FEMININE STEM ROLE MODELS: ATTEMPTS TO IMPROVE WOMEN'S MOTIVATION IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS FIELDS BY COUNTERING THE UNFEMININE-STEM STEREOTYPE

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Women remain underrepresented in science, technology, engineering, and mathematics (STEM) fields, perhaps in part because STEM is seen as incompatible with femininity. Interventions that change perceptions of academic fields (e.g., counterstereotypic role models) can boost motivation, but feminine STEM role models remain untested. It may seem daunting to combine the incompatible qualities of femininity and success in “unfeminine” fields, making feminine STEM role models less effective motivators than more everyday, gender-neutral women in STEM. Studies 1a and 1b test this possibility by asking middle school girls to read interviews with college women who were feminine or gender-neutral in terms of appearance and hobbies, and who were succeeding in STEM fields or in school generally. Study 1a suggests that feminine STEM role models dampen girls’ self-rated ability and future plans in math. Study 1b corroborates past evidence that role models are more threatening than inspiring when their success feels unattainable: girls disinterested in STEM (who were most harmed by reading about feminine STEM role models in Study 1a) saw feminine STEM success as least attainable. Study 2 aimed to replicate these effects with a female college sample, with “humanities” replacing “school” as the comparison role model condition. STEM role models generally improved English self-ratings and harmed math self-ratings. Perceiving STEM role models as less attainable than humanities role models mediated their negative effect on math self-concept. Study 3 used improved stimuli and found that gender-neutral female STEM role models were more motivating than feminine STEM role models. Study 3 also assessed three individual differences. A Single-Category Implicit Association Test (SC-IAT) was developed to measure implicit associations between STEM-related words and photos representing unfeminine appearance, as opposed to photos representing feminine appearance. Explicit unfeminine-STEM stereotypes and participants' endorsement of feminine appearance were also assessed. Feminine STEM role models were least motivating for participants with strong implicit or explicit stereotypes, yet feminine appearance endorsement did not moderate feminine STEM role model effects. Overall, gender-neutral STEM role models were found to be more effective motivators than feminine STEM role models. Implications for interventions aimed girls and women in STEM are discussed.

Key Words: gender, femininity, stereotype, role models, science, math, academics, cognitive associations, motivation

CHAPTER I

Introduction

The gender gap in STEM—or science, technology, engineering, and math—is a highly visible problem. In the United States, nearly twice as many men as women intend to major in STEM[1] fields, especially engineering, computer science, and the physical sciences (American Association of University Women [AAUW], 2010). They earn 38.4% of bachelor's degrees awarded in STEM fields (driven by relatively greater participation in biological and life sciences as well as mathematics; National Science Foundation [NSF], 2007), but with workforce attrition, women hold just 24% of STEM jobs (United States Department of Commerce, 2011; Hewlett et al., 2008). These numbers have been crunched by thousands of articles in psychology alone, as researchers from diverse sciences attempt to understand why this gap exists.

One of the most prominent explanations points to a sense of incompatibility, poor fit, or mismatch between being female and succeeding in STEM. In general, people's career choices are shaped by perceived fit. According to Gottfredson's (1981) influential circumscription and compromise theory, students gradually narrow down potential careers by cutting out jobs whose typical representatives do not share their own interests and abilities. For instance, middle school students show the most interest in fields where they feel they resemble the "typical student" (Hannover & Kessels, 2004). Similarly, Eccles' (Parsons [Eccles], Adler, & Meece, 1984)

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[1] This term excludes the health and medical sciences, fields that are federally funded by a separate agency (the National Institutes of Health rather than the National Science Foundation) and in which women are more equally represented.

expectancy-value model argues that students are drawn to fields that seem to fit both their abilities and their values, or what they think is important in life.

These broad ideas have specific implications for women's perceived fit in STEM. Gottfredson (1981) argued that as early as kindergarten, students become less likely to consider jobs typically associated with the other gender. Indeed, adolescent girls report feeling less similar to typical science students than young boys do, and this self-science discrepancy partially explains girls' weaker interest in those careers (Lee, 1998; see also Cheryan & Plaut, 2010). Recent work also suggests that women's interest in STEM is eroded by a perceived mismatch between STEM careers and communal values (Diekman, Brown, Johnston, & Clark, 2010; Diekman, Clark, Johnston, Brown, & Steinberg, 2011). Girls may also show less interest in math than boys because they feel less talented at it (Eccles, 1994; Davis-Kean, & Eccles, 2006; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991).

That girls feel less talented than boys in math is unsurprising given the prevalent stereotype asserting that very idea (e.g., Nosek et al., 2009). Research on stereotype threat shows that reminders of this ability stereotype can harm women's performance in math (e.g., Spencer, Steele, & Quinn, 1999), engineering (Logel et al., 2009), and science (Miyake et al., 2010). This occurs whether the reminders are blatant (e.g., being told that men tend to perform better than women in math [Spencer et al., 1999] or interacting with a sexist man [Logel et al., 2009]) or more subtle (being the only woman in a group of men [Sekaquaptewa & Thompson, 2003] or simply reporting one's gender before a calculus test [Danaher & Crandall, 2008]). Even though threat can affect women who do not actually endorse this belief (e.g., Huguet & Régner, 2009; Kiefer & Sekaquaptewa, 2007b), the stereotype is reflected in men's and women's assessments of their own abilities. Boys report feeling more competent than girls do in math (Else-Quest, Hyde, & Linn, 2010) and science (DeWitt et al., 2011). Further, women tend to underestimate and men to overestimate their math ability (Correll, 2001), which has direct implications for the likelihood of selecting quantitative high school classes (Simpkins et al., 2006) and college majors (Correll, 2001).

However, girls and women's lower participation in STEM fields is not fully explained by beliefs about ability. This is especially apparent in light of their rapid advances in math and science achievement: the most recent meta-analyses find essentially no gender difference in U.S. students' standardized test scores (Hyde, Lindberg, Linn, Ellis, & Williams, 2008; Lindberg, Hyde, Petersen, & Linn, 2010). Beyond stereotypes about ability, girls must also contend with a larger "double bind" that pits academic or professional success against traditional femininity. Essentially, women who portray masculine qualities—including those deemed necessary for success in traditionally masculine spaces— are expected to compensate for their transgression by also displaying feminine features, even though those features may be regarded as incompatible with masculine success. Matina Horner (1969; 1989) asserted that "a bright woman is caught in a double bind," meaning a woman viewed as intelligent or accomplished risked being viewed as insufficiently feminine. In research from the 1990s, young girls echoed this sentiment, speaking of the trade-off between being smart and social, and between being high-achieving and nice (Bell, 1996; Roberts & Petersen, 1992). Agentic female leaders' competence is met with punishment for an assumed lack of warmth (Eagly, 2007; Heilman & Okimoto, 2007; Heilman, Wallen, Fuchs, & Tamkins, 2004; Phelan & Rudman, 2010; Rudman & Glick, 2001). A double bind is essentially a "no-win situation" (Bateson, Jackson, Haley, & Weakland, 1963).

Women in male-dominated STEM fields face a similar double bind, as success in STEM is perceived as incompatible with femininity. What exactly does it mean, however, to have one's femininity questioned? Femininity can be thought of as a set of personality traits, gender roles, and appearance standards that solidify one's identity as a woman—in part by distinguishing women from men (Cole & Zucker, 2007; Mahalik et al., 2005; Twenge, 1999). Research identifies points of incompatibility between STEM success and each of these three facets.

Several of the classic double binds shared earlier implicate feminine traits: a successful woman runs the risk of seeming insufficiently social, nice, and warm. These are examples of expressive or communal traits (Bem, 1974), which characterize the ideal female personality: sensitive, nurturing, and kind (Rudman & Glick, 2001). Women who succeed in STEM are assumed to be lower in these traits than women who succeed in more traditional domains. For instance, college students rate female engineers as having fewer expressive/feminine traits (including kindness, gentleness, nurturance, warmth, and intentions to marry or have children) than female nurses (Yoder & Schleicher, 1996). Middle schoolers describe the "typical" physics student (whether described as male or female) as having fewer feminine traits than the "typical" music student (Kessels, 2005). Computer scientists are stereotyped as lacking the feminine trait of sociability (Cheryan, Siy, Vichayapai, Drury & Kim, 2011; Faulkner, 2009). After reading real mission statements for engineering schools and liberal arts colleges, university participants imagined engineering students to be less feminine (e.g., soft spoken, eager to soothe feelings) and more masculine (e.g., dominant, forceful) than liberal arts students (de Pillis & de Pillis, 2008). These person perceptions extend to perceptions of entire fields. Compared to female stereotypic careers (including nurses, social workers, and teachers), careers in STEM (engineers, computer scientists, and environmental scientists) are rated less likely to satisfy the communal goals of intimacy, affiliation, and altruism (Diekman et al., 2010).

In addition to traits, femininity is characterized by adherence to traditional gender roles. One such role calls for investment in heterosexual romantic relationships (Mahalik et al., 2005). However, research suggests that college women view math-related goals as impediments to romance-related goals (Park, Young, Troisi, & Pinkus, 2011), suggesting a point of conflict between this role and STEM success. Another feminine role involves dedication to children and home over paid work (Mahalik et al., 2005). Indeed, women consistently spend more time on household duties than men, regardless of their relative income or work hours (Bittman, England, Sayer, Folbre, & Matheson, 2003; Maume, 2006), and women working in science, engineering, and technology corporations report that these duties conflict with long hours in the lab (Frome, Alfeld, Eccles, & Barber, 2006; Hewlett et al., 2008). Ceci, Williams, and Barnett (2009) review survey research that echoes this reported conflict from women in the field. Of note, economist Jennifer Hunt (2010) finds that inadequate pay and promotion opportunities offer a much more robust explanation for why more women than men leave engineering careers, as well as non-STEM male-dominated vocations. Nevertheless, there is evidence that STEM careers are thought to make romance or childrearing difficult.

Finally, femininity is defined by appearance, including clothing (such as dresses, skirts, soft lines, and pale colors), styled hair, and makeup that prioritize frippery and fashion over function and that show effortful dedication to marking oneself as female (Forsythe, Drake, & Cox, 1985; Mahalik et al., 2006; Moore, 2006). Women's success in STEM is also presumed to carry a cost in feminine appearance. In my own work, female college students described women who are good at math with more unfeminine physical features (e.g., unkempt hair, unstylish clothing) and fewer feminine physical features (e.g., styled hair, make-up) than women who are bad at math (Betz & Sekaquaptewa, 2011). Wearing make-up has been rated incompatible with math success (although fashion consciousness was not; Pronin, Steele, & Ross, 2004). Some women in science, technology, and engineering professions report eschewing makeup and feminine clothing in order to be taken seriously and to avoid harassment in the workplace (Hewlett et al., 2008; Faulkner, 2009). Jorgenson (2002) and Faulkner (2009) both observed that by drawing attention to their gender, women would undermine their status as engineers.

Popular Images of Women in STEM: The Unfeminine and the Defiantly Feminine

Whether assessing traits, roles, or appearance, evidence abounds that women in STEM are stereotyped as unfeminine. Where do these images come from? The sheer lack of women in STEM fields may reinforce their male stereotypicality, heightening the perception that women who do succeed in them must be lacking in femininity (e.g., Heilman & Okimoto, 2007). The male-STEM association emerges frequently in real life situations, including advertisements marketing science kits to boys rather than girls (Halim & Ruble, 2010), pictures of men populating college science department websites (Cundiff, Matsick, & Vescio, 2011), and high-level math classes disproportionately populated by men (AAUW, 2010). The media features female scientists less frequently than male scientists. In the 1990s, more male than female scientists were featured in The New York Times' Science section, and two thirds of scientist protagonists in popular films were male (reviewed in Steinke, 2012). In an analysis of twelve popular television shows watched by adolescents, just 30% of scientist characters were female (the proportion jumped to 42% when 2 NSF-funded shows were included; Long et al., 2010). It is no wonder that in a national survey run by L'Oreal's "For Women in Science" campaign, 65% of adult respondents could not name a single female scientist (PR Newswire, 2009).

Over time, popular film may have reinforced the stereotype women in science are unfeminine. Eva Flicker (2003; 2007) argues that between 1929 and 2004, female scientists in film fell into seven archetypal categories, several of which portrayed an incompatibility between femininity and scientific competence. For instance, the “old maid” and the “male woman/gruff women’s libber” archetypes are scientifically competent but unemotional, uninterested in romance, and explicitly unattractive (albeit by Hollywood standards, which may just mean glasses and shapeless clothing). The “naïve expert” and “daughter/assistant” are sweet and attractive, yet gullible and emotional, and thus incompetent. They are also subordinate to men, whether in their jobs on screen or in their role in the film narrative. The “lonely heroine,” characteristic of films in the 90s, sacrifices meaningful relationships for her scientific success.

However, recent images of female scientists are more feminine than those of the past (Steinke, 2012). Flicker (2003) argues that the “lonely heroine” of 90s cinema is more conventionally attractive than the “old maid” of the 50s or the “gruff women’s libber” of the 70s. Yet, she is also more competent than the “naïve expert” or the “daughter/assistant.” Steinke (2012) notes female scientists in films from the 1990s onward are younger, cooler, and more romantically involved than those in older films, and that male and female scientist characters are shown as generally equal in competence and status. This move towards an image of women in science that is no longer incompatible with femininity can also be seen off screen in Faulkner’s (2009) interviews with female engineers. Faulkner asserted that in comparison to other women interviewed a decade earlier, her subjects actually disagreed that success had to come at the expense of their femininity.

Implications of Feminine Women in Science

Do these trends reflect a resolution to the double bind, a sense that women can indeed be successful in masculine fields without having their femininity challenged? Or do they reflect yet more prescriptive stereotyping, still greater demands on the way women should be? Steinke

(2005) has also noted a rise in overt objectification of female scientist characters on film and "makeovers" that transformed the scientists from nerds into sexy women. The "lonely heroine" has been replaced by the "clever, digital beauty" of the early 2000s (the primary example being technologically-skilled archaeologist Lara Croft of the *Tomb Raider* franchise; Flicker, 2007). This is an archetype that is not just attractive but hyper-sexualized and objectified. The female forensic scientists on popular crime series *CSI* are also frequently objectified (Kleminski, 2006).

Off camera, Faulkner (2009) describes a "delicate juggling act" in her subjects' negotiation of professional and feminine identity, an effort to approach feminine "girls with nails" without being deemed "too girly'" (p. 181). She observes "a tension between two gender messages: one which says, 'To be a woman engineer is to be somewhat less conventionally feminine, or more masculine, than most women'; the other which says, 'To be a ''real woman''…one must conform to stereotypical understandings of femininity.'" (Faulkner, 2009, p. 181). The apparent need to assert that women in STEM are indeed "real women" is evident in newspapers and magazines' coverage of female scientists, emphasizing how they play a supporting role to men; their happiness in domesticity, marriage and motherhood; and their bodies, hair, clothing, and age (reviewed in Steinke, 2012). It seems that this feminine image is presented not as an additional option for women in STEM, but actually the prescribed and preferred option.

Some real women in math and science have even used these overtly feminine images as a potential recruitment strategy for young girls. 2010 saw the release of pink-laptop-toting Computer Engineer Barbie, co-designed by the Society of Women Engineers with the goal of helping girls see computer science as cool (Mattel.com, n.d.). "Dr. Erika" is a former Miss Massachusetts pageant winner and an MIT-trained biochemist who does science experiments while wearing her tiara on her own cable access show. Mathematician and actress Danica McKellar (e.g., 2007) has written four popular press books telling girls why math is cool in pointedly girly ways: algebra is helpful for baking, and figuring out sales while shopping, for instance. Most recently came “Science: It’s a Girl Thing,” a campaign aimed at teenage girls launched by the European Union’s Commission for Research and Innovation (Revkin, 2012). The campaign made headlines when it released a video featuring three young women in skirts and high heels, dancing and giggling as images of test tubes and petri dishes were intercut with lipstick and makeup compacts.

Changing the Face of a Field

So what is the impact of a sexy scientist, a feminine mathematician, or an engineer with painted nails? On the one hand, they may change people’s prototypic visions of what women in STEM can be like, or look like. Counterstereotypic figures in general can have wonderful effects by changing people’s notions about who will succeed in a given field, thus giving students a wider array of options that they could potentially see themselves in. Powerful female faculty can shatter college women’s stereotypes about men making better leaders (Dasgupta & Asgari, 2004). Successful women in math (Marx & Roman, 2002) and engineering (Stout, Dasgupta, Hunsinger, & McManus, 2012) counter stereotypes about ability, thus encouraging attempts to emulate those women: female students report greater motivation and even perform better in the fields where the role models succeed.

