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When Do Female Role Models Benefit Women? The Importance of Differentiating Recruitment From Retention in STEM

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Increasing the participation of women in science, technology, engineering, and mathematics (STEM) involves two distinct challenges. One is increasing the *retention* of women who are already in STEM fields. The second is increasing the *recruitment* of women who enter the STEM pipeline. Nilanjana Dasgupta (this issue) suggests that female role models assist in both of these efforts by improving women's performance and sense of belonging in STEM. In the current article, we conceptually differentiate recruitment from retention and propose that although female role models may be effective in the retention of women in STEM, female and male role models can be equally effective in recruitment efforts. For interventions using role models to be most effective, we must understand when female role models matter and when male role models can be just as effective. Doing so helps to ensure we are "rendering onto the right students the right intervention" (Steele, 1997, p. 624).

Retention: The Power of Female Role Models

Same-gender role models are helpful for women who are already in STEM fields. Women who are in STEM fields contend with negative stereotypes that cast doubt on their abilities to perform well in these fields (Spencer, Steele, & Quinn, 1999). The fear of confirming these negative stereotypes, known as stereotype threat (Steele, 1997; Steele & Aronson, 1995), causes women who are personally identified with the domain to underperform (Schmader, Johns, & Forbes, 2008; Spencer et al., 1999) and disidentify with the field (Davies, Spencer, & Steele, 2005; Murphy, Steele, & Gross, 2007). Interventions designed to prevent harmful effects of stereotype threat can thus protect women by preventing them from underperforming and leaving the field.

One such intervention involves deploying female role models. Female role models inoculate women who are highly identified with STEM against the harmful effects of such negative stereotypes (Marx & Roman, 2002; Stout, Dasgupta, Hunsinger, & McManus, 2011). Women who were highly identified with math performed better on a math test when they encountered a female role model (i.e., a woman who was portrayed as highly competent in math) than when they encountered a male role model (Marx & Roman, 2002). Similarly, taking a calculus course with a female professor enhanced women's implicit math self-concept and improved their implicit attitudes toward math compared to taking a calculus course with a male professor (Stout et al., 2011). Finally, women who read about a successful graduate of their university who majored in the same field as them rated themselves higher on success-related traits when the role model was female compared to male (Lockwood, 2006). Female role models are thus effective in preventing women who are highly identified with STEM from underperforming and disidentifying from the field.

Recruitment: Male and Female Role Models Are Equally Effective

To our knowledge, all experiments that have shown benefits of female versus male STEM role models have done so in retention contexts with women in the field or otherwise highly identified with STEM.[1] To increase the representation and success of women in STEM, we must not only retain women in the field but also improve the recruitment of women into STEM (de Cohen & Deterding, 2009). Women enter STEM majors at lower rates than would be predicted by their abilities in these fields (Ceci, Williams, & Barnett, 2009; Strenta, Elliott, Adair, Matier, & Scott, 1994). There are no longer gender differences on standardized tests of math abilities (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), and in high schools in the United States, girls now take as many STEM classes as boys and receive higher grades than boys (Ceci

[1]One experiment by McIntyre, Paulson, and Lord (2003) found that undergraduate women performed better on a math test after they learned about the achievements of other women compared to when they did not learn about role models. However, because the control condition of this study used no role model instead of a male role model, it is difficult to know whether improved performance was due to the presence of a successful exemplar or if it was specific to female role models.

et al., 2009; Stockard & Wood, 1984). Despite these markers of progress, women and girls remain much less likely to choose STEM careers than their male peers (Ceci & Williams, 2010; Cheryan, in press), suggesting a need for greater recruitment of women into STEM.

Efforts to recruit more women into STEM fields commonly rely upon the use of female role models. Female engineers are sent to high school classrooms (e.g., MIT's Women's Initiative), Web sites tout the careers of female scientists and engineers (National Academy of Engineering's http://www.engineergirl.org), and companies run camps specifically targeted at exposing girls to computer science and engineering (e.g., Microsoft's DigiGirlz). Many such programs showcase successful women in the field based on the assumption that female role models have an immediate and enduring influence on girls' and women's aspirations. This assumption is so widespread that women who have achieved great success in their fields often cite the desire to attract other women into their field as one of the main reasons they choose to make public appearances (see Biskupic, 2009, and Campbell & Wolbrecht, 2008, for quotes from Supreme Court justice Ruth Bader Ginsburg and U.S. senator Susan Collins).

