). Awareness of negative gender stereotypes can lead women to question whether they will belong, be valued, and be treated fairly in STEM settings. These concerns are legitimate and adaptive, but can be burdensome and constrain women’s full potential. To address these concerns, social psychologists have developed scientific interventions that change how students think and feel about their social environments and provide students with more optimistic ways to interpret negative experiences (Aguilar, Walton, & Wieman, 2014; Cohen, Purdie-Vaughns, & Garcia, 2012; Yeager, Walton, & Cohen, 2014). Everyone experiences negative events, such as being excluded from a study group or receiving a poor grade on an exam, but for students who contend with stereotypes, negative events are more meaningful and signal to these students that they do not belong in STEM. Simple but carefully implemented interventions can provide students with alternative perspectives for interpreting negative events. Importantly, these interventions are designed to catalyze student potential and academic resources in ways that complement rather than replace structural changes.

One intervention focuses on changing students' beliefs about the nature of STEM ability (Dweck, 2007). Some students believe that STEM ability is fixed and cannot change. For these students, setbacks (e.g., a poor grade on a math exam) represent a lack of ability, which makes stereotypes that imply low ability even more sinister and threatening. By contrast, teaching students that ability is expandable and can be developed over time with hard work and good strategies – known as a *growth mindset* – buttresses the debilitating effects of ability stereotypes and increases motivation and achievement, especially among girls for whom negative stereotypes apply (Blackwell et al., 2007; Good, Aronson, & Inzlicht, 2003; see also Good et al., 2012). STEM educators and leaders can emphasize growth mindsets by, for example, rewarding development rather than achievement, providing students with opportunities to revise their work, portraying famous scientists as deeply committed and hard-working rather than innately brilliant, sharing their personal stories of struggle and setbacks, and normalizing help-seeking behavior by portraying it as a necessary and expected component of achieving success. These strategies send the message that STEM ability is a quality that must be developed, rather than one that is innate, which makes stereotypes less credible and less threatening.

Another intervention focuses on students' concerns about belonging. Uncertainty about belonging can lead students to interpret even commonplace social stressors, such as difficulty making friends or having one's ideas criticized, as evidence they do not belong in general.

However, conveying to students that concerns about belonging are normal and dissipate with time can lessen the sting of negative social experiences and help students cope effectively (Walton, Logel, Peach, Spencer, & Zanna, 2015; see also Walton & Cohen, 2007, 2011). One way to convey these messages is to present students with results from a student survey showing that almost all upper-level students had initially worried about being accepted by other students and professors, but with time and good strategies, they eventually made friends, developed positive relationships with professors, and now felt comfortable and accepted. STEM educators and mentors could also share their own experience with concerns and struggles they have faced and how they coped. The goal is to normalize concerns (e.g., everyone feels this way in the beginning) and portray positive outcomes as likely and obtainable.

A third intervention known as *values-affirmation* has also successfully reduced gender gaps in STEM outcomes (Martens, Johns, Greenberg, & Schimel, 2006; Miyake et al., 2010). The intervention typically involves a writing activity in which students reflect upon and affirm core personal values (e.g., personal relationships, being creative, religious beliefs). The activity reminds students they are more than a stereotype and reinforces self-worth and integrity, which enables students to persevere in the face of setbacks. By putting commonplace stressors in a broader context, values-affirmation interventions make negative events seem less significant and help attenuate fears that stifle learning and effective coping (Cohen & Sherman, 2014; Critcher & Dunning, 2015; Sherman et al., 2013).

The interventions described above – growth-mindset, social-belonging, and values-affirmation – are brief and seemingly simple yet have powerful and long-lasting effects, making them seem almost magical (Yeager & Walton, 2011). However, to be effective, psychological interventions must be *wise* – that is, carefully crafted, stealthy, timely, and avoid stigmatizing participants as in need of help (Walton, 2014). Wise interventions improve the experiences and outcomes of not only women, but also other stigmatized groups who contend with the threat of negative stereotypes, including ethnic-minority students (Walton & Cohen, 2007, 2011) and first-generation college students (Harackiewicz et al., 2014).

In addition to wise psychological interventions, exposure to female role models can also buffer women from the harmful effects of stereotypes (Dasgupta, 2011; McIntyre, Paulson, & Lord, 2003; Stout, Dasgupta, Hunsinger, & McManus, 2011). Female role models provide women with accessible models for achieving success in STEM, enabling women to imagine themselves in STEM roles and the pathways to get there. STEM departments can increase exposure to female role models by inviting female speakers to campus and by including stories of successful women in course content. Of course, role models will be most effective when they are perceived as similar to the women they aim to inspire (Asgari et al., 2012; Betz & Sekaquaptewa, 2012; Cheryan, Drury, et al., 2013; Marx & Ko, 2012) and are fully integrated into curriculum rather than marginalized and presented as an afterthought (Cundiff, 2013).

In addition to female role models, social support and encouragement from close others fosters women's persistence and success in STEM (Aschbacher, Li, & Roth, 2010; Buday, Stake, & Peterson, 2012; Leaper, Farkas, & Brown, 2012; London, Rosenthal, Levy, & Lobel, 2011; MacPhee, Farro, & Canetto, 2013; Richman, vanDellen, & Wood, 2011). To capitalize on the positive benefits of social support, departments could sponsor peer mentoring programs that pair beginning students with upper-level students. They could also provide opportunities for students to network with alumni and local professionals, as well as sponsor students to attend conferences (e.g., Grace Hopper Celebration of Women in Computing) where they can develop a peer network and meet other students who are similar to themselves.

Conclusion

Stereotypes create subtle barriers to gender equity in STEM. These barriers are subtle in the sense that they are often taken for granted as business as usual. People are not necessarily intending to dissuade girls/women from pursuing STEM careers or intending to impede women's advancement in STEM careers. Yet, when left unexamined, business as usual – including the objects we choose to display, the people we choose to represent STEM, and the procedures we choose for hiring, promotion, and assigning tasks – inadvertently detracts talented individuals from STEM and constrains the ability of STEM fields to capitalize on the full potential of a diverse talent pool. Even when bias is unconscious, that does not absolve us of responsibility; we have a responsibility to interrupt unconscious bias and minimize its effects on our behavior. By critically examining and rethinking business as usual, we can better recognize hidden barriers and work to interrupt the processes that prevent talented individuals from pursuing and succeeding in STEM.

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