Although past research has not explicitly attempted to “make STEM feminine,” it has catalogued what happens when STEM is made to seem compatible with feminine traits, gender roles, and even appearance. Reading about a scientist behaving communally in the course of her day increased women’s interest in science careers (Diekman et al., 2011). Women in STEM corporations report wanting a mentor who balances career and family, thus fulfilling the family-centered feminine gender role (Hewlett et al., 2008). Computerized role models who were dressed in a “cool” way (thus perhaps countering appearance stereotypes) and who emphasized socially helpful aspects of engineering (thus emphasizing the communal nature of science, and perhaps even engineers’ social skill) increased high school girls’ interest in engineering careers (Plant, Baylor, Doerr, & Rosenberg-Kima, 2009). Even those sexy *CSI* scientists can expand students’ prototypic scientist image (Jones & Bangert, 2006).

It seems that a counterstereotypically feminine woman in STEM could have encouraging impacts on female students’ own aspirations. Some, like the Society of Women Engineers or Danica McKellar, may hope so. However, the literature on role models should also make us wary of this strategy. Role models are defined by their ability to inspire, to serve as figures that others look to in the hope of achieving similar success. To be inspiring, however, the role model’s success must seem plausible and attainable (Lockwood & Kunda, 1997). Role models that display success that feels impossible for others to achieve are actually threatening rather than motivational (Hoyt, 2012). Women who excel in a counterstereotypic field while still meeting a stereotypic feminine ideal—simultaneously fulfilling contradictory roles—may not seem attainable. Thus, rather than inspiring assimilation to her scientific prowess, she may inspire contrast in the form of weakened self-concepts and future goals in STEM.

The move towards highlighting feminine women in STEM may be intended to show girls an alternative to the predominant unfeminine image. However, given the prescriptive nature of female stereotypes, feminine STEM role models may instead signal that girls *should* be both feminine and talented in male-stereotyped fields. The command to combine two seemingly incompatible things, to defeat the double bind, might seem unattainable, making contrast effects more likely. Thus, adding a stereotypically feminine sheen to a female STEM role model could undercut her motivating power, or even cause it to backfire.

Present Aim

The aim of this dissertation is to understand the effects of feminine STEM role models. It attempts this by using a variety of role model manipulations aimed at two developmentally different populations. Although evidence suggests benefits of counterstereotypic role models, and even benefits from highlighting the femininity of STEM, it is possible that the pairing of overt femininity and STEM success may not effectively motivate female students. Studies 1a and 1b look at role model effects for middle school girls, comparing the effectiveness of feminine as compared to gender-neutral role models succeeding in either STEM or in school more generally. Study 2 extends the paradigm to college women, a population that may view femininity, STEM success, or their combination somewhat differently. Study 3 improves on Study 2's stimuli and assesses how individual differences in feminine appearance endorsement, explicit unfeminine-STEM stereotypes, and implicit unfeminine-STEM associations may moderate the impact of role models.

CHAPTER II

Study 1a: Feminine STEM Role Models and Middle School Girls

Studies 1a and 1b address middle school girls' response to different kinds of academic role models, varying in femininity as well as domain of success. This sample was selected because they are at a unique stage of development in their academic identities as well as their gender identities. At this time, girls really begin to question their math abilities relative to boys' (Pajares, 2005; Wigfield et al., 1991), perhaps because the middle school climate encourages social comparison (Good & Aronson, 2008; Tracey, 2001). At around age of twelve, students are sensitive to comparison and aware that others may to view them through a stereotyped lens (Good & Aronson, 2008). Some suggest that this is the age when students first become susceptible to stereotype threat (Good & Aronson, 2008; Huguet & Régner, 2007; Muzzatti & Agnoli, 2007), although some evidence points to threat effects emerging as early as kindergarten (Ambady, Shih, Kim, & Pittinsky, 2001). Others' stereotypes affect students' own expectations and goals for future academic success (Oyserman & Fryberg, 2006). Indeed, by the 8th grade, girls' weaker math self-confidence predicts worse grades (Correll, 2001) and less math and science participation down the road (Simpkins et al., 2006). No wonder this young population is so often targeted for STEM intervention and recruitment, both by social scientists and practitioners in the field.

Of relevance to the particular impact of an "unfeminine" stereotype, middle school also brings heightened pressure to conform to gender norms. "Gender intensification" at this age makes acting appropriately for one's gender feel even more important (Hill & Lynch, 1983;

Wigfield et al., 2001). This means not just liking things that girls are supposed to like, including certain school subjects (Frome & Eccles, 1998), but also being nice, social, modest, and attractive (Bell, 2009; Tolman, Impett, Tracy, & Michael, 2006; Sengupta, 2006). The stereotype that people in math and science lack feminine traits like sociality or that women in science look unfeminine may make these paths seem particularly off-putting.

Given the potential drawbacks of STEM's unfeminine image, the impulse to counter it with feminine STEM role models seems to make sense. And yet, other research suggests that this strategy may backfire. As discussed, role models who display unattainable success should make people feel less motivated (Lockwood & Kunda, 1997). Middle school girls have already reported feeling that scientists wouldn't make good role models because they are "too good" and "too smart" (Buck, Plano Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2007). Adding femininity to the equation may be even more daunting, particularly for young girls. Their stereotypes about gender are rigid (Halim & Ruble, 2010) and gender conformity is paramount (Hill & Lynch, 1983), so a woman succeeding in a masculine field while remaining feminine may seem quite unlikely. It is possible that young girls may see a feminine STEM role model as "too good" to be motivating. As a result, they may feel that their own abilities in a similar domain pale in comparison (Lockwood & Kunda, 1997).

However, feminine STEM role models may have different effects on different kinds of girls. Whereas all girls may feel a bit worse about themselves in comparison to a superstar, expectations for the future may fare differently. Girls who like STEM may feel more capable than STEM-disinterested girls of one day attaining the STEM success of even very feminine scientists, given their better grades (Simpkins et al., 2006) and higher expectations for themselves in these fields (Oyserman & Fryberg, 2006). Upward social comparisons can be more damaging to current self-views than expected future success (Kemmelmeier & Oyserman, 2001). Thus, for these girls, current self-evaluations may suffer, but future plans in math may be protected. In contrast, students who already dislike STEM may react the worst to feminine STEM role models. These students may already have a hard time imagining themselves succeeding in STEM in the future, as students who perform poorly in school find it more difficult than those performing well to imagine getting good grades in the future (Oyserman & Fryberg, 2006). Exposure to a role model who combines this feat with idealized femininity may further depress expectations of attaining similar success in the future.

Study 1a tested two predictions. First, current self-ratings of math interest, ability and short-term success expectancies (Simpkins et al., 2006) were expected to decrease for all girls who viewed feminine STEM role models. Second, girls who disliked STEM at the outset were expected to report weaker future plans to study math following exposure to feminine STEM role models. In contrast, role models were not expected to affect math plans among girls who already liked STEM (whose math plans may have been stronger to begin with). To test these predictions, middle school girls viewed feminine STEM role models, STEM role models who were more gender-neutral, and feminine and gender-neutral role models succeeding in general academics but not STEM in particular. Because overall school success is not as likely to be branded "unfeminine," these general school role models should not harm math outcomes even if they are feminine. The inclusion of this comparison group was designed to counter the possibility that negative outcomes of feminine STEM role models were driven solely by feminine cues (Steele & Ambady, 2006). Instead, such outcomes would speak to the unique implications of combining feminine characteristics with success in an unfeminine field.

Method

Participants. One hundred ninety three girls in the sixth (*n* = 92) and seventh grade (*n* = 52) participated in exchange for a science magazine and an entry in a $100 raffle. Fourteen participants quit the study before completing the first attitude scale, 33 participants failed to answer the manipulation check properly, and two participants scored three standard deviations below the mean on the first attitude scale, leaving 144 participants in the final analysis (75 White or Middle Eastern, 19 Black, 15 Asian, 5 Hispanic, 15 other (e.g., "American") or multiracial, 15 chose not to report; M_{age} = 11.56, *SD* = .67). Chi-square analyses revealed that dropped participants were not proportionately different in their liking for STEM (χ^2(1, N = 193) = 0.15, *p* = .70) or their assigned condition (χ^2(3, N = 193) = 1.81, *p* = .61). In exchange for participation, students received a youth magazine and an entry into a $100 lottery.

Materials.

STEM Liking. Participants read a list of school subjects (English, Foreign Language, Math, Music, Physical Education, Science, Social Studies, "other") and were asked to indicate up to three of their favorites. Seventy-eight participants (54.5%) selected math, science, and/or a STEM-related "other" class (e.g., "technology"). These students were coded as liking STEM. Those that did not select any math, science, or technology classes were coded as disliking STEM.

Role Models. Participants read one of four magazine-type interviews. Each magazine contained three pages, with each page containing one interview and an accompanying photograph of the interview subject. The women in the photographs were the same across conditions, but their appearance and the content of the interview was systematically varied to manipulate role model femininity and domain of success.[2] Role model femininity was manipulated by what the women were wearing, the cues in the background of their photographs, and some information about their preferred leisure activities. Feminine role models wore pink or pastel-colored clothing and make-up, and were pictured with cues like a pink photo album and a dorm-style bed covered in decorative pillows (in keeping with a traditional feminine emphasis on one's personal appearance and the appearance of one's home; Cole & Zucker, 2007). They were also described as having hobbies like dance and yoga, reading fashion magazines and romance novels, and watching the television shows *Gossip Girl* and *Grey's Anatomy* with friends. Gender-neutral role models wore clothing that was darker colored and less fashionable, less or no make-up, and glasses; they were pictured with neutral cues like an office calendar and a dorm-style bed with regular twin pillows; and they were given hobbies like working out, reading, and watching her favorite TV shows every week (hobbies seen as gender-neutral; Athenstaedt, Mikula, & Bredt, 2009).

STEM role models were described as succeeding in chemistry, math, and engineering (e.g., introduced as an "engineering star," received praise from a chemistry professor, discussed having attained a summer research position in math). General school role models had almost identical descriptions, but references to those three fields were removed (e.g., introduced as a "freshman star," received praise from a professor, discussed having attained a summer research position). Following role model literature, role models were designed to appear similar to

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[2] Feminine and gender-neutral photos were pretested by 29 college participants. Each participant viewed eight photographs (role model 1 in three different poses, role model 2 in three different poses, and role model 3 in two different poses), in which the role models were dressed in a gender-neutral way, a feminine way, or a feminine way with glasses. The photographs were always paired with the appropriate feminine or gender-neutral STEM interview. From this pretest, one photo of each role model in feminine dress and one photo of each role model in gender-neutral dress was chosen. The photos selected were rated as equally competent in math across condition ($p = .41$), but more feminine in the feminine condition ($p < .001$).

participants (i.e., they were all the same gender as the participants; they represented three different races [White, Black, and South Asian] so that different girls could potentially find a race or ethnicity connection; they attended the local university) and to portray attainable success (i.e., they were college-aged so that younger girls could perceive sufficient time to achieve similar success; they emphasized hard work rather than inborn skill in discussing their road to success; Lockwood & Kunda, 1997). See Appendix A for feminine STEM and gender-neutral school role model stimuli.

Manipulation check. Participants answered open-ended memory questions about the role models' names, majors, and hobbies in order to check for attention to the femininity and domain manipulations.

Role model ratings. Participants used 7-point scales (1 = not at all, 7 = very much so) to evaluate the role model on four positive attributes (smart, hardworking, likable, friendly), which were averaged into a measure of positivity ($\alpha = .87$). They also rated how similar the role model seemed to themselves.

Current self-ratings. Participants used seven-point scales to answer twelve items about their current math self-concept (e.g., "How good at math are you?"), interest (e.g., "Compared to most of your other activities, how much do you like math"), and the importance of math (e.g., "In general, how useful is what you learn in math?"; Simpkins et al., 2006).[3] Scale anchors varied by item, but higher values always indicated higher ratings of self-concept, interest, and

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[3] Three additional items measured perceived difficulty of math (e.g., "In general, how hard is math for you?"; Frome & Eccles, 1998). High internal reliability is maintained when these items are reverse scored and averaged with the other math self-ratings ($\alpha = .88$), and the 2x2x2 ANOVA yields identical pattern of main effects and interactions. However, Study 1 results are presented with only the twelve-item composite because the difficulty items were omitted form Studies 2 and 3. This allows easier comparisons of findings across studies.

importance. The twelve items were internally reliable ($\alpha = .89$) and thus averaged into a single measure of current math self-ratings.

Future plans. Girls then answered two items by using a seven-point scale to rate their likelihood of taking math in high school and math in college, from 1 (not at all) to 7 (very much so). These items were correlated ($r = .56$, $p < .001$) and combined into a single “future math plans” measure.

Participants used the same scale to rate their likelihood of taking high school science classes, taking high school English classes, and attending college. See Appendix B for all self-rating and future plan outcome measures.

Procedure.

Students whose parents had previously consented to their participation took part in the study on classroom laptops during their regular math class. Participants first reported STEM liking, then read one of four possible role model interviews. This yielded a 2 (STEM vs. general school) x 2 (feminine vs. gender neutral) x 2 (participant STEM-liking vs. disliking) design. Participants then completed the manipulation check and rated the role models reported their current self-evaluations and future plans, and were debriefed and compensated.

Results

Manipulation check. Open-ended responses were coded to determine whether participants could correctly identify at least the major and hobby (as these were how domain and femininity were manipulated) of at least two of the three role models (to ensure that they had paid attention for more than one role model). Thirty-three participants failed this manipulation check and were removed from analysis.

Role model ratings.

Positivity. A 2x2x2 factorial ANOVA revealed no differences on overall positivity ratings of the role models based on role model femininity, role model domain, or STEM liking (all *F*s < 1, all *p*s > .40). See Table 1 for all means and standard deviations.

Similarity. The same analysis revealed no significant differences on perceived similarity, with the effect closest to marginal significance being higher perceived similarity among girls who liked STEM ($M = 4.86$, $SD = 1.56$) compared to girls who disliked STEM ($M = 4.4$, $SD = 1.6$, $F(1,134) = 2.70$, $p = .103$, $d = .28$). All other *F*s were less than 1.9, and all *p*s were greater than .17. See Table 1 for all means and standard deviations.

Current self-ratings. A 2x2x2 factorial ANOVA revealed an effect of role model femininity ($F(1,136) = 11.64$, $p = .001$), which was qualified by the predicted two-way interaction with role model domain ($F(1,136) = 7.81$, $p < .01$, $d = .48$). Simple effect analyses revealed that the effect of femininity was significant only in the STEM role model condition ($F(1,141) = 17.05$, $p < .001$, $d = .70$), such that feminine STEM role models yielded lower current math self-ratings ($M = 4.65$, $SD = 1.01$) than gender-neutral STEM role models ($M = 5.40$, $SD = .66$). Current self-ratings did not differ between feminine ($M = 5.08$, $SD = .89$) and gender-neutral school role model conditions ($M = 5.20$, $SD = .69$, $F < .01$, $p = .97$, $d = .02$). In addition, within the feminine condition, STEM role models yielded lower math self-concept ratings than school role models ($F(1,141) = 7.19$, $p < .01$, $d = .45$). STEM role models did not differ from school role models in the gender-neutral condition ($F(1,141) = 2.52$, $p = .12$, $d = .27$). See Figure 1. A significant effect of STEM-liking also emerged ($F(1, 136) = 16.15$, $p < .001$, $d = .70$), such that girls who liked STEM reported higher math self-ratings ($M = 5.49$, $SD = .92$) than girls who disliked STEM ($M = 4.96$, $SD = .91$). No other main effects or interactions emerged on math self-ratings (all *F*s < .72, all *p*s > .40).

Future plans.

Math plans. A factorial ANCOVA, including likelihood of attending college as a significant covariate ($F(1,128) = 4.21$, $p = .04$, $d = .36$), revealed a significant effect of femininity ($F(1,128) = 5.90$, $p < .02$, $d = .43$), a marginal effect of domain, ($F(1,128) = 3.29$, $p = .07$, $d = .32$), a significant 2-way interaction between role model femininity and domain ($F(1,128) = 3.96$, $p = .05$, $d = .35$), and a significant effect of STEM liking ($F(1,128) = 25.70$, $p < .001$, $d = .90$). These were all qualified by the expected three-way interaction ($F(1,128) = 9.21$, $p < .01$, $d = .54$).