However, empirical data suggest that when it comes to recruiting, female role models may be no more effective than male role models in drawing women into STEM. Correlational data from several departments across three universities (Princeton, University of Michigan, and Whittier College) found that increases in the proportion of female faculty in a department did not lead to subsequent increases in the proportion of female students who majored in that field (Canes & Rosen, 1995; see also Price, 2010). Further, when women in male-dominated fields looked back on who influenced them to pursue STEM, they were just as likely to report male role models as female role models (Baruch & Nagy, 1977; Downing, Crosby, & Blake-Beard, 2005; Lunneborg, 1982). Although this finding could be due to the greater representation of men in the field, it suggests that men can successfully serve as role models for women. Experimental work also runs counter to assumptions about the efficacy of female versus male role models in recruiting. In one set of experiments, women who interacted with an upperclassman computer science major were just as interested in majoring in computer science and anticipated being equally successful in the field regardless of whether their interaction partner was female or male (Cheryan, Drury, & Vichayapai, 2011; Cheryan, Siy, Vichayapai, Drury, & Kim, in press). In another set of experiments, women who were told about an introductory computer science course were no more interested in enrolling in that course when the professor was female than when he was male (Cheryan, Tabak, & Meltzoff, 2011).[2] Together, these data suggest that when recruiting women into STEM, providing female role models may not always be more effective than providing male role models.

Why might female versus male role models be effective in the retention of women but less effective in recruiting women into STEM? The psychological threats that prevent recruitment are different from those that prevent retention. Negative stereotypes about women's abilities are less of a concern for women who have yet to identify with the domain than they are for STEM-identified women (Schmader et al., 2008; Steele, 1997). As a result, deploying female instead of male role models, an intervention that is designed to reduce the threat of negative stereotypes, may not be an effective strategy for the population of women who are not highly identified with STEM. Indeed, among women not highly identified with the field, feelings of belonging are a stronger predictor of women's interest in STEM than their concerns about negative stereotypes about their abilities (Cheryan & Plaut, 2010).

Instead, current stereotypes of the people in STEM fields—as unsociable and preoccupied with technology (Barbercheck, 2001)—may be more powerful factors in women's deterrence from STEM than the lack of female role models in the field. STEM stereotypes are a deterrent to women because they are perceived as masculine and incompatible with the female gender role (Cheryan, Plaut, Davies, & Steele, 2009; Diekman, Brown, Johnston, & Clark, 2010). These stereotypes are communicated through the media, environments, and role models (Cheryan, in press). Women who were exposed to an introductory computer science classroom environment containing objects that were stereotypical of the field (e.g., Star Trek posters, video games) experienced a decreased sense of belonging in computer science, lower interest in majoring in the field, and anticipated less success in computer science compared to women who were exposed to the same classroom with nonstereotypical objects (e.g., nature posters, water bottles; Cheryan, Meltzoff, & Kim, 2011; Cheryan et al., 2009)—regardless of whether the professor in the classroom was male or female (Cheryan, Tabak, et al., 2011). Similarly, encountering computer science role models who embody these stereotypes in appearance (e.g., wearing a T-shirt that says, "I code therefore I am") and preferences (e.g., reads *Electronic Gaming Monthly*) decreased women's sense of belonging, interest in majoring in the field, and anticipated

[2]Null effects of role model gender were obtained in the context of an intervention known to successfully recruit women into STEM: changing stereotypes of the field (discussed further in the upcoming paragraphs). Because role model gender did not influence recruiting but another intervention did, we can be more confident that null effects were due to role model gender and not to a flaw in the experimental design or the nature of the dependent measures.

success in computer science compared to encountering a computer science role model who did not embody these stereotypes (Cheryan, Drury, et al., 2011; Cheryan et al., in press). This effect was found regardless of whether the role model was male or female. Taken together, these results suggest that changing current stereotypes of STEM may be more effective in recruitment of women than replacing male role models with female role models.