A simple interaction analyses revealed that the role model domain by femininity interaction was significant among girls who did not report liking STEM ($F(1,133) = 10.23$, $p < .01$, $d = .55$), but not among girls who liked STEM ($F = .19$, $p = .66$, $d = .08$). Simple effects analyses revealed that among girls who disliked STEM, feminine STEM role models ($M = 3.94$, SD = 1.22) yielded weaker self-reported likelihood of taking math in high school and college relative to gender-neutral STEM role models ($M = 5.61$, SD = 1.04, $F(1,131) = 11.14$, $p = .001$, $d = .58$). For girls who liked STEM, this simple effect was not significant ($F = .05$, $p = .83$). Future plans did not differ between feminine and gender-neutral school role models for either type of participant ($F_{dislike} = 1.15$, $p = .29$, $d = .19$; $F_{like} =.77$, $p = .38$, $d = .15$). See Figure 2.

Future math plans and current self-ratings correlated at $r = .53$ ($p < .001$). See Table 2 for all bivariate correlations among role model ratings and outcome variables.

Science plans. A 2x2x2 ANOVA revealed that plans to take high school science classes were unaffected by role model type, although girls who reported liking STEM reported marginally stronger plans ($M = 5.78$, $SD = 1.54$) than girls who did not report liking STEM ($M = 5.30$, $SD = 1.52$, $F(1,127) = 2.77$, $p < .10$, $d = .30$; all other Fs < 1.17, ps > .28). The fact that different outcomes emerged for math plans compared to science plans fits with past work on STEM-related interests at this age (Simpkins et al., 2006), perhaps because of girls' greater interest in life compared to physical sciences.

English plans. A 2x2x2 ANOVA revealed that plans to take high school English classes (a field lacking negative female stereotypes) showed no effect of role model or STEM liking (all *F*s < 1.18, all *p*s > .28).

Discussion

In keeping with predictions, feminine STEM role models decreased middle school girls' current self-ratings in math relative to gender-neutral STEM role models. Feminine STEM role models also weakened future plans to study math only among girls who disliked STEM. Femininity did not moderate the impact of general school role models on math self-ratings or future plans, suggesting that mere feminine cues were not wholly responsible for the observed decrease (Steele & Ambady, 2006). Rather, the unique combination of femininity and STEM success was most likely to yield a pattern of contrast away from the role models' domain of success, in the form of reduced math self-ratings and aspirations.

Although role models may be demotivating if people do not feel sufficiently similar to them (Cheryan et al., 2011), girls did not feel less similar to the feminine STEM role models, which yielded the most negative effects. In fact, despite what may be predicted by theories of gender intensification, girls felt equally similar to all role models. This argues against the lay notion that girls will connect better with "feminine" women.

The negative effects in this study were argued to be related to the relative incompatibility of STEM and femininity making such role models seem less attainable, rather than less similar to girls. Further, the prediction that girls who disliked STEM would feel least motivated by feminine STEM role models reflects the assumption that the combination of these seemingly incompatible features would seem most daunting to students who may already feel unlikely to attain STEM success. However, Study 1a did not directly assess how attainable students felt each kind of role model's success actually was. Therefore, Study 1b tests the assertion that participants' STEM-liking would determine whether succeeding in STEM while meeting a feminine ideal seemed achievable.

CHAPTER III

Study 1b: Attainability of Feminine STEM Role Models

Girls who dislike STEM may view feminine STEM role models as particularly unattainable for a number of reasons. Students' "future selves" are strongly related to their present self-conceptions (Oyserman & Fryberg, 2006). Girls who currently dislike STEM may not picture themselves pursuing STEM in the future, making STEM role models' academic success feel less personally attainable than it might for girls who currently like STEM. In addition, people figure out how likely a given event is by comparing it to their pre-existing mental representations. This judgmental bias, known as the representativeness heuristic (Kahneman & Tversky, 1973), makes unfamiliar or unimagined outcomes feel less likely than those that we already hold in our minds. Due to the relative incompatibility of femininity and STEM success, the image of a feminine woman in STEM may be relatively unlikely to exist in students' minds, and so may feel unlikely to occur. It might feel even *less* likely for girls who dislike STEM, who may already not expect success in these fields. Study 1b directly assesses how students with different levels of STEM interest assess how likely it is that they could combine academic STEM success with femininity. Specifically, girls who liked and disliked STEM rated how attainable this combination of features seemed in feminine compared to gender-neutral STEM role models.

Method

Participants. Forty-five girls participated in the summer before they entered the sixth (*n* = 25), seventh (*n* = 9), eighth (*n* = 2) or ninth (*n* = 1) grade. The same manipulation check used in Study 1a was used in Study 1b. The same girls who failed the manipulation check also failed to fill out the dependent variable, leaving a final sample of forty-two girls (21 White or Middle Eastern, four Asian, three Black, eight other or multiracial, and six chose not to report; M_{age} = 11.38, *SD* = .83). They participated in exchange for a youth magazine or a package of "Silly Bandz," a children's bracelet that was popular at the time of data collection.

Materials.

STEM liking. As in Study 1a, participants reported their three favorite school subjects, and 19 participants (45.2%) were coded as liking STEM.

Role models. The feminine and gender-neutral STEM role model stimuli from Study 1a were reused in Study 1b. This yielded a 2 (STEM-liking) x 2 (STEM role model femininity) design.

Attainability rating. Participants used a seven-point scale (1 = not at all likely, 7 = very likely) to rate their likelihood of one day emulating their assigned role models' success (i.e., "How likely do you think it is that you could be both as successful in math/science AND as feminine or girly as these students by the end of high school?").

Procedure. The children participated on paper surveys either in their math classrooms or in a public park during an outdoor art festival. They reported STEM liking, then read one of two role model interviews, then rated the role model's attainability and provided demographic information.

Results

A 2x2 ANOVA on attainability ratings revealed a significant interaction between STEM-liking and role model femininity ($F(1,38) = 5.31$, $p = .03$, $d = .75$). A simple effect analysis found that girls who disliked STEM felt significantly less likely to achieve the feminine role models' combination of femininity and STEM success by the end of high school ($M = 4.08$, $SD = 1.73$) compared to gender-neutral role models ($M = 5.45$, $SD = 1.64$; $F(1,39) = 4.15$, $p = .05$, $d = .65$). Likelihood ratings among girls who liked STEM did not differ by role model femininity ($M_{gender\text{-}neutral} = 4.37$, $SD = 1.69$; $M_{feminine} = 5.36$, $SD = 1.5$, $F(1,39) = 1.81$, $p = .19$, $d = .43$). Additionally, girls who disliked STEM felt marginally less likely to emulate feminine role models compared to girls who liked STEM ($F(1,39) = 3.63$, $p = .06$, $d = .61$). STEM-liking yielded nonsignificant effects in the gender-neutral condition ($F(1,39) = 2.21$, $p = .15$, $d = .48$). See Figure 3.

Discussion

For girls who disliked STEM, the success of a feminine STEM superstar felt less attainable than that of a gender-neutral STEM superstar. This outcome fits with work on the representativeness heuristic as well as future selves research. When girls who disliked STEM, and likely held weaker math-related future selves, compared themselves to an uncommonly feminine woman in STEM, they discounted their own likelihood of achieving comparable success in these two domains.

Studies 1a and 1b offer initial evidence that feminine STEM role models may demotivate rather than inspire young girls, encouraging contrast away from the role model's field of success rather than assimilation towards it (Hoyt, 2012). Study 1a showed that girls who disliked STEM—and might benefit most from piqued interest in these fields—responded most negatively. Study 1b suggested that their response was related to the perceived unlikelihood of combining femininity and STEM success. Research on future selves (as well as STEM-liking effects seen in Study 1a) already implies that girls who dislike math and science may not picture themselves in these fields; the current findings suggest that adding femininity to the equation may further impede the formation of such future selves.

Despite these contributions, some important limitations remain. First, role model effects and attainability ratings were not collected in the same study, making it impossible to directly test how they impacted one another. Second, the possibility has been raised that girls reported weaker math self-ratings and fewer math plans because the role model encouraged contrast effects. However, participants in Study 1 did not have the opportunity to boost themselves in another domain where the successful role model may have seemed less threatening – for instance, by assessing their skills in humanities classes. Finally, the findings of Studies 1a and 1b are limited to a middle school population. Study 2 addresses all of these limitations by asking college participants to read about feminine or gender-neutral role models in STEM or humanities, to rate the perceived attainability of these role models' success, and then to report academic self-ratings and future plans in both STEM and humanities fields.

CHAPTER IV

Study 2: Feminine STEM Role Models and College Women

Study 2 focuses on a college rather than a middle school sample. STEM's unfeminine reputation may matter for adult women's entry into and persistence in STEM fields. For instance, following a reminder of computer science's "geeky" image, women but not men expected less belonging in the major and showed less interest in it (Cheryan, Plaut, Davies, & Steele, 2009). College women perceive math pursuits as an impediment to romance (Park et al., 2011). In one survey of college engineering students, 80% of female respondents agreed that being seen as unfeminine by others was a problem they faced (Hartman & Hartman, 2008). This was just one of several perceived challenges (including feeling torn between family and career, having insufficient role models, experiencing discrimination from teachers, and facing stereotypes about women's aptitude or drive), but it was the only problem that significantly predicted less satisfaction with their major ($r = -.27$, $p < .05$; Hartman & Hartman, 2008).

Thus, as with middle school girls, there is an intuitive appeal to the idea that college women would benefit from seeing a woman in STEM counterstereotypically maintaining her femininity. Women succeeding in counterstereotypic ways, whether encountered in the classroom or displayed on a computer screen (e.g., Dasgupta & Asgari, 2004; Stout et al., 2011), can weaken stereotypes about those fields or encourage identification with them. However, the role models' success must still feel feasible, and just like young girls, college women may see a feminine woman succeeding in an unfeminine field as too lofty to be inspiring. The hypotheses tested in Study 1a could thus apply to Study 2: feminine STEM role models may demotivate college students relative to gender-neutral STEM role models. This could affect current self-ratings among all students, regardless of STEM liking. It may only harm future STEM plans among students who dislike math and science at the outset.

However, those hypotheses required updating to better reflect Study 2's older sample. Adults' stereotypes are more flexible than those held by children (Halim & Ruble, 2010). This makes sense: compared to children, adults should have had more time to encounter the actual diversity of women in male-dominated fields. As Faulkner (2009) noted, "actual people and practices tend to be diverse, while people's accounts of them are often gender dualised" (p. 184). To an adult population, a feminine woman in STEM may not seem so unlikely and thus more feasibly attainable. Nevertheless, a feminine STEM role model should still yield less motivation than a gender-neutral STEM role model, as she still represents an additional achievement that students may feel pressured to meet. However, rather than *demotivating* college women*,* feminine STEM role models may simply fail to motivate as effectively as gender-neutral STEM role models. In order to test whether feminine STEM role models yield demotivation or depressed motivation, Study 2 adds a "no role model" control condition. It was expected that gender-neutral STEM role models would increase STEM self-ratings relative to control, whereas feminine STEM role models would not differ from control.

Because Study 2 expected positive effects from gender-neutral STEM role models moreso than negative effects of feminine STEM role models, expectations regarding the role of students' STEM liking also needed to be updated. Specifically, it was possible that students who liked STEM would show greater boosts in self-concept as well as future plans from gender-neutral STEM role models. They might be more likely to identify with a STEM role model and thus reap more benefits (Lockwood & Kunda, 1997; Lockwood, 2006). Study 2's focus on motivating rather than demotivating effects also highlighted the possibility that role models would equally boost current self-ratings as well as aspirations (Hoyt & Simon, 2011). This is in contrast to Study 1a, in which unattainable social comparisons were expected to be more widely harmful to present self-views than to future plans (Kemmelmeier & Oyserman, 2001). Thus, it was possible that gender-neutral STEM role models would especially benefit students who liked STEM.

To better isolate the impact of feminine STEM role models, additional updates were made to Study 2's design and measurements. First, the comparison group of school role models from Study 1a was replaced with humanities role models. Self-ratings and future plans in humanities were also assessed. Like general school, humanities fields are not stereotyped as unfeminine. Thus, a woman succeeding in a field like English, as opposed to a masculine STEM field, should not be presumed to be unfeminine, even in the absence of "pink" cues (Heilman & Okimoto, 2007). A humanities role model could boost self-ratings or future plans in humanities, but femininity was not expected to moderate these effects. Self-ratings and future plans in science were also assessed, and a test of math persistence was added. Gender-neutral STEM role models were expected to yield stronger self-ratings and future plans in both math and science, and more math persistence, relative to feminine STEM role models and relative to baseline.

Finally, to better understand how feminine STEM role models exert their effects, Study 2 asked participants to rate how attainable the role models' success was. This allowed for a direct test of the relationship between a role model's perceived attainability and her impact on academic self-ratings, a relationship only hinted at in Studies 1a and 1b. It was expected that gender-neutral STEM role models would yield more positive math and science outcomes to the extent that they were perceived as more attainably successful than feminine STEM role models.

Method

Participants. Two hundred forty-two college women (168 White, 38 Asian, 14 Black, 5 Hispanic, 15 other or multiracial, 2 did not report) participated in exchange for a half hour credit towards their introductory psychology research requirement (*n* = 229) or for seven dollars (*n* = 13).

Materials.

STEM liking. STEM liking was assessed with four items, allowing a more nuanced measure than was used in Studies 1a and 1b. Study 2 participants reported their college major (28.9% reported a STEM major), and the category of major they were most likely to consider if they were undecided. Participants then selected their three favorite high school subjects (31% chose zero math or science subjects, 45% chose one, 23% chose two, and two participants chose three math or science subjects). Finally, students reported any STEM-relevant academic experiences they had taken part in at the University, including undergraduate research, living-learning communities, and special seminars (19% reported a STEM-relevant activity). Answers to all four questions were used to create a dichotomous “STEM liking” variable. Students were coded as liking STEM (*n* = 117) if they reported a STEM major, listed 2 or more STEM classes as their high school favorites, had participated in a STEM activity, or were undecided and considering a STEM major.

Role models. Participants then read an article presented as an interview with a “star” UM alumna called Jennifer. The photograph of the White interview subject from Studies 1a and 1b was reused here, such that Jennifer either had a feminine appearance (wearing a pink shirt and jewelry, photographed with a pink photo album in the background) or a more gender-neutral appearance (e.g., wearing a black shirt and no jewelry, photographed with a white office calendar in the background). The article accompanying Jennifer's photograph described her as pursuing graduate studies in either chemistry (for the STEM condition) or English (for the humanities condition). The content of her interview was updated from Studies 1a and 1b to Study 2 to reflect post-collegiate accomplishments so that the college participants could perceive sufficient time to achieve similar success. The content marking her identity as feminine (enjoying dance and yoga, reading about fashion and romance) or gender-neutral (enjoying working out and reading) was reused from the previous studies. Because much of their content had been used in Study 1, these new materials were not pretested. See Appendix C for feminine STEM and gender-neutral humanities role model stimuli.

Role model ratings. After reading about the role model, participants used 7-point scales to evaluate the role model on a series of positive attributes (smart, hardworking, organized, likable, friendly, outgoing, $\alpha = .82$), and also how similar to themselves the role model seemed. In an update to Study 1a, participants used the same 7-point scales to rate how successful and feminine the role models seemed. Finally, participants rated their own likelihood of being as successful as the role model one year after graduation and how similar they would like to be to her at that time.

Current self-ratings. Participants answered the same twelve questions used in Study 1a to assess self-ratings, adapted for math ($\alpha = .95$), science ($\alpha = .95$), and English ($\alpha = .93$). These items were appropriate for an undergraduate sample because they have been used with participants as advanced as high school seniors (Simpkins et al., 2006).

Future plans. Participants answered two items to report their likelihood of taking future classes in math, natural science (hereafter referred to as "science"), and humanities (hereafter referred to as "English," to avoid confusion with references to the humanities role model). They also reported future plans for Social Science and Creative Expression (which includes writing, art, and music classes), because together, these comprise the five course categories offered by the University of Michigan's College of Literature, Arts, and Sciences.[4] Using a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly), participants first rated whether they would consider taking classes in each category in order to fulfill graduation credits. Next they rated whether they were looking forward to classes in required categories (i.e., science, English) or if they would choose to take classes in the optional categories (i.e., math; *r*s ≥ .62, *p*s ≤ .001). See Appendix B for all self-rating and future plan outcome measures.

Math persistence task. Participants completed the "36 game," which tested math persistence by asking participants to combine the digits 2, 3, and 7 in as many ways as possible to yield a sum, product, difference, or dividend of 36 (Oyserman, Gant & Ager, 1995). Answers were coded to yield two scores: total number of attempts, and percentage of those attempts that were correct and original. See Appendix B for math persistence measure.