Who Makes a Good Role Model? The Importance of Similarity

The analysis just presented elucidated how effective role models in recruitment might differ from effective role models in retention. However, one aspect of role modeling that may be important in improving both recruitment and retention of women in STEM is: a sense of perceived similarity to the role model. In recruitment, Cheryan et al. (2011) found that women felt more similar to nonstereotypical versus stereotypical role models. This greater sense of similarity mediated the relationship between stereotypicality of role model and anticipated success in computer science. In addition, Diekman, Clark, Johnston, Brown, and Steinberg (in press) found that greater similarity between students' own communal goals (i.e., to work with and help others) and a STEM role model's daily activities predicted more positivity toward that role model's career. In addition, Stout and colleagues (2011) found that female students who related more to female faculty than male faculty had greater feelings of self-efficacy in math domains. Perceiving oneself to be similar to another person leads to an assimilation of self-views to the characteristics displayed by that person (Brown, Novick, Lord, & Richards, 1992; Collins, 1996; Lockwood & Kunda, 1997; Mussweiler, 2003). It is important to note that it is *perceptions* of this similarity, not an objective similarity, that most strongly influences people's responses to others (Murray, Holmes, Bellavia, Griffin, & Dolderman, 2002; Selfhout, Denissen, Branje, & Meeus, 2009). In fact, perceived similarity may be even more important than demographic similarity in predicting successful mentoring (Ensher, Grant-Vallone, & Marelich, 2002; Ensher & Murphy, 1997).

The factors that are salient for women in determining this perceived similarity may differ based on whether they are being recruited or retained. For women in STEM, negative stereotypes of women's abilities are salient, and women may feel a particular identification with female role models who help to demonstrate that negative stereotypes are unwarranted and that women can succeed in STEM (Lockwood, 2006). However, for women not yet identified with STEM, concerns about negative gender stereotypes are less of a barrier to participation than concerns about dissimilarity from people in the field (Cheryan & Plaut, 2010; Cheryan et al., 2009). Seeing an exemplar, whether male or female, who embodies traits compatible with how women see themselves may engender the sense of belonging that women need to become interested in STEM (Cheryan, Drury, et al., 2011).

Implications for Interventions

Female role models are currently being deployed both to help recruit more women into STEM and to retain them once they are there. However, our analysis suggests that female role models may be best saved for retention efforts, whereas male role models can be further encouraged to help with recruitment. Due to women's underrepresentation in the field, there is currently a dearth of women available to serve as STEM role models. As such, knowledge about where women's participation may have the biggest impact will help avoid overburdening women who are currently available to serve as STEM role models and further incorporate male role models into diversification efforts. Identifying the contexts in which female role models are most beneficial will allow for the design of interventions that effectively match the needs of the women they target.

This analysis also suggests that maximizing a sense of perceived similarity to role models is key in both recruiting and retaining women in STEM fields. Finding additional ways to connect with a role model is particularly important for recruiting efforts, as our analysis suggests that sharing the same gender might not be a sufficient source of similarity for female recruits. Moreover, because recruiting efforts necessarily entail role models being in a different field from the potential recruit, relying on a sense of similarity afforded by being in the same field (Lockwood & Kunda, 1997) is less available in recruiting than in retention efforts. As such, to increase their effectiveness, role models should be selected who are highly similar to students in other ways (e.g., attitudes, values: see Brown et al., 1992). This strategy may help to increase the number of role models available for both STEM recruitment and retention efforts.

Does This Analysis Undermine Diversity Efforts?

Our argument that male and female role models are equally effective in bringing more women into STEM may, at first glance, seem at odds with diversification efforts in STEM fields. After all, the efficacy of female role models is sometimes used as a justification for why we need more women in STEM (e.g., Anderson, 2011). However, acknowledging the effectiveness of both male and female role models in recruitment should not be seen as antithetical to diversity efforts for two reasons. First, as previously noted, female role models are key to the retention of women in STEM fields. Thus, bringing more women into STEM fields should help prevent other women from dropping out of these fields, thereby increasing women's participation over time.

Second, using both male and female role models can in some ways be seen as a *more* inclusive approach to alleviating gender disparities in STEM, as it broadens the role model pool to employ men. When all of the pressure to be a role model is placed on women in STEM, diversification may come to be seen as a female issue rather than a societal issue. By relocating some of the responsibility for recruitment onto men, we can ease the pressure on women in the field to assure that their gender is well represented in STEM. Such strategies have been effective in educational settings. For instance, enrollment of women in Harvard's notoriously difficult introductory computer science course has dramatically increased recently to its highest proportion. This change has been attributed to a male computer science professor who defies computer science stereotypes (e.g., he is also an emergency medical technician who volunteers each year at the Boston Marathon) and values pedagogical approaches that may appeal to women ("Harvard Portrait," 2009). This strategy will also help free women in STEM to participate in efforts where their presence may be most beneficial, such as retention.