Believability. To be sure that participants did not find certain role models more plausible than others, participants rated the believability of the role model by answering "How realistic or believable was the woman you read about in the magazine?" on a 1 (not at all) to 7 (very much) scale.

Procedure. Participants first answered the STEM Liking questions. The order of the next two tasks was counterbalanced: four fifths of the participants read the role model interview and rated the role model, then completed the outcome measures of self-ratings, future plans, and

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[4] Participants first wrote down the specific class they had in mind when considering each category. This was intended to assess if students thinking of male dominated science classes (e.g., physics) had different outcomes than students thinking of gender equal or female dominated science classes (e.g., biology). Analyses suggested that these students did not differ on any major outcome. This item is not further discussed.

math persistence. The remaining one fifth of participants acted as the control condition by completing outcome measures, then reading the role model interview, and then rating the role model. For all conditions, the role model interviews were then collected, and all participants ended by rating the role model's believability. This item came last because the role models were always described as real students, and asking believability in the beginning may have aroused suspicion. This yielded a 2 (STEM vs. English) x 2 (feminine vs. gender-neutral) x 2 (participant STEM-liking vs. disliking) design, with an additional hanging control condition.

Results

Role model ratings. Analyses of role model ratings exclude participants in the control condition because (a) completing self-evaluations first may have colored impressions of the role models and (b) ratings chiefly matter for participants who could have been affected by the role models. Thus, 195 participants were included in a series of 2 (role model domain) x 2 (role model femininity) x 2 (STEM-liking) factorial ANOVAs on role model ratings. See Table 3 for means and standard deviations for all role model ratings. See Table 4 for correlations among role model ratings.

Feminine. As anticipated, feminine role models ($M = 5.75$, $SD = .90$) were rated more feminine than gender-neutral ($M = 4.98$, $SD = 1.11$, $F(1,187) = 30.14$, $p < .001$, $d = .80$). Unexpectedly, albeit in keeping with the stereotypes associated with each field, humanities role models were rated more feminine ($M = 5.55$, $SD = 1.03$) than STEM role models ($M = 5.30$, $SD = 1.09$, $F(1,187) = 4.03$, $p = .05$, $d = .29$). No other main effects or interactions emerged (all Fs < .45, all ps > .50).

Positivity. Unexpectedly**,** feminine role models were rated marginally more positively ($M = 5.76$, $SD = .72$) than gender-neutral role models ($M = 5.60$, $SD = .67$, $F(1,187) = 3.15$, $p = .08$, *d* = .26). A domain by STEM-liking interaction also emerged (*F*(1,187) = 6.57, *p* = .01, *d* = .37). A simple effect analysis revealed that the STEM role model (*M* = 5.87, *SD* = .59) was rated more positively than the humanities role model (*M* = 5.5, *SD* = .74, *F*(1,194) = 6.43, *p* = .01, *d* = .36) by students who liked STEM, but not by students who disliked STEM (*p* = .41).

Successful. Unexpectedly, STEM role models were rated more successful (*M* = 6.45, *SD* = .71) than English (*M* = 6.13, *SD* = .93, *F*(1,187) = 6.8, *p* = .01, *d* = .38) role models. No other main effects or interactions emerged (all *F*s < 2.02, all *p*s > .15).

Attainability of success. STEM role models were rated less attainably successful (*M* = 5.23, *SD* = 1.31) than English role models (*M* = 5.64, *SD* = 1.07, *F*(1,187) = 7.36, *p* < .01, *d* = .40). However, contrary to prediction, role model domain did not interact with role model femininity (*p* = .35). No other main effects or interactions emerged (all *F*s < 1.36, all *p*s > .24).

Similar. Unexpectedly, feminine role models were rated more similar to participants (*M* = 4.02, *SD* = 1.53) than gender-neutral role models (*M* = 3.71, *SD* = 1.55, *F*(1,187) = 4.38, *p* = .04, *d* = .31). A main effect of domain (*F*(1,187) = 6.28, *p* = .01, *d* = .37) and a nearly marginal main effect of STEM liking (*F*(1,187) = 2.70, *p* = .10, *d* = .24) were qualified by a significant interaction between domain and STEM-liking (*F*(1,187) = 10.87, *p* = .001, *d* = .48). A simple effect analysis revealed that the STEM role model (*M* = 4.37, *SD* = 1.40) was rated more similar to oneself than the English role model (*M* = 3.06, *SD* = 1.42, *F*(1,192) = 18.15, *p* < .001, *d* = .61) by students who liked STEM, but not by students who did not like STEM (*p* = .68). No other main effects or interactions emerged (all *F*s < 1.43, all *p*s > .23).

Desired similarity. No effect of role model or STEM liking emerged on how similar participants would like to be to the role models in the future (all *F*s < 1.87, all *p*s > .17).

Believable. No effect of role model or STEM liking emerged on how believable participants found the role models (all Fs < 2.11, all ps > .14). Ratings for each type of role model ranged from 5.29 (SD = 1.19) to 6.0 (SD = 1.33) for participants who did not like STEM, and from 5.34 (SD = 1.82) to 5.83 (SD = 1.10) for participants who liked STEM. One-sample t-tests revealed that means in all of these conditions were significantly above the midpoint of four (all ts > 3.90, all ps < .001), indicating that the role models seemed generally believable.

Role model effects on current self-ratings. Role model effects were assessed with a 2 (role model domain) x 2 (role model femininity) x 2 (STEM-liking) factorial ANOVA, excluding control participants. Whenever a significant role model effect emerged, comparisons to the control group were assessed with post-hoc contrasts.

Math self-ratings. A 2 (role model domain) x 2 (role model femininity) x 2 (STEM liking) factorial ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity ($F(1,187) = .98, p = .32, d = .14$). The three-way interaction was also nonsignificant ($F(1,187) = .21, p = .65, d = .07$). Participants who liked STEM reported higher math self-ratings ($M = 4.68, SD = 1.25$) than participants who did not like STEM ($M = 3.53, SD = 1.32, F(1,187) = 36.47, p < .001, d = .88$). No other significant main or interactive role model effects emerged (all Fs < 1.29, all ps > .25). See Table 5 for all means and standard deviations.

Science self-ratings. A 2x2x2 ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity ($F(1,187) = .41, p = .52, d = .09$). The three-way interaction was also nonsignificant ($F(1,187) = .01, p = .94, d = .01$). Participants who liked STEM reported higher science self-ratings ($M = 5.13, SD = 1.18$) than participants who did not like STEM ($M = 4.19, SD = 1.22, F(1,187) = 28.05, p < .001, d = .77$). No other significant main or interactive role model effects emerged (all *F*s < 2.34, all *p*s > .12). See Table 6 for all means and standard deviations.

English self-ratings. Unexpectedly (because role model femininity was not expected to moderate English effects), a marginal effect of role model femininity (*F*(1,187) = 3.10, *p* = .08, *d* = .26) was qualified by a significant two-way interaction with role model domain (*F*(1,187) = 4.28, *p* = .04, *d* = .30). A simple effect analysis revealed that gender-neutral STEM role models yielded marginally stronger English self-ratings (*M* = 5.40, *SD* = .89) than gender-neutral humanities role models (*M* = 4.94, *SD* = 1.21, *F*(1,192) = 3.25, *p* = .07, *d* = .26). Post-hoc contrasts revealed that the gender-neutral STEM role model condition also yielded significantly stronger English self-ratings than control (*M* = 4.66, *SD* = 1.20, *F*(1,237) = 8.81, *p* < .01, *d* = .39). The feminine STEM role model (*M* = 5.03, *SD* = 1.05) yielded marginally stronger English self-ratings than control (*F*(1,237) = 2.86, *p* = .09, *d* = .22). See Figure 4. In addition, participants who liked STEM reported lower English self-ratings (*M* = 4.65, *SD* = 1.13) than participants who did not like STEM (*M* = 5.45, *SD* = .93, *F*(1,187) = 29.74, *p* < .001, *d* = .80). The three-way interaction was nonsignificant (*F*(1,187) = .81, *p* = .34, *d* = .13). See Table 7 for all means and standard deviations.

Role model effects on future plans.

Math plans. A 2x2x2 ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity (*F*(1,187) = 2.26, *p* = .14, *d* = .22), nor the hypothesized three-way interaction (*F*(1,187) = 2.34, *p* = .13, *d* = .22). STEM fans (or students who liked STEM) reported greater likelihood to take math classes (*M* = 4.0, *SD* = 1.88) than non-STEM fans (or students who did not like STEM; *M* = 2.69, *SD* = 1.72, *F*(1,187) = 23.70, *p* <

.001, $d = .71$). No other significant main or interactive effects emerged (all *F*s < 2.34, all *p*s > .12). See Table 8 for all means and standard deviations.

Science plans. A 2x2x2 ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity ($F(1,187) = .20$, $p = .65$, $d = .07$). The three-way interaction was also nonsignificant ($F(1,187) = .66$, $p = .42$, $d = .12$). STEM fans reported greater likelihood to take science classes ($M = 5.15$, $SD = 1.85$) than non-STEM fans ($M = 3.65$, $SD = 2.01$, $F(1,187) = 24.90$, $p < .001$, $d = .73$). No other significant main or interactive effects emerged (all *F*s < 2.14, all *p*s > .14). See Table 9 for all means and standard deviations.

English plans. A 2x2x2 ANOVA did not reveal a main effect of role model domain ($F(1,186) = .001$, $p = .98$, $d < .01$), a two-way interaction between femininity and domain ($F(1,186) = .11$, $p = .74$, $d = .05$), nor the three-way interaction ($F(1,186) = 1.55$, $p = .22$, $d = .18$). STEM fans reported less likelihood to take English classes ($M = 4.82$, $SD = 1.69$) than non-STEM fans ($M = 5.69$, $SD = 1.24$, $F(1,187) = 19.0$, $p < .001$, $d = .64$). No other significant main or interactive effects emerged (all *F*s < 2.53, all *p*s > .11). See Table 10 for all means and standard deviations.

Role model effects on math persistence.

Math attempts. A 2x2x2 factorial ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity ($F(1,187) = 2.16$, $p = .14$, $d = .21$). However, the three-way interaction was significant ($F(1,187) = 4.78$, $p = .03$, $d = .32$). A simple interaction analysis revealed that role model domain and femininity interacted significantly among STEM fans ($F(1,192) = 7.13$, $p < .01$, $d = .39$), but the simple interaction was not significant among participants who did not like STEM ($p = .79$). A simple effect analysis on STEM fans' scores found that feminine STEM role models yielded fewer math attempts (*M* = 5.0, *SD* = 2.71) than the feminine humanities condition (*M* = 7.93, *SD* = 5.69, *F*(1,190) = 8.5, $p < .01$, *d* = .42), but not significantly fewer than the gender-neutral STEM condition (*M* = 6.94, *SD* = 3.33, *F*(1,190) = 1.87, *p* = .17, *d* = .20). Feminine humanities role models yielded more math attempts than the gender-neutral humanities condition (*M* = 6.12, *SD* = 3.41, *F*(1,190) = 5.41, *p* = .02, *d* = .34). Post-hoc contrasts revealed that no condition differed from STEM-liking participants in the control condition (*M* = 6.54, *SD* = 4.49, *ps* > .13). See Figure 5.

Percent correct. Neither the expected 2-way interaction between role model femininity and role model domain (*F*(1,184) = .001, *p* = .98, $d < .01$) nor the 3-way interaction (*F*(1,184) = 2.09, *p* = .15, *d* = .21) was significant on percent of math solutions deemed correct and original. All other *F*s were less than 1.55 and all *p*s were greater than .21. See Table 11 for all means and standard deviations for math attempts and percent correct.

Exploratory analysis of self-rating subscales. The positive impact of STEM role models on English self-ratings was unexpected. In the face of a STEM role model that had been rated more successful and less attainably successful than the humanities role model, participants may have highlighted their aptitude in English, a field where the STEM role model might have been assumed to be less talented. If this was the case, some sort of deflation in the role model's field of success (math or science) should also have emerged, i.e., in the math and science self-ratings. Thus, exploratory analyses of the self-rating subscales (self-concept, interest, and importance) in math and science were undertaken.

Math self-concept. A 2x2x2 factorial ANOVA revealed a significant effect of domain (*F*(1,187) = 3.88, *p* = .05, *d* =.29) such that STEM role models yielded weaker math self-concept (*M* = 4.16, *SD* = 1.47) than humanities role models (*M* = 4.51, *SD* = 1.42). A post-hoc contrast revealed that the STEM role models marginally weakened math self-concept relative to control ($M = 4.40$, $SD = 1.41$; $F(1,237) = 3.71$, $p = .055$, $d = .25$). Participants who liked STEM also reported higher math self-concept ($M = 4.82$, $SD = 1.27$) than participants who disliked STEM ($M = 3.89$, $SD = 1.47$, $F(1,187) = 21.75$, $p < .001$, $d = .68$). See Figure 6.

Other subscales. Analyses of math interest, math importance, science self-concept, science interest, and science importance yielded no statistically significant role model effects, although students who liked STEM scored significantly higher on all five subscales compared to students who disliked STEM.

Mediation of math self-concept effect via attainability. Because the STEM and humanities role models unexpectedly differed in perceived attainability of success, a mediation analysis tested whether that condition differences could account for the observed effect on math self-concept.

Following Baron and Kenny (1986), three hierarchical linear regression models were estimated, excluding control participants. For the first estimation, math self-concept was regressed on role model domain (as well as the standardized control variables of STEM liking, ratings of role model similarity and success, role model femininity, and the interaction of domain and femininity). The model was significant ($F(5,189) = 5.33$, $p < .001$, $R^2 = .12$). Domain was marginally significant ($\beta = .13$, $p < .08$) such that STEM role models (coded as 0) predicted worse math self-concept than humanities role models (coded as 1).

In the second estimation, the same variables were used to predict the proposed mediator of attainability. The model was significant ($F(5,189) = 3.21$, $p < .01$, $R^2 = .08$). Domain was significant ($\beta = .21$, $p < .01$) such that STEM role models were rated less attainable than English.[5]

In the third estimation, all variables including attainability were used to predict math self-concept. The model was significant ($F(6,188) = 8.07$, $p < .001$, $R^2 = .21$). Domain was nonsignificant ($\beta = .06$, $p = .37$) whereas attainability was significant ($\beta = .30$, $p < .001$) such that greater perceived attainability of one's assigned role model predicted greater math self-concept. This suggests that STEM role models' lower attainability ratings mediated their negative impact on math self-concept.[6] See Figure 7.

Hayes and Preacher's MEDIATE macro (2013) was also used to generate bootstrapped confidence intervals based on samples of 10,000 cases, in order to provide a direct significance test of the mediation model. The 95% confidence intervals revealed an indirect effect that was significantly different from zero (Mediated Effect = .07, SE = .04, 95% CI = 0.009 to .153). STEM role models indirectly reduced math self-concept by portraying success that seemed relatively unattainable.

Discussion

Study 2 found a pattern of effects somewhat different than that uncovered in Study 1a, and somewhat counter to its hypotheses. STEM role models were rated as particularly successful and more unattainably so than humanities role models. They were also motivating on English self-ratings rather than math or science self-ratings. In addition, although overall math self-

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[5] In the first estimation, liking STEM (coded as 0) also significantly positively predicted math self-concept ($\beta = .33$, $p < .001$). In the second estimation, role model similarity ratings were also significantly positively related to attainability ($\beta = .20$, $p < .01$).

[6] Attainability did not mediate role models' effects on English self-ratings or math attempts. Similar analyses yielded no evidence that similarity, positivity, or success ratings mediated the role models' effects on any outcome (self-ratings, future plans, math persistence).

ratings were unaffected, exploratory analyses found that STEM role models reduced math self-concept relative to humanities role models and relative to the no role model control condition.

These effects may reflect participants contrasting away from their assigned role models, rather than assimilating towards them. This may be tied to the particular role model manipulations used in Study 2. First, participants saw only one role model instead of three. As a result, the role model may have served as a singular exemplar, which can encourage contrast rather than assimilation (Mussweiler, Rüter, & Epstude, 2004). In addition, STEM role models (but not feminine STEM role models in particular) seemed more successful and less attainably successful than humanities role models. Mediation analysis suggested that STEM role models deflated participants' self-ratings in math, a field relevant to the role model's domain of success, because they were rated less attainably successful.

Contrast effects may also explain why STEM role models improved English self-ratings, even though role models were not expected to affect outcomes in domains outside of their own. In the face of a more successful other, participants may have attempted to boost their self-esteem by highlighting their abilities in English, a field the STEM role model may have been assumed to be less talented in. This contrast emerged most clearly following exposure to the gender-neutral STEM role model, perhaps because she (as a less feminine woman) was especially likely to be seen as less talented in English (a stereotypically feminine field).