One question that remains is whether our analysis applies when the goal is to diversify STEM along other demographic lines, such as race. Although much of the work on role models has focused on issues of gender, there is other work that has investigated the effects of role models matched for race. For Blacks who are highly identified with a domain, some studies have found that Black role models protect test performance (Marx & Goff, 2005), whereas other studies suggest they have no effect on test performance relative to White role models (Aronson, Jannone, McGlone, & Johnson-Campbell, 2009). To our knowledge, experimental work has yet to examine how same-race role models affect recruitment of minorities into academic domains. Future research should continue to investigate under what conditions role models representing other identities are effective in diversifying academic domains.

Conclusion

Women who have yet to identify with STEM experience a different set of concerns than those who are already identified (Kawakami, Steele, Cifa, Phills, & Dovidio, 2008; Schmader et al., 2008; Steele, 1997). For women who have already chosen the field, exposure to female role models protects performance (Marx & Roman, 2002) and improves their implicit STEM self-concepts (Stout et al., 2011). However, interventions designed to address stereotype threat, such as deploying female role models, may not most effectively address the concerns of women not yet in STEM (i.e., those we hope to recruit into this domain). Given the limited number of women in these fields, it may be most useful to concentrate their efforts on the retention of other women while encouraging more men in STEM to serve as role models for potential female recruits.

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Note

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References

Anderson, M. J. (2011, August 5). Why STEM needs women. *The Glass Hammer*. Retrieved from http://www.theglasshammer.com/news/2011/08/05/why-stem-needs-women/

Aronson, J., Jannone, S., McGlone, M. S., & Johnson-Campbell, T. (2009). The Obama effect: An experimental test. *Journal of Experimental Social Psychology*, *45*(4), 957–960.

Baruch, R., & Nagy, J. (1977). *Females and males in the potential scientist pool: A study of the early college years*. Washington, DC: National Science Foundation.

Barbercheck, M. (2001). Mixed messages: Men and women in advertisements in science. In M. Wyer, M. Barbercheck, D. Giesman, H. O. Ozturk, & M. Wayne (Eds.), *Women, science, and technology: A reader in feminist science studies* (pp. 117–131). London, England: Routledge.

Biskupic, J. (2009, May 5). Ginsburg: Court needs another woman. *USA Today*. Retrieved from http://www.usatoday.com/news/washington/judicial/2009-05-05-ruthginsburg_N.htm

Brown, J. D., Novick, N. J., Lord, K. A., & Richards, J. M. (1992). When Gulliver travels: social context, psychological closeness, and self-appraisals. *Journal of Personality and Social Psychology, 62*, 717–727.

Campbell, D. E., & Wolbrecht, C. (2008). See Jane run: Women politicians as role models for adolescents. *The Journal of Politics, 68*, 233–247.

Canes, B. J., & Rosen, H. S. (1995). Following in her footsteps? Faculty gender composition and women's choices of college majors. *Industrial and Labor Relations Review, 48*, 486–504.

Ceci, S. J., & Williams, W. M. (2010). Sex differences in math-intensive fields. *Current Directions in Psychological Science, 19*, 275.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin, 135*, 218–261.

Cheryan, S. (in press). Understanding the paradox in math-related fields: Why do some gender gaps remain while others do not? *Sex Roles*.

Cheryan, S., Drury, B. J., & Vichayapai, M. (2011). *The enduring effects of STEM-stereotypic role models on women's academic aspirations*. Manuscript in preparation.

Cheryan, S., Meltzoff, A. N., & Kim, S. (2011). Classrooms matter: The design of virtual classrooms influences gender disparities in computer science classes. *Computers & Education, 57*, 1825–1835.

Cheryan, S., & Plaut, V. C. (2010). Explaining underrepresentation: A theory of precluded interest. *Sex Roles, 63*, 475–488.

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*, 1045–1060.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (in press). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science*.

Cheryan, S., Tabak, J. T., & Meltzoff, A. N. (2011). *What matters in recruiting? Effects of professor gender and classroom environment on women's interest in STEM*. Manuscript in preparation.

Collins, R. L. (1996). For better or worse: The impact of upward social comparison on self-evaluations. *Psychological Bulletin, 119*, 51–69.

Davies, P. G., Spencer, S. J., & Steele, C. M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology, 88*, 276–287.

de Cohen, C. C., & Deterding, N. (2009). Widening the net: National estimates of gender disparities in engineering. *Journal of Engineering Education, 98*, 211–226.

Diekman, A. B., Brown, E., Johnston, A., & Clark, E. (2010). Seeking congruity between goals and roles: A new look at why women opt out of STEM careers. *Psychological Science, 21*, 1051–1057.

Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R., & Steinberg, M. (in press). Malleability in communal goals and beliefs influences attraction to STEM careers: Evidence for a goal congruity perspective. *Journal of Personality and Social Psychology*.

Downing, R. A., Crosby, F. J., & Blake-Beard, S. (2005). The perceived importance of developmental relationships on women undergraduates' pursuit of science. *Psychology of Women Quarterly, 29*, 419–426.

Ensher, E. A., Grant-Vallone, E. J., & Marelich, W. D. (2002). Effects of perceived attitudinal and demographic similarity on protégés' support and satisfaction gained from their mentoring relationships. *Journal of Applied Social Psychology, 32*, 1407–1430.

Ensher, E. A., & Murphy, S. E. (1997). Effects of race, gender, perceived similarity, and contact on mentor relationships. *Journal of Vocational Behavior, 50*, 460–481.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). DIVERSITY: Gender similarities characterize math performance. *Science, 321*, 494–495.

Kawakami, K., Steele, J. R., Cifa, C., Phills, C. E., & Dovidio, J. F. (2008). Approaching math increases math = me and math = pleasant. *Journal of Experimental Social Psychology, 44*, 818–825.

Lockwood, P. (2006). "Someone like me can be successful": Do college students need same-gender role models? *Psychology of Women Quarterly, 30*, 36–46.

Lockwood, P., & Kunda, Z. (1997). Superstars and me: Predicting the impact of role models on the self. *Journal of Personality and Social Psychology, 73*, 91–103.

Lunneborg, P. W. (1982). Role model influencers of nontraditional professional women. *Journal of Vocational Behavior, 20*, 276–281.

Malan, D. J. (2009, July–August). Harvard portrait. *Harvard Magazine*, p. 51.

Marx, D. M., & Goff, P. A. (2005). Clearing the air: The effect of experimenter race on targets' test performance and subjective experience. *British Journal of Social Psychology*, *44*, 645–657.

Marx, D. M., & Roman, J. S. (2002). Female role models: Protecting women's math test performance. *Personality and Social Psychology Bulletin, 28*, 1183–1193.

Marx, D. M., Stapel, D. A., & Muller, D. (2005). We can do it: The interplay of construal orientation and social comparisons under threat. *Journal of Personality and Social Psychology, 88*, 432–446.

McIntyre, R. B., Paulson, R. M., & Lord, C. G. (2003). Alleviating women's mathematics stereotype threat through salience of group achievements. *Journal of Experimental Social Psychology, 39*, 83–90.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science, 18*, 879–885.

Murray, S. L., Holmes, J. G., Bellavia, G., Griffin, D. W., & Dolderman, D. (2002). Kindred spirits? The benefits of egocentrism in close relationships. *Journal of Personality and Social Psychology, 82*, 563–581.

Mussweiler, T. (2003). Comparison processes in social judgment: Mechanisms and consequences. *Psychological Review, 110*, 472–489.

Price, J. (2010). The effect of instructor race and gender on student persistence in STEM fields. *Economics of Education Review*, *29*, 901–910.

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review, 115*, 336–356.

Selfhout, M., Denissen, J., Branje, S., & Meeus, W. (2009). In the eye of the beholder: Perceived, actual, and peer-rated similarity in personality, communication, and friendship intensity during the acquaintanceship process. *Journal of Personality and Social Psychology, 96*, 1152–1165.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology, 35*, 4–28.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*, 613–629.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*, 797–811.

Stockard, J., & Wood, J. W. (1984). The myth of female underachievement: A reexamination of sex differences in academic underachievement. *American Educational Research Journal, 21*, 825–838.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept and professional goals in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology, 100*, 255–270.

Strenta, C., Elliott, R., Adair, R., Matier, M., & Scott, J. (1994). Choosing and leaving science in highly selective institutions. *Research in Higher Education, 35*, 513–547.