It was possible that students who liked STEM would benefit most from gender-neutral STEM role models. Although this did not occur due to the overall lack of positive role model effects in Study 2, STEM fans alone did work harder at the math test after viewing feminine humanities role models. This may have occurred because these STEM-identified students had the most to gain by contrasting themselves away from a woman in a more stereotypically expected field. Alternatively, this may have occurred because people tend to contrast away from outgroup members (Brewer & Weber, 1994), and students who liked STEM felt dissimilar from English role models. Either way, their increased math persistence may have been their way of contrasting themselves away from the presumed skills of a woman who fit the stereotypic image of a woman succeeding in a field so different from their own.

In short, Study 2 failed to find the expected difference between feminine and gender-neutral STEM role models on math and science outcomes. It is possible that this occurred because the STEM role models seemed too successful to yield inspiration or too singular to encourage assimilation. Study 3 thus developed new stimuli that were better matched on attainability, and increased the number of role models each participant saw. This was intended to allow a cleaner assessment of college women's reactions to feminine STEM role models.

CHAPTER V

Study 3: Individual Differences and Reactions to Role Models

Study 3 aimed to further clarify how STEM outcomes were affected by feminine STEM role models by updating its operationalization of femininity. Studies 1a, 1b, and 2 manipulated the femininity of the role models' personal appearance, home appearance, and leisure activities. This distinguished the studies from other work that had highlighted femininity in STEM via communal traits or values (e.g., Diekman et al., 2011). However, the present work had not yet determined if feminine appearance alone was enough to influence the effectiveness of STEM role models.

Appearance is central to cultural stereotypes about women. Toddlers quickly learn to describe girls in terms of appearance or clothing, and boys in terms of traits or actions (Halim & Ruble, 2010). Theoretical definitions of femininity include clothing, hairstyles, make-up, and grooming practices (Moore, 2006). The Conformity to Feminine Norms Inventory (used in this study) includes a subscale asking solely about women's make-up and hairstyling habits (Mahalik et al., 2005). Fittingly, women are judged for the femininity of their appearance across diverse (and irrelevant) domains. For instance, women judged as too feminine (e.g., wearing too much make-up) are seen as less competent and deemed worthy of lower starting salaries (Forsythe et al., 1985; Kyle & Mahler, 1996). Yet, women judged as not feminine enough (i.e., not wearing enough make-up) are seen as less confident, less healthy, and as having a lower earning potential (Nash, Fieldman, Hussey, Leveque, & Pineau, 2006). Study 3 narrowed its focus to this aspect of femininity by manipulating only the interview subjects' appearance.

Participants also viewed two role models each rather than one in order to discourage contrast effects that may arise from comparisons to singular exemplars. Although it would have been ideal to present participants with three role models, as was done in Studies 1a and 1b, only two volunteers (one Black and one White) were available to pose for role model photographs. Thus, a South Asian role model was not presented. These materials, varying in femininity as well as domain, were subjected to pre-tests with a college sample. Feminine role models were intended to appear more feminine than yet equally intelligent as gender-neutral role models, and STEM role models were designed to appear equally successful and equally attainably successful as humanities role models.

Study 3 tests the same hypotheses tested (but not supported) by Study 2. Gender-neutral STEM role models were expected to yield stronger self-ratings and future plans in both math and science, and more math persistence, relative to the feminine STEM role model condition and to a no role model control condition. It was possible that humanities role models would boost self-ratings and future plans in humanities, but femininity was not expected to moderate these effects. Further, it was possible that gender-neutral STEM role models would especially benefit students who liked STEM (as these students might best identify with a STEM role model; Lockwood & Kunda, 1997).

In addition, Study 3 assessed how these predicted effects might be moderated by previously unexplored individual differences. Studies 1a, 1b, and 2 highlighted the importance of STEM liking as an individual difference: middle school girls who disliked STEM were most deflated by feminine STEM role models, and college women who liked STEM were most likely to contrast away from feminine humanities role models. Study 3 shifted its focus from a STEM-relevant individual difference to three femininity-relevant variables. Specifically, it assessed implicit and explicit stereotypes about femininity and STEM, as well as participants' own endorsement of feminine appearance norms.

The extent to which women endorse stereotypes about gender and STEM is related to academic outcomes, including vulnerability to stereotype threat (Schmader, Johns, & Barquissau, 2004). Importantly, stereotypes can exist at either the implicit or the explicit level. Implicit stereotypes are nonconscious associations between two concepts, and they typically reflect whatever is frequently paired in one's environment (Rudman, 2004). For instance, men are more visible in STEM fields than women, and so implicit male-math and male-science associations are more prevalent than female-math or female-science associations (e.g., Nosek et al., 2009). In contrast, explicit stereotypes are consciously held beliefs about the characteristics of a given social group (Rudman, 2004). Whereas explicit stereotypes are under some conscious control, implicit stereotypes cannot be purposefully endorsed or rejected. As a result, one can explicitly reject female stereotypes (or even be a female math major; Nosek, Banaji, & Greenwald, 2002) yet still absorb an implicit male-math association from the surrounding culture.

Although research has found explicit endorsement of the unfeminine-STEM stereotype, it remained unclear whether this link also existed at an implicit level. Given the rise of the "sexy scientist" in the media, it was unclear how prevalent this implicit link might be in a female college-aged sample. It was important to assess both kinds of stereotypes because explicit stereotypes have been found to be less predictive of academic outcomes than implicit stereotypes (Kiefer & Sekaquaptewa, 2007b; Ramsey & Sekaquaptewa, 2010). For instance, the weaker women's implicit male-math stereotype, the better they performed on a stereotype-threat-free math test (Kiefer & Sekaquaptewa, 2007b), and the worse they performed in real college math courses (Kiefer & Sekaquaptewa, 2007a; Ramsey & Sekaquaptewa, 2010).

Study 3 assessed implicit associations between unfeminine appearance and STEM with a timed computer task. Participants paired words related to STEM with images related to feminine appearance and with images related to unfeminine appearance. If the unfeminine-STEM pairings were completed more quickly than the feminine-STEM pairings, this indicated a stronger unfeminine-STEM stereotype. It was predicted that participants who strongly held the implicit stereotype would be least motivated by feminine STEM role models, as such a combination might feel least likely and thus least motivating to participants who most strongly link STEM and unfeminine appearance. In contrast, participants who lacked the implicit stereotype might respond equivalently to feminine and gender-neutral STEM role models, as they might not view the feminine-STEM combination as unlikely or difficult.

Study 3 also assessed participants' level of explicit stereotyping. Participants were asked to report how strongly they agreed with the notion that women in STEM fields look unfeminine. Given explicit stereotypes' poorer predictive validity, explicit stereotypes were not expected to moderate reactions to feminine STEM role models. At the very least, explicit stereotypes were expected to moderate outcomes less consistently compared to implicit stereotypes.

The final individual difference variable measured was participants' own endorsement of feminine appearance norms. Effective role models are those that seem similar to their audience on some important dimension. For instance, aspiring teachers were more inspired by successful teachers than successful accountants, and vice versa (Lockwood & Kunda, 1997), and women may derive unique benefits from same-gender role models (Lockwood, 2006). Women who personally endorse a feminine appearance might thus feel just as motivated by feminine STEM role models as gender-neutral STEM role models, if not more so. That is, participants who valued or adhered more to feminine appearance might have been expected to assimilate to the academic outcomes portrayed by feminine role models, even in a field considered to be “unfeminine.”

The changes made to Study 3’s manipulations and the addition of these three individual differences allowed for a fuller assessment of the role of femininity in STEM role models. First, the femininity of role models was manipulated solely in terms of feminine appearance. Second, participants’ own feminine appearance endorsement was assessed, with the expectation that feminine STEM role models would be less ineffective to participants high in this trait. Third, participants’ associations between STEM and unfemininity were assessed, with the expectation that implicit stereotypes would more consistently moderate the impact of feminine STEM role models compared to explicit stereotypes.

Method

Participants. One hundred-sixty-one undergraduate women (100 White, 40 Asian, 9 Black, 7 Hispanic, 5 multiracial; M_{age} = 19.48, *SD* = 2.14) participated in exchange for either one hour of credit for their introductory psychology class (*n* = 90) or twelve dollars (*n* = 71). The majority of students were in their first (*n* = 60) year, followed by second (*n* = 43), third (*n* = 33), fourth (*n* = 20), and fifth or beyond (*n* = 3). One hundred seven students were majoring in a non-STEM field (including business, nursing, sociology, and general psychology), and 54 in STEM (including biology, chemistry, engineering, and neuroscience). Four participants failed to complete the implicit stereotype test due to computer error, yielding a sample size of 157 for all analyses assessing implicit stereotypes.

Materials

Individual differences prescreen. Before coming to the lab, participants had the option of completing a computerized pretest questionnaire that contained the measures of feminine appearance endorsement and explicit stereotyping. Thirty-seven participants opted not to complete the prescreen, yielding a sample size of 124 for all analyses assessing these two variables.

Feminine appearance endorsement. Participants used 7-point scales (1 = strongly disagree, 7 = strongly agree) to answer two items taken from the Conformity to Feminine Norms Inventory ("I regularly wear makeup" and "I get ready in the morning without looking in the mirror very much" [reverse coded], Mahalik et al., 2005), and three original items ("It is important to me that I look feminine," "Women should pay attention to their appearance," and "Women should look feminine.") The items displayed sufficient internal reliability (α = .69) and were averaged into a single measure of feminine appearance endorsement.

Explicit stereotype endorsement. Participants used a 7-point Likert scale to report their agreement (1 = strongly disagree, 7 = strongly agree) with one statement assessing explicit endorsement of the unfeminine-STEM stereotype: "I think that women in STEM really do look less feminine than women in more traditional fields."

Single-Category Implicit Association Test. Participants' automatic associations between STEM and unfeminine appearance were assessed with a modified Single-Category Implicit Association Test (Karpinski & Steinman, 2006). This test is adapted from the original Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998). The SC-IAT allows for a comparison of the strength of two associations with a single construct (here, STEM's association with unfemininity compared to femininity), whereas the classic design would also require a comparison of those associations with STEM and an "opposite" construct, typically humanities.

Participants were seated at a computer screen, where they read that their task was to categorize photographs and words according to labels appearing on either the left or right side of their screen. The stimuli participants sorted were six STEM-related words (engineering, physics, biology, technology, mathematics, and chemistry) and twelve photographs of clothing or accessories. These photographs portrayed either an unfeminine version or a feminine version of each of six items (sweater, coat, shoe, watch, necklace/lanyard, and bag).[7] See Appendix D for all SC-IAT feminine and unfeminine photographs.

Over four rounds (including two practice rounds featuring 24 sorting tasks and two critical rounds featuring 72 sorting tasks), participants sorted these stimuli into three categories of interest: "Math/Science", "Unfeminine", and "Feminine." In each round, the "feminine" category label appeared on one side of the screen and the "unfeminine" category label appeared on the other. For half of the rounds, the STEM label was paired with the unfeminine label, and for the other half, it was paired with the feminine label. To avoid bias related to handedness, half of the participants first completed rounds with unfeminine on the right side and the other half first completed rounds with unfeminine on the left side. To avoid bias related to which pairing came first, half of the participants saw STEM paired with unfeminine first and the other half saw it paired with feminine first.

As each word and photograph appeared one by one in the center of the screen, participants were asked to press the "Z" key on their keyboard to assign it to the category or categories on the left side of the screen and to press the "M" key to assign it to any of the categories on the right side of the screen. The faster that participants were able to assign unfeminine pictures and STEM words when those categories shared a response side, relative to the speed with which they paired

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[7] In pilot testing, 32 participants rated each photograph on a scale from 1 (extremely unfeminine) to 7 (extremely feminine), with 4 being labeled "neither feminine nor unfeminine." The final six "feminine appearance" items were deemed significantly more feminine than neutral (e.g., a pink cardigan sweater with a bow; $t(31) = 50.66$, $p < .001$, $M = 6.78$, $SD = 0.3$) and the six "unfeminine appearance" items were rated significantly more unfeminine than neutral (e.g., a shapeless brown turtleneck; $t(31) = -9.59$, $p < .001$, $M = 2.82$, $SD = 0.69$).

feminine pictures and STEM words, the stronger that participant's implicit unfeminine-STEM stereotype was determined to be. See Appendix E for an illustration of the SC-IAT.

In keeping with author recommendations (Karpinski & Steinman, 2006), participants received positive feedback (a green circle) for each correct categorization and negative feedback (a red x) for each incorrect one. They were also given a maximum response time window of 1600 ms. If they had not categorized a stimulus word or picture within 1.6 seconds, they received an error message reading "Please respond more quickly," and that trial was not included in final response time calculations.

Role model stimuli. Participants read a pair of interviews ostensibly conducted with recent University of Michigan graduates. The interviews and photographs differed along two key dimensions: femininity of appearance and domain of success.

The feminine role models (one White woman and one Black woman) wore make-up, long hair, pink or pastel-colored clothing, and jewelry. The gender-neutral photographs featured the same women wearing no make-up, dark-colored clothing, a ponytail, and no jewelry. The photographs were pretested and found to be significantly more feminine-looking in the feminine appearance condition (ps < .001), yet equivalently intelligent (ps > .74) regardless of appearance.[8]

The role models' domain of success was manipulated via the content of the interview and one element of one of the role model's photographs. The role models were described as successful either in STEM fields or in the humanities. The STEM versions featured a

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[8] Seventy-three pilot participants rated the femininity and intelligence of the role models on seven-point scales. They viewed four photographs (two different photos of each of the two volunteers) dressed in a gender-neutral way, feminine way, or feminine way with glasses. The final photographs feature feminine women in glasses in order to ensure that the feminine and gender-neutral role model photographs were as similar as possible in all respects save for outfit.

biochemistry graduate now pursuing a PhD in Chemistry and Biomedical Engineering at the University of California at Berkeley and an engineering graduate working at an engineering design firm in New York City. The humanities versions featured an English graduate now pursuing a PhD in English Language and Literature at UC Berkeley and an art history graduate now working at the Metropolitan Museum of Art in New York City. These interviews were pretested to ensure that both versions conveyed equally impressive yet feasible success.[9] In addition, one role model was pictured in front of a blackboard with math equations in the STEM condition, but in front of a blackboard with the equations digitally erased in the humanities condition. The other role model was photographed in a library, a setting that could seem STEM- or humanities-related, depending on the accompanying interview. See Appendix F for feminine STEM and gender-neutral humanities role model materials.

The study thus utilized a 2 (domain) x 2 (femininity) design, as well as a hanging control condition, as in Study 2. To approximate STEM-liking, which was measured in the prior three studies, major (STEM vs. non-STEM) was included as an additional factor, yielding a 2x2x2 design.

Role model ratings. After reading their role model interview, participants used a 7-point Likert scale ranging from 1 (not at all) to 7 (very much so) to rate the role models the 6-item positivity measure used in Study 2 ($\alpha = .86$), on perceived similarity to themselves (as in Study 2, no particular domain of similarity was specified), and on perceived success. They also rated the role models on the item “feminine-looking” (as opposed to merely “feminine," as was asked in Study 2). Participants were then asked three questions about how likely it was that they could

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[9] Forty-two pilot participants read both interviews in either the STEM or humanities condition and used seven-point scales to rate how successful the women seemed and the extent to which it was possible to achieve similar success. There was no significant difference on ratings of success ($F(1,40) = .62$, $p = .44$, $d = .25$) or attainability ($F(1,40) = .20$, $p = .66$, $d = .14$).

be similar to the role models one year after their own graduation in three different domains: as academically successful, as feminine, and *both* as academically successful *and* as feminine. Finally, they reported how similar they would one day like to be to the role models in terms of academics, femininity, and *both* academics and femininity.

Current self-ratings. Participants completed self-rating scales for mathematics (α = .95), science (α = .93), and English (α = .93; Simpkins et al., 2006). The items were identical to those used in Study 2, save for the omission of one item related to self-concept. This item asked how well students expected to do in a current or upcoming class in that field, and was dropped because some students may not have been planning to take classes in certain fields.

Future plans. Participants responded to the same future plans measure that was used in Study 2. The items correlated positively for mathematics ($r = .78, p < .001$), science ($r = .82, p < .001$), and English ($r = .76, p < .001$).

Math persistence. Participants completed the 36 game, and their responses were again coded for number of attempts and percent correct.

Procedure. Participants first had the option of completing a computerized pretest questionnaire at home. Once in the psychology lab, all participants first completed the implicit stereotyping measure, the SC-IAT. As in Study 2, they were then randomly assigned into one of five role model conditions (including a control condition) and completed outcome measures. They ended by rating the role model's believability and reporting demographics. Finally, they were debriefed and dismissed.

Results

Role model ratings. As in Study 2, analyses of role model ratings excluded participants in the control condition. Thus, 129 participants were included in a series of 2 (role model domain) x 2 (role model femininity) x 2 (STEM major) factorial ANOVAs on role model ratings. Although multi-faceted STEM liking was not assessed, STEM major (as a reflection of STEM liking) was included as a factor for the sake of symmetry between studies. See Table 12 for means and standard deviations for all role model ratings. See Table 13 for correlations among role model ratings.

Feminine-looking. As predicted, feminine role models were rated more feminine-looking ($M = 6.07$, $SD = .99$) than gender-neutral role models ($M = 4.86$, $SD = 1.43$, $F(1,121) = 27.34$, $p < .001$, $d = .95$) regardless of whether they were in the STEM or humanities domain (all remaining Fs < 1.34, all ps > .25).

Positivity. Diverging from Study 2, a 2x2x2 ANOVA on positivity revealed a marginal effect of role model femininity ($F(1,121) = 3.18$, $p = .08$, $d = .32$) and a significant effect of domain ($F(1,121) = 12.85$, $p < .001$, $d = .65$), both of which were qualified by a significant 2-way role model domain by femininity interaction ($F(1,121) = 4.49$, $p = .04$, $d = .39$). A simple effect analysis revealed that feminine STEM role models were rated more positively ($M = 6.58$, $SD = .44$) than feminine humanities role models ($M = 5.78$, $SD = .88$, $F(1,126) = 17.88$, $p < .001$, $d = .75$) or than gender-neutral STEM role models ($M = 6.0$, $SD = .71$, $F(1,126) = 8.71$, $p < .01$, $d = .53$). No other main effects or interactions emerged (all Fs < 1.92, all ps > .16).

Successful. Despite pretesting, STEM role models ($M = 6.7$, $SD = .53$) were again rated more successful than humanities ($M = 6.13$, $SD = 1.08$, $F(1,121) = 14.11$, $p < .001$, $d = .68$). Also, non-STEM majors gave marginally higher success ratings ($M = 6.51$, $SD = .83$) than STEM majors ($M = 6.18$, $SD = 1.04$, $F(1,121) = 3.41$, $p = .07$, $d = .34$). No other main effects or interactions emerged (all Fs < 1.45, all ps > .23).

Attainability. As desired, and unlike in Study 2, STEM and humanities role models seemed equally attainable in terms of academics (all *F*s < 1, all *p*s > .32). They also seemed equally attainable in terms of combined academics and femininity (all *F*s < 1.77, all *p*s > .18). However, feminine role models seemed more attainable (*M* = 6.38, *SD* = 1.05) than gender-neutral (*M* = 5.67, *SD* = 1.38, *F*(1,121) = 7.20, *p* < .01, *d* = .49) in terms of femininity. All other *F*s were lower than 2.33, and all *ps* greater than .13.

Similar. Similar to Study 2, a significant effect of domain (*F*(1,121) = 10.41, *p* < .01, *d* = .59) was qualified by a significant interaction with major (*F*(1,121) = 5.95, *p* < .02, *d* = .44). STEM majors rated STEM role models more similar to themselves (*M* = 5.39, *SD* = .98) than humanities role models (*M* = 3.59, *SD* = 1.68, *F*(1,126) = 10.78, *p* = .001, *d* = .58). No other main effects or interactions emerged (all *F*s < 2.49, all *p*s > .11).

Desired similarity. Similar to Study 2, the role models did not differ on desired academic similarity (all *F*s < 1.34, all *p*s > .24). Participants reported wanting to be more similar in terms of femininity to the feminine role models (*M* = 5.39, *SD* = 1.80) than the neutral role models (*M* = 4.46, *SD* = 2.02, *F*(1,120) = 5.66, *p* < .02; all other *F*s < 1.21, all *p*s > .27), and marginally more similar to the feminine role models than the gender-neutral role models in terms of combined academic *and* feminine similarity (*F*(1,120) = 3.02, *p* < .09, *d* = .32), perhaps in part because this question directly followed the feminine similarity question. All other *F*s were lower than 1.24, and all *p*s greater than .26.

Believable. Unexpectedly, a 2x2x2 ANOVA revealed a significant effect of domain on believability ratings (*F*(1,120) = 16.8, *p* < .001, *d* = .75), qualified by a significant interaction with major (*F*(1,120) = 6.6, *p* = .01, *d* = .47) such that only STEM majors felt that the STEM role models (*M* = 6.28, *SD* = .90) were more believable than the humanities role models (*M* =

4.68, *SD* = .90, *F*(1,125) = 19.29, *p* < .001, *d* = .79). No other main effects or interactions emerged (all *F*s < 2.55, all *p*s > .11). One-sample t-tests revealed that means in all of these conditions were significantly (all *t*s > 3.81, all *p*s < .01) or marginally above the midpoint of four (STEM majors' ratings of feminine English role models, *M* = 4.71, *SD* = 1.44, *t*(13) = 1.86, *p* < .09). Thus, the role models seemed generally believable.

Role model effects on current self-ratings.

Math self-ratings. A 2 (role model domain) x 2 (role model femininity) x 2 (STEM major) factorial ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity (*F*(1,121) = .91, *p* = .34, *d* = .17). The three-way interaction was also nonsignificant (*F*(1,121) = .37, *p* = .55, *d* = .11). STEM majors (*M* = 5.25, *SD* = 1.21) had stronger math self-ratings than non-STEM majors (*M* = 3.89, *SD* = 1.33, *F*(1,121) = 29.68, *p* < .001, *d* = 1.15). No other main effects or interactions emerged (all *F*s < 2.52, all *p*s > .11). See Table 14 for all means and standard deviations.

Science self-ratings. A 2x2x2 factorial ANOVA did not reveal the expected two-way interaction between role model domain and role model femininity (*F*(1,121) = 1.95, *p* = .17, *d* = .25). The three-way interaction was also nonsignificant (*F*(1,121) = 2.01, *p* = .16, *d* = .26). STEM majors (*M* = 5.40, *SD* = .98) had stronger science self-ratings than non-STEM majors (*M* = 4.59, *SD* = 1.30, *F*(1,121) = 10.48, *p* = .001, *d* = .59). No other significant effects emerged (all *F*s < 2.62, all *p*s > .10). See Table 15 for all means and standard deviations.

English self-ratings. A 2x2x2 ANOVA did not reveal an effect of role model domain (*F*(1,121) = .43, *p* = .51, *d* = .12), nor the two-way interaction between role model domain and role model femininity (*F*(1,121) = .25, *p* = .62, *d* = .09), nor the three-way interaction (*F*(1,121) = .17, *p* = .68, *d* = .07). STEM majors (*M* = 4.22, *SD* = 1.20) had weaker English self-ratings than non-STEM majors (*M* = 4.96, *SD* = 1.09, *F*(1,121) = 11.62, *p* = .001, *d* = .62). No other main effects or interactions emerged (all *F*s < .74, all *p*s > .39). See Table 16 for all means and standard deviations.

Role model effects on future plans.

Math plans. A 2x2x2 ANOVA did not reveal the hypothesized interaction between role model domain and role model femininity (*F*(1,121) < .001, *p* = .98, *d* = .01), nor the three-way interaction (*F*(1,121) = 1.29, *p* = .26, *d* = .21). However, the main effect of role model femininity was significant such that feminine role models yielded weaker math plans (*M* = 3.03, *SD* = 1.72) than gender-neutral role models (*M* = 3.84, *SD* = 2.18, *F*(1,121) = 12.72, *p* = .001, *d* = .65). Although the two-way interaction was not significant, the means suggested that this effect was driven mainly by the STEM role model condition. Indeed, the simple effect of femininity was significant in the STEM role model condition (*F*(1,126) = 5.21, *p* = .02, *d* = .41), but not in the humanities condition (*p* = .29). Gender-neutral STEM role models (*M* = 4.23, *SD* = 2.10), yielded stronger math plans than feminine STEM role models (*M* = 3.08, *SD* = 1.72), and marginally stronger than control (*M* = 3.31, *SD* = 2.0, *F*(1,156) = 3.38, *p* = .07, *d* = .29 [according to post-hoc contrasts]). Thus, the feminine STEM role model did not diminish math plans compared to control; rather the gender-neutral STEM role model raised them compared to control. See Figure 8. In addition, STEM majors (*M* = 4.54, *SD* = 2.05) reported stronger math plans than non-STEM majors (*M* = 2.91, *SD* = 1.74, *F*(1,121) = 31.56, *p* < .001 *d* = 1.02).

Science plans. A 2x2x2 factorial ANOVA revealed the predicted role model domain by femininity interaction (*F*(1,121) = 3.96, *p* < .05, *d* = .36). That interaction, along with a significant main effect of major (*F*(1,121) = 6.51, *p* = .01, *d* = .46), was qualified by a significant 3-way interaction (*F*(1,121) = 3.96, *p* < .05, *d* = .36). The simple interaction of role model domain and femininity was significant for STEM majors ($F(1,126) = 7.61$, $p < .01$, $d = .49$) but not non-STEM majors ($p = .93$). For STEM majors, feminine STEM role models ($M = 4.28$, $SD = 2.06$) yielded marginally weaker science plans than gender-neutral STEM role models ($M = 5.78$, $SD = 1.15$, $F(1,124) = 3.0$, $p < .09$, $d = .31$). In contrast, feminine humanities role models yielded stronger science plans than feminine STEM role models ($M = 5.86$, $SD = 1.25$, $F(1,124) = 5.62$, $p < .02$, $d = .43$) or the gender-neutral humanities role models ($M = 4.56$, $SD = 1.70$, $F(1,124) = 4.55$, $p < .04$, $d = .38$). However, no role model condition differed from STEM majors in the control condition ($M = 5.38$, $SD = 1.63$, all ps > .17). See Figure 9.

English plans. A 2x2x2 ANOVA did not reveal an effect of role model domain ($F(1,121) = .06$, $p = .80$, $d = .04$), nor the two-way interaction between role model domain and role model femininity ($F(1,121) = 2.06$, $p = .15$, $d = .26$), nor the three-way interaction ($F(1,121) = .22$, $p = .64$, $d = .09$). STEM majors ($M = 4.14$, $SD = 1.77$) had weaker English plans than non-STEM majors ($M = 5.20$, $SD = 1.56$, $F(1,121) = 10.07$, $p = .002$, $d = .58$). No other significant effects emerged (all *F*s < 1.2, all *p*s > .27). See Table 17 for all means and standard deviations.

Role model effects on math persistence.

Math attempts. A 2x2x2 ANOVA did not reveal the hypothesized interaction between role model domain and role model femininity ($F(1,121) = .88$, $p = .35$, $d = .17$). The three-way interaction was also nonsignificant ($F(1,121) = .01$, $p = .95$, $d = .02$). Unexpectedly, however, role model femininity was significant such that feminine role models yielded more math attempts ($M = 7.37$, $SD = 6.50$) than gender-neutral role models ($M = 5.35$, $SD = 3.59$, $F(1,121) = 4.97$, $p < .03$, $d = .41$). STEM majors ($M = 8.25$, $SD = 7.62$) made more math attempts than non-STEM majors ($M = 5.47$, $SD = 3.56$, $F(1,121) = 7.24$, $p < .01$, $d = .49$). No other main effects or interactions emerged (all *F*s < .88, all *p*s > .35). See Table 18 for all means and standard deviations.

Percent correct. As in Study 2, the hypothesized interaction between role model domain and role model femininity did not emerge (*F*(1,121) = 1.16, *p* = .28, *d* = .20), nor did the three-way interaction (*F*(1,121) = .21, *p* = .65, *d* = .08). No other effects emerged (all *F*s < 2.60, all *p*s > .11). See Table 18 for all means and standard deviations.

Mediation of role model effects via attainability. Neither Baron and Kenny's (1986) mediation method nor Hayes and Preacher's MEDIATE macro (2013) revealed evidence for mediation of any of the above effects via academic attainability, feminine attainability, or combined femininity/academic attainability. As in Study 2, mediation analyses also found no mediation of role models' effects via perceived positivity, similarity, or success.

Individual difference descriptives. See Table 19 for correlations among the three individual difference variables.

Implicit unfeminine-STEM stereotype. Reaction times for each of the two critical 72-trial blocks were used to calculate unfeminine-STEM implicit stereotype scores, following the scoring procedures described by Karpinski & Steinman (2006). Calculations excluded responses faster than 350ms and slower than 1400ms. Incorrect responses had a 400ms penalty added. Each of the blocks' average reaction time was then calculated with these trials. The average reaction time for the block featuring stereotypic categorizations (i.e., pairing STEM words with unfeminine photographs) was subtracted from the reaction time for the block featuring counterstereotypic categorizations (i.e., pairing STEM words with feminine photographs). Finally, this difference score was divided by the standard deviation of all correct response times (Karpinski & Steinman, 2006).

The average score on the unfeminine-STEM implicit IAT was .29 (*SD* = .33), with a range of -.92 to 1.06. The positive mean score indicates that counterstereotypic (feminine-STEM) pairings took longer on average to complete than stereotypic (unfeminine-STEM) pairings. A two-tailed one-sample t-test found that this mean score was significantly different than zero (*t*(156) = 11.16, *p* < .001, *d* = 1.79). Thus, participants displayed an implicit association between STEM and unfemininity. An independent-samples t-test revealed that IAT scores did not differ by major ($M_{\text{non-STEM,}}$ = .30, *SD* = .33, M_{STEM} = .29, *SD* = .32, t(155) = -.18, *p* = .86, *d* = -.03).

Explicit stereotype endorsement. The average score on the seven-point explicit stereotype endorsement item was 2.56 (*SD* = 1.53). Scores ranged from 1 to 6. A two-tailed one-sample t-test found that this mean score was significantly lower than the scale midpoint of four (*t*(123) = -10.44, *p* < .001, *d* = -1.88). Thus, participants tended to disagree with the explicit unfeminine-STEM stereotype. An independent-samples t-test revealed that non-STEM majors (*M* = 2.32, *SD* = 1.41) tended to disagree with this statement more strongly than STEM majors (*M* = 3.0, *SD* = 1.65; *t*(122) = 2.44, *p* = .02, *d* = .44).

Feminine appearance endorsement. The average score on the seven-point feminine appearance endorsement composite was 4.59 (*SD* = 1.10). Scores ranged from 1.2 to 7. A two-tailed one-sample t-test found that this mean score was significantly higher than the scale midpoint of four (*t*(123) = 5.98, *p* < .001, *d* = 1.08). Thus participants tended to moderately endorse feminine appearance. An independent-samples t-test revealed that feminine appearance scores did not differ by major ($M_{\text{non-STEM}}$ = 4.67, *SD* = 1.11, M_{STEM} = 4.45, *SD* = 1.07, *t*(122) = -1.05, *p* = .30, *d* = .19).

Moderation of role model effects by individual differences.

Hierarchical linear regression models were used to determine if individual differences moderated the effects of feminine STEM role models. Step one included standardized academic attainability ratings and major as control variables. Major is not included as a factor because the intention was to assess the moderating role of femininity-relevant individual differences, rather than this STEM-relevant individual difference, and because the sample power was insufficient for the interpretation of four-way interactions. Step two included role model domain, role model femininity, and the individual difference variable of interest. Step three included all two-way interactions. Step four included the three-way interaction among domain, femininity, and the individual difference. The three-way interaction was hypothesized to emerge for implicit stereotypes and feminine appearance endorsement on math and science outcomes. The interaction was not hypothesized to emerge for explicit stereotyping.

Figures 10 through 17 portray mean scores predicted from these regression models. Although line graphs are typically used to illustrate regression slopes, in this case, slopes reflect differences between two levels of dichotomous variables (e.g., feminine vs. gender-neutral role models). Therefore, bar graphs are presented.

Implicit stereotype.

Math self-ratings. Although the full model was significant ($F(9,115) = 4.36, p < .001, R^2 = .26$), the hypothesized three-way interaction among role model domain, role model femininity, and implicit stereotype scores did not emerge ($\beta = -.10, p = .26$).

Science self-ratings. Although the full model was significant ($F(9,115) = 4.68, p < .001, R^2 = .27$), the hypothesized three-way interaction among role model domain, role model femininity, and implicit stereotype scores did not emerge ($\beta = .10, p = .26$). An unexpected 2-way interaction between domain and implicit stereotype scores emerged ($\beta = -.23, p < .01$).

Analyses of simple slopes revealed that participants with weak implicit stereotypes showed higher science self-ratings in the humanities role model condition than in the STEM role model condition ($\beta = .27$, $p = .02$), and higher self-ratings than people with strong implicit stereotypes in the humanities role model conditions ($\beta = -.36$, $p < .01$). See Figure 10.

English self-ratings. The full model was significant ($F(9,115) = 2.38$, $p = .02$, $R^2 = .16$). Implicit stereotype scores did not interact with role model domain or femininity (all *p*s > .20). This was expected, as beliefs about the femininity of math and science were expected to moderate only reactions to STEM role models, which were not predicted to affect English outcomes.

Math plans. The full model was significant ($F(9,115) = 4.34$, $p < .001$, $R^2 = .25$), and the hypothesized three-way interaction among role model domain, role model femininity, and implicit stereotype scores was marginally significant ($\beta = -.16$, $p < .07$). Simple slope analyses revealed that the overall effect of femininity was significant for participants with strong implicit stereotypes ($\beta = .21$, $p = .04$), such that gender-neutral role models (coded as 1) improved math plans relative to feminine role models (coded as 0). However, this was driven by the STEM role model condition. Participants with strong implicit stereotypes reported greater math plans after viewing a gender-neutral STEM role model compared to a feminine STEM role model ($\beta = .85$, $p < .01$), and greater math plans compared to the gender-neutral humanities condition ($\beta = -.74$, $p = .04$). This positive effect of gender-neutral STEM role models fits the hypothesized pattern.

The overall effect of femininity ($\beta = .27$, $p = .03$) was also significant for participants with weak implicit stereotypes (those who did not associate STEM with either femininity or unfemininity). In this case, the effect was driven by the humanities role model condition. These participants reported greater math plans after viewing a gender-neutral humanities role model compared to a feminine humanities role model ($\beta = .80$, $p = .02$). However, the gender-neutral humanities role model did not improve math plans relative to a gender-neutral STEM role model ($p = .64$). See Figure 11.

Science plans. The full model was significant ($F(9,115) = 3.18$, $p < .01$, $R^2 = .20$), but the hypothesized three-way interaction among role model domain, role model femininity, and implicit stereotype scores was not significant ($\beta = .12$, $p = .19$). As had emerged for science self-ratings, the two-way interaction between domain and implicit stereotype scores was unexpectedly significant ($\beta = -.18$, $p = .04$). Analyses of simple slopes revealed a pattern identical to that found on science self-ratings. Participants with weak implicit stereotypes showed greater science plans in the humanities role model condition than in the STEM role model condition ($\beta = .25$, $p < .05$), and greater plans than people with strong implicit stereotypes in the humanities role model conditions ($\beta = -.40$, $p < .01$). See Figure 12.

English plans. The full model was significant ($F(9,115) = 2.37$, $p = .02$, $R^2 = .16$). As predicted, implicit stereotype scores did not interact with role model domain or femininity (all *p*s > .34).

*Math attempts***.** The full model was significant ($F(9,115) = 2.40$, $p = .02$, $R^2 = .16$), and the hypothesized three-way interaction among role model domain, role model femininity, and implicit stereotype scores was significant ($\beta = -.19$, $p < .05$). Simple slopes analyses revealed that the overall effect of role model femininity was marginally significant in the STEM role model condition ($\beta = -.21$, $p = .09$), but in an unexpected direction. Gender-neutral STEM role models reduced math attempts relative to feminine STEM role models. However, this was driven by participants with weak implicit stereotypes, who tried harder on the math task in the feminine STEM condition than the gender-neutral STEM condition ($\beta = -1.97$, $p = .04$).

Although the overall effect of role model femininity was not significant in the humanities role model condition ($\beta = -.13$, $p = .30$), participants with strong implicit stereotypes made marginally fewer math attempts in the gender-neutral humanities condition compared to the feminine humanities condition ($\beta = -1.75$, $p = .07$), and marginally fewer than participants with weak implicit stereotypes in the gender-neutral humanities condition ($\beta = -1.77$, $p = .08$). See Figure 13.

Percent correct. The full model was not significant ($F(9,114) = 1.57$, $p = .13$, $R^2 = .11$).

Explicit stereotype endorsement.

Math self-ratings. As predicted, although the full model was significant ($F(9,90) = 4.69$, $p < .001$, $R^2 = .32$), explicit stereotype scores did not interact with role model domain or femininity (all *p*s > .26).

Science self-ratings. As predicted, although the full model was significant ($F(9,90) = 3.29$, $p < .01$, $R^2 = .25$), explicit stereotype scores did not interact with role model domain or femininity (all *p*s > .33).

English self-ratings. The full model was significant ($F(9,90) = 2.57$, $p = .01$, $R^2 = .21$), the three-way interaction among role model domain, role model femininity, and explicit stereotyping was nonsignificant ($\beta = -.09$, $p = .35$). However, role model femininity unexpectedly interacted with explicit stereotype scores ($\beta = -.22$, $p = .03$). Simple slopes analyses revealed that participants with stronger explicit stereotypes reported higher English self-ratings in the feminine role model condition than in the gender-neutral role model condition ($\beta = -.33$, $p = .02$), and higher self-ratings than people with weak explicit stereotypes in the feminine condition ($\beta = .29$, $p = .04$). See Figure 14.

Math plans. As predicted, although the full model was significant ($F(9,90) = 3.64$, $p = .001$, $R^2 = .27$), explicit stereotype scores did not interact with role model domain or femininity (all ps > .29).

Science plans. The full model was significant ($F(9,90) = 2.35$, $p = .02$, $R^2 = .19$), and the three-way interaction among role model femininity, domain, and explicit stereotype endorsement was unexpectedly a marginally significant predictor ($\beta = -.16$, $p < .10$). Simple slopes analyses revealed that the overall effect of role model femininity was marginally significant within the STEM role model condition ($\beta = .26$, $p = .054$), such that gender-neutral STEM role models marginally improved science plans relative to feminine STEM role models. However, this was driven by participants high in explicit stereotyping. Participants with strong explicit stereotypes reported marginally greater science plans after viewing a gender-neutral STEM role model compared to a feminine STEM role model ($\beta = .69$, $p = .06$) or a gender-neutral humanities role model ($\beta = -.73$, $p = .06$). These effects were nonsignificant for participants with weak explicit stereotypes (ps > .37). The positive effect of gender-neutral STEM role models fits the hypothesized pattern, which also emerged significantly for STEM majors in a 2x2x2 ANOVA that did not account for explicit stereotyping. See Figure 15.

English plans. The full model was significant ($F(9,90) = 2.67$, $p < .01$, $R^2 = .21$), and the three-way interaction was nonsignificant ($\beta = -.07$, $p = .45$). Unexpectedly, two two-way interactions emerged: explicit stereotyping interacted significantly with role model femininity ($\beta = -.20$, $p = .04$) and also with role model domain ($\beta = .20$, $p < .05$). Participants with strong explicit stereotypes reported fewer English plans in the gender-neutral role model condition than the feminine condition ($\beta = -.29$, $p = .03$), and than participants with weak stereotypes in the gender-neutral condition (β= -.28, $p < .05$). As with English self-concept, participants with strong explicit stereotypes scored highest in the feminine role model condition. See Figure 16a.

Participants with weak stereotypes reported marginally more English plans in the STEM role model condition than the humanities role model condition (β = -.24, p = .08), and marginally more than participants with strong explicit stereotypes in the STEM condition (β = -.26, p = .07). See Figure 16b.

Math attempts. As predicted, although the full model was significant ($F(9,90) = 1.99$, $p < .05$, $R^2 = .17$), explicit stereotype scores did not interact with role model domain or femininity (all ps > .36).

Percent correct. The full model was not significant ($F(9,88) = .36$, $p = .95$, $R^2 = .04$).

Feminine appearance endorsement.

Math self-ratings. Although the full model was significant ($F(9,90) = 4.63$, $p < .001$, $R^2 = .32$), the hypothesized three-way interaction among role model domain, role model femininity, and feminine appearance endorsement did not emerge (β = -.13, p = .15).

Science self-ratings. Although the full model was significant ($F(9,90) = 3.16$, $p = .002$, $R^2 = .24$), the hypothesized three-way interaction among role model domain, role model femininity, and feminine appearance endorsement did not emerge (β = .02, p = .86).

English self-ratings. The full model was only marginally significant ($F(9,90) = 1.87$, $p = .07$, $R^2 = .16$). As predicted, feminine appearance endorsement did not interact with role model domain or femininity (all ps > .55).

Math plans. Although the full model was significant ($F(9,90) = 4.04$, $p < .001$, $R^2 = .29$), the hypothesized three-way interaction among role model domain, role model femininity, and feminine appearance endorsement did not emerge (β = -.07, p = .49). An unexpected 2-way interaction between domain and feminine appearance endorsement emerged ($\beta = -.19, p < .05$). Participants who strongly endorsed feminine appearance reported stronger math plans in the STEM role model condition than the humanities role model condition ($\beta = -.31$, $p = .02$), but not more than participants who weakly endorsed feminine appearance in the STEM role model condition ($p = .23$). See Figure 17.

Science plans. Although the full model was significant ($F(9,90) = 2.20, p = .03, R^2 = .18$), the hypothesized three-way interaction among role model domain, role model femininity, and feminine appearance endorsement did not emerge ($\beta = -.02, p = .87$).

English plans. Although the full model was significant ($F(9,90) = 2.26, p = .03, R^2 = .18$). As predicted, feminine appearance endorsement did not interact with role model domain or femininity (all ps > .77).

Math attempts. The full model was not significant ($F(9,90) = 1.67, p = .11, R^2 = .14$).

Percent correct. The full model was not significant ($F(9,88) = .84, p = .59, R^2 = .08$).

Discussion

Study 3 found some support for the notion that gender-neutral STEM role models are more motivating than feminine STEM role models. Adding femininity to the role model's appearance seemed to wipe out benefits that might otherwise emerge from a STEM role model. More specifically, positive effects of gender-neutral STEM role models were most likely for STEM-identified participants (STEM majors) or for participants with strong implicit unfeminine-STEM stereotypes. Gender-neutral STEM role models yielded stronger science plans than feminine STEM role models only among STEM majors, and stronger math plans only among people with strong implicit unfeminine-STEM stereotypes. Although explicit stereotypes were less predictive overall, gender-neutral STEM role models were also most motivating in terms of science plans for participants with strong explicit unfeminine-STEM stereotypes. These participants, like participants who implicitly linked unfeminine and STEM, may have been less motivated by feminine STEM role models compared to gender-neutral STEM role models because of the relatively greater difficulty of achieving an unlikely combination feminine appearance and success in STEM.

However, unlike in Study 2, no evidence suggested that STEM role models' effects were mediated by attainability. On the one hand, this may be related to the improved materials used in Study 3, in that lower attainability was not confounded with the role models being in STEM. Yet, the hypothesis that gender-neutral STEM role models are more motivating because they seem more attainable was not supported. Nor were the effects mediated by perceived similarity (Cheryan et al., 2011) or positivity (even though feminine STEM role models were rated most positive of all the role models). Future research should continue to probe precisely how gender-neutral and feminine STEM role models elicit their effects.

Unlike Study 1a, most movement in Study 3 occurred on future plans rather than current self-ratings. This makes sense given that predictions for college women were based more in motivation, whereas predictions for middle schoolers were based more in demotivation. A motivating role model should boost intentions for achieving similar success, even if it remains impossible to boost one's current achievements to reach those of the role model. Indeed, rather than the feminine STEM role model weakening math plans compared to baseline, the gender-neutral STEM role model strengthened them. It also makes sense given that older students likely have more stable self-concepts than younger students (Bong & Skaalvik, 2003), making the self-concepts of this adult sample more resistant to change.

There was one case where feminine STEM role models seemed more motivating than gender-neutral role models, but only when qualified by an individual difference. People with a weak (or nonexistent) implicit stereotype made more attempts on a math task after seeing a feminine STEM role model than a gender-neutral STEM role model. Perhaps, as predicted, such a role model might not seem so unlikely to people who do not link STEM and unfemininity. Thus, that role model had the potential to be equally as motivating as the gender-neutral STEM role model, or even (as it turned out) more motivating. Nevertheless, the feminine STEM role model never improved intentions for pursuing math or science, which may be more meaningful indicators of STEM motivation (Simpkins et al., 2006).

Whereas explicit stereotype endorsement was rather low, the Single-Category Implicit Association Test did reveal that women on average nonconsciously associated STEM with unfemininity over femininity. This disconnect has precedent in previous comparisons of explicit and implicit stereotypes (Nosek et al., 2002). Also as predicted, implicit stereotypes were the most meaningful individual difference in terms of moderating feminine STEM role model effects. Strong implicit stereotypes predicted greater math plans following exposure to gender-neutral STEM role models, whereas weak implicit stereotypes predicted more math attempts following exposure to feminine STEM role models. In contrast, explicit stereotypes moderated fewer specific effects of exposure to feminine or gender-neutral STEM role models.

Although humanities role models were not expected to influence math or science outcomes, some two-way interactions suggested a pattern of contrast versus assimilation effects moderated by individual differences. In general, weak stereotypes promoted contrast away from humanities role models. People with weak explicit stereotypes reported stronger science plans following exposure to humanities role models. People with weak implicit stereotypes reported higher science self-ratings following exposure to humanities role models, and greater math plans following exposure to the gender-neutral humanities role model. Women succeeding in stereotypically feminine fields, regardless of appearance, might most motivate contrast in the form of heightened STEM motivation among people who do not see STEM as incompatible with femininity.

In contrast, strong feminine appearance endorsement encouraged assimilation to humanities role models in the form of weakened math plans. Participants who value feminine appearance might take another woman's stereotypically feminine success (in terms of domain, if not necessarily appearance) as an encouragement to eschew math. Somewhat surprisingly, feminine appearance endorsement did not moderate reactions to feminine as compared to gender-neutral role models. Perhaps the femininity of one's field of success provides a stronger cue than appearance in terms of meeting feminine norms. This latter point is speculative, however, given that participants' views about the femininity of humanities fields were not assessed.

It is interesting to note that feminine STEM role models were rated most positively overall, even though they were less effective motivators than gender-neutral STEM role models. The fact that feminine role models were rated most positively overall in Study 2, and feminine STEM role models most positively in Study 3 speaks to the cultural value that is still placed on feminine women. Yet, adding that positively valued femininity to a successful woman in STEM did not improve her ability to motivate women in her field of success.

CHAPTER VI

General Discussion

Echoing real world efforts to highlight STEM's compatibility with femininity, these four studies tested whether feminine STEM role models could improve girls' and women's math and science motivation. Results suggest that such role models—women in STEM who hold feminine interests or even just look overtly feminine—are less motivating than more "everyday" female STEM role models. Study 1a found that among younger girls, feminine STEM role models reduced math self-ratings compared to either gender-neutral STEM role models or to feminine role models outside of STEM. Study 3 found that among college women, gender-neutral STEM role models yielded stronger math plans compared to a no role model control condition, whereas feminine STEM role models failed to boost math or science outcomes above baseline.

These effects, however, depended to some extent on individual differences. For one, college women and middle school girls responded differently to feminine STEM role models. Young girls reported more negative effects on current self-concepts, whereas college women's future plans were more widely affected. This may be because academic self-concepts become more stable over time, and thus perhaps less moveable by short-term interventions (Bong & Skaalvik, 2003). Relatedly, adults' less rigid stereotypes may make feminine STEM role models seem less daunting than they do to younger girls (albeit still more lofty than gender-neutral STEM role models). This would make positive effects of gender-neutral STEM role models more likely than overly negative effects of feminine STEM role models, and such motivating effects may be more likely to emerge on future plans than on current self-concepts. Young girls and adult women are both targeted by messages prescribing feminine norms and attempting to counter STEM's supposed compatibility with those norms. Future research should continue to assess how such messages differently affect students at various developmental stages, as well as the mechanisms underlying those effects. It is particularly important to identify which effects (from Study 1a's demotivating feminine STEM role models, to Study 2's contrast-inducing STEM role models, to Study 3's motivating gender-neutral STEM role models) are due to aspects of the role model manipulation, and which are due to developmental differences between young girls and adult women.

STEM interests also seemed to intensify the negative or positive effects of STEM role models. A demotivating role model was most harmful to students who had already begun to disidentify with the model's field of success. That is, in Study 1a, girls who did not express interest in math or science at the outset of the study reported decreased math self-ratings as well as lower likelihood of taking future math classes after viewing feminine STEM role models. A motivating role model, on the other hand, most benefitted students already identified with her domain. In Study 3, only STEM majors reported stronger intentions to take science classes after viewing gender-neutral STEM role models compared to feminine STEM role models. To reach gender parity in STEM, interventions must encourage female students' entry into STEM fields, and prevent attrition from women already in the field (AAUW, 2010; Frome et al., 2006). It is therefore essential to calibrate role models and other interventions to reach students with varying levels of interest in STEM.

Beliefs about femininity were another individual difference that predicted the impact of feminine-STEM role models. For instance, gender-neutral STEM role models were more effective than feminine STEM role models particularly among participants with strong unfeminine-STEM stereotypes, at either the implicit or explicit level. These two stereotypes looked quite different in Study 3's sample, as implicit and explicit cognitions often do (e.g., Nosek et al., 2002). Participants explicitly rejected the idea that women in STEM look unfeminine, yet nonconsciously associated STEM more strongly with unfeminine appearance than feminine appearance. Women's explicit rejection of the stereotype is encouraging, to the extent that STEM's unfeminine reputation is discouraging to women. Yet, implicit stereotypes tend to be better predictors of academic outcomes, and implicit unfeminine-STEM stereotypes moderated more outcomes than explicit stereotypes did. In spite of modern examples of feminine scientists, the prevailing image that women are absorbing from the culture, and that may impact their academic plans, still appears to be one of an unfeminine STEM woman.

One underlying notion that may explain why individual differences in STEM interest and unfeminine stereotypes is the idea of attainability. The role model literature already shows that role models who seem too difficult to match can deflate rather than inspire (Hoyt, 2012; Lockwood & Kunda, 1997). Hints of this emerged in the present studies. In Study 1b, the kinds of girls who were most demotivated by feminine STEM role models in Study 1a (i.e., girls who disliked STEM) also saw the combination of overt femininity and STEM success as least attainable. Study 2 found that STEM role models reduced math self-concept because they seemed less attainably successful than humanities role models. This effect, however, was not limited to feminine STEM role models, and instead may have been related to flaws in the number of role models presented or in a failure to match the role model's success across domain. Although Study 3 did not find evidence of mediating factors, the fact that participants who saw STEM as unfeminine were least motivated by feminine STEM role models suggests that seeing

STEM as incompatible with femininity is related to feeling unmotivated by feminine women in STEM.

Although failure to connect STEM with femininity (that is, holding the stereotype that STEM women are not feminine) exacerbated the effects of feminine STEM role models, the importance participants placed on their own feminine appearance did not seem to matter. Nevertheless, future research should continue to explore how feminine identity affects STEM-related choices, not just in women but also in young girls. Although a bit dated, past research found that eleven-year-old girls describing themselves as feminine were more likely to view science fields as masculine and thus unappealing (Kelly & Smail, 1986). The perception that women in STEM are unfeminine—not just in terms of communal values or personality traits, but even in appearance—may still be a barrier for people who value feminine appearance. Feminine STEM role models may simply not be the best way to remove that barrier.

Additional studies will shed more light on how the unfeminine-STEM stereotype affects academic choices, what kinds of role models or other interventions might alter that relationship, and for whom these effects might emerge. In other words, next steps should address the measures, manipulations, and samples used in these four studies. For instance, the SC-IAT photographs meant to represent "unfeminine" appearance could easily be perceived as "masculine" instead. This overlap is somewhat understandable, given that male and female are commonly regarded as "opposites." Yet, this means that participants' SC-IAT scores may reflect "male-STEM" associations rather than "unfeminine-STEM." Developing a more precise assessment of the implicit unfeminine-STEM stereotype would further the goals of this research.

The role model manipulations' focus on feminine appearance also merits examination. Additional studies might ask exactly why the mere appearance of a woman in STEM might affect students' math and science motivation. Appearance may act as a signal for underlying communal traits, or may signal interest in romance or romantic desirability. More detailed measures of role models' perceived traits and abilities might help answer this question. Another area of improvement lies in the design of the humanities role models. Humanities as a field of study may seem more diffuse than STEM, in that an English major might seem to have less in common with an art history major, compared to an engineering and a biochemistry major. More carefully crafted comparison role models would help isolate the unique effects of feminine STEM role models on STEM motivation.

Finally, the outcomes of all of these lines of inquiry likely depend on the sample. Viewing STEM as unfeminine may mean something different to young girls than to college women. Perhaps appearance in and of itself is more important to younger girls, serving as a clear-cut indicator of prized gender conformity, whereas college women might value feminine appearance to the extent that it serves romantic goals. The kinds of academic choices and the reasons behind them should also differ for each of these groups. Taking a high school math class might seem like more of a "given" than selecting an engineering major, and may speak less to a student's career goals. Toward this end, future studies should also examine high school students' stereotypes and reactions to role models. Their academic choices may feed more directly into occupational choices than those of middle schoolers, and successful interventions could encourage exploration of different careers before a major is chosen. In addition, future research should consider samples of different racial, ethnic, and cultural backgrounds, as notions of feminine incompatibility or the attractiveness of different careers may change in different contexts (e.g., South Asia as compared to the United States).

Feminine STEM role models should be regarded cautiously, and not just because of their failure to motivate across these studies. Swami and colleagues (2010) argue that endorsement of the feminine appearance ideal is problematic: it emphasizes that women should look good (i.e., feminine) in order to please and attract men. Feminine role models' emphasis on appearance could activate romantic concerns, which would likely conflict with goals in math or other "unfeminine" pursuits (Park et al., 2011). Swami and colleagues (2010) also report that endorsement of appearance norms is associated with objectification, or regarding women's bodies (including one's own) as objects for others' pleasure (Fredrickson & Roberts, 1997). Objectification cues, or reminders of how others view one's body, impair women's cognition, wasting energy otherwise needed for intellectual tasks and yielding worse performance on stereotype-relevant tasks such as math tests (Fredrickson, Roberts, Noll, Quinn, & Twenge, 1998; Gervais, Vescio, & Allen, 2011; Kiefer, Sekaquaptewa, & Barczyk, 2006). Such outcomes are quite the opposite of what a STEM role model is meant to do, and highlight why extra caution is called for when considering what kinds of figures are held up for girls and women to aspire to.

Feminine STEM role models may not be as effective as some may hope, but the underrepresentation they are designed to address remains a pressing issue. So what kinds of figures do make good role models? It was argued that reading about singular examples in Study 2 encouraged contrast rather than motivation. Some work has found that women benefit from reading about multiple role models, whether in STEM (e.g., five famous female engineers; Stout et al., 2011) or other male-stereotyped domains such as leadership (Dasgupta & Asgari, 2004). However, other studies suggest that women's math identification and performance can be improved by exposure to just one role model (e.g., a mathematically-talented female peer [Marx

& Roman, 2002] or a female calculus professor [Stout et al., 2011]). Future research should assess whether students are best motivated by multiple counterstereotypic examples, or under which conditions a single role model may be effective. Given the paucity of women in high-ranking STEM positions (AAUW, 2010), understanding how to harness the power of even a single counterstereotypically successful woman could have a real impact.

Of note, the current studies only tested the effects of reading about role models, whereas the individual role models discussed above were real people that the participants actually met. Some evidence suggests that actual interactions with scientists may be particularly effective at increasing young girls' interest in science (Buck et al., 2008). Meeting real people in the field can change girls' images of scientists as cartoonishly stereotypic (Bardeen, 2000) or unattainably successful (Buck et al., 2008) into something more relatable, and thus more inspiring. Good, Aronson, and Inzlicht's (2003) successful stereotype threat intervention similarly relied on real interactions, and found that regular meetings with a single college mentor improved female and ethnic minority students' standardized test scores. When students have the opportunity to actually connect with a role model, one may be sufficient. Perhaps even feminine role models could be effective in this context, which would allow for conversations about the many kinds of people in math and science, rather than a simplistic endorsement of feminine appearance.

The intention behind a feminine STEM role model is good, and her appeal may be intuitive. Efforts to counter stereotypes, whether about academic fields or the people in them, can undoubtedly help to close educational gaps. Yet, as these four studies show, those efforts must be carefully calibrated to avoid backfiring. Across these studies, feminine STEM role models either hurt or failed to help, especially if feminine STEM success seemed unattainable or unlikely, and regardless of whether the women reading about the role models valued feminine appearance.

Attempting to simultaneously counter the stereotype that women are not good at math and science (by showing successful women in STEM) and the stereotype that women in those fields are unfeminine (by making those women appear feminine) may be a less effective strategy than simply showing a diversity of women succeeding in unexpected fields.

TABLES

Table 1

Role Model Positivity and Similarity Ratings by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 1)*

Rating			Feminine	Gender-Neutral
Positivity:	STEM-disliking participants	STEM Role Model	6.32 (*.71*)	6.13 (1.*27*)
		Humanities Role Model	6.23 (*.65*)	6.08 (1.*06*)
	STEM-liking participants	STEM Role Model	6.22 (*.88*)	6.42 (*.64*)
		Humanities Role Model	6.18 (*.99*)	6.18 (*.93*)
Similar:	STEM-disliking participants	STEM Role Model	4.12 (*2.03*)	4.25 (*1.52*)
		Humanities Role Model	4.75 (*1.22*)	4.63 (*1.50*)
	STEM-liking participants	STEM Role Model	4.76 (*1.54*)	4.76 (*1.82*)
		Humanities Role Model	4.18 (*1.50*)	5.21 (*1.48*)

Table 2

Bivariate correlations among role model ratings and outcome variables (*Study 1)*

	1	2	3	4	5	6
1. Role Model Positivity Rating	--					
2. Role Model Similarity Rating	.32***	--				
3. Math Self-Ratings	.09	.31***	--			
4. Future Math Plans	.03	.22**	.53***	--		
5. Future English Plans	.15†	.09	.10	.26**	--	
6. Future Science Plans	.08	.23**	.08	.46***	.23**	--

$^{\dagger}p \leq .10$; *$p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 3

Seven Role Model Ratings by Role Model Domain, Role Model Femininity, and STEM-*liking* (*Study 2)*

Rating			Feminine	Gender-Neutral
Feminine:	STEM-disliking participants	STEM Role Model	5.58 (*1.03*)	4.74 (*1.15*)
		Humanities Role Model	5.96 (*.75*)	5.14 (*1.08*)
	STEM-liking participants	STEM Role Model	5.64 (*.78*)	4.89 (*1.11*)
		Humanities Role Model	5.87 (*.97*)	5.06 (*1.03*)
Positivity:	STEM-disliking participants	STEM Role Model	5.75 (*.75*)	5.47 (*.68*)
		Humanities Role Model	5.81 (*.63*)	5.72 (*.77*)
	STEM-liking participants	STEM Role Model	5.93 (*.62*)	5.77 (*.55*)
		Humanities Role Model	5.57 (*.76*)	5.37 (*.52*)
Successful:	STEM-disliking participants	STEM Role Model	6.29 (*.90*)	6.53 (*.61*)
		Humanities Role Model	6.38 (*.50*)	6.14 (*.71*)
	STEM-liking participants	STEM Role Model	6.46 (*.58*)	6.61 (*.61*)
		Humanities Role Model	5.87 (*1.36*)	6.24 (*.75*)
Attainable:	STEM-disliking participants	STEM Role Model	5.48 (*1.09*)	5.26 (*1.49)*
		Humanities Role Model	5.79 (*1.14*)	5.50 (*1.07*)
	STEM-liking participants	STEM Role Model	5.21 (*1.32*)	4.78 (*1.44*)
		Humanities Role Model	5.53 (*1.04*)	5.29 (*1.36*)
Similar:	STEM-disliking participants	STEM Role Model	4.13 (*1.84*)	3.68 (*1.20*)
		Humanities Role Model	4.08 (*1.50*)	4.07 (*1.41*)
	STEM-liking participants	STEM Role Model	4.75 (*1.08*)	3.78 (*1.67*)
		Humanities Role Model	3.20 (*1.54*)	2.82 (*1.19*)
Desired Similarity:	STEM-disliking participants	STEM Role Model	4.84 (*1.61*)	4.47 (*1.95*)
		Humanities Role Model	4.75 (*1.45*)	4.64 (*1.70*)
	STEM-liking participants	STEM Role Model	4.96 (*1.73*)	4.17 (*1.69*)
		Humanities Role Model	4.00 (*1.78*)	4.29 (*1.45*)
Believable:	STEM-disliking participants	STEM Role Model	5.29 (*1.19*)	6.00 (*1.33*)
		Humanities Role Model	5.54 (*1.67*)	5.70 (*1.30*)
	STEM-liking participants	STEM Role Model	5.68 (*.91*)	5.83 (*1.10*)
		Humanities Role Model	5.34 (*1.82*)	5.47 (*1.07*)

Table 4

Bivariate Correlations Among Role Model Ratings (*Study 2)*

	1	2	3	4	5	6	7
1. Feminine	--						
2. Positivity	.35***	--					
3. Successful	.13†	.56***	--				
4. Attainability	.10	-.06	.01	--			
5. Similarity	.22**	.37***	.19**	.18*	--		
6. Desired Similarity	.11	.18*	.17*	.11	.37***	--	
7. Believability Rating	-.02	.21***	.31***	.16*	.25***	.11	--

$^{\dagger}p \leq .10$; *$p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 5

Math Self-Ratings by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	3.46 (*1.37*)	3.53 (*1.15*)
	Humanities Role Model	3.43 (*1.22*)	3.70 (*1.50*)
	Control	4.13 (*.94*)	
STEM-liking participants	STEM Role Model	4.63 (*1.25*)	4.37 (*1.51*)
	Humanities Role Model	4.72 (*1.25*)	5.01 (*.93*)
	Control	4.75 (*1.32*)	

Table 6
Science Self-Ratings by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	4.32 (*1.25*)	4.20 (*1.01*)
	Humanities Role Model	4.06 (*1.36*)	4.14 (*1.25*)
	Control	4.51 (*1.14*)	
STEM-liking participants	STEM Role Model	5.04 (*1.10*)	4.82 (*1.60*)
	Humanities Role Model	5.29 (*1.12*)	5.33 (*.86*)
	Control	5.29 (*1.13*)	

Table 7

English Self-Ratings by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	5.43 (*1.00*)	5.56 (*.69*)
	Humanities Role Model	5.55 (*.85*)	5.33 (*1.09*)
	Control	4.85 (*1.30*)	
STEM-liking participants	STEM Role Model	4.59 (*.94*)	4.23 (*1.05*)
	Humanities Role Model	4.56 (*1.27*)	4.30 (*1.14*)
	Control	4.49 (*1.10*)	

Table 8

Math Plans by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	2.69 (*1.73*)	2.84 (*1.75*)
	Humanities Role Model	2.56 (*1.87*)	2.70 (*1.66*)
	Control	3.43 (*1.69*)	
STEM-liking participants	STEM Role Model	4.45 (*1.76*)	3.44 (*1.89*)
	Humanities Role Model	3.73 (*2.10*)	4.32 (*1.54*)
	Control	3.89 (*2.17*)	

Table 9

Science Plans by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	3.55 (*1.98*)	4.13 (*1.91*)
	Humanities Role Model	3.63 (*2.18*)	3.48 (*2.02*)
	Control	3.86 (*2.01*)	
STEM-liking participants	STEM Role Model	4.98 (*2.02*)	4.72 (*2.38*)
	Humanities Role Model	5.43 (*1.64*)	5.38 (*1.27*)
	Control	5.25 (*1.94*)	

Table 10

English Plans by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

		Feminine	Gender-Neutral
STEM-disliking participants	STEM Role Model	5.23 (*1.48*)	5.89 (*.81*)
	Humanities Role Model	5.90 (*1.41*)	5.88 (*1.21*)
	Control	5.23 (*1.92*)	
STEM-liking participants	STEM Role Model	5.23 (*1.57*)	4.57 (*1.71*)
	Humanities Role Model	4.70 (*1.78*)	4.53 (*1.74*)
	Control	5.13 (*1.43*)	

Table 11

Math Attempts and Percent of Math Attempts that were Correct by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 2)*

Outcome			Feminine	Gender-Neutral
Math Attempts:	STEM-disliking participants	STEM Role Model	5.23 (*2.86*)	4.89 (*2.92*)
		Humanities Role Model	4.92 (*2.60*)	5.32 (*2.87*)
		Control	5.45 (*4.04*)	
	STEM-liking participants	STEM Role Model	5.00 (*2.71*)	6.94 (*3.33*)
		Humanities Role Model	7.93 (*5.69*)	6.12 (*3.41*)
		Control	6.54 (*4.49*)	
Percent Correct:	STEM-disliking participants	STEM Role Model	.84 (*.23*)	.76 (*.30*)
		Humanities Role Model	.85 (*.20*)	.87 (*.23*)
		Control	.85 (*.26*)	
	STEM-liking participants	STEM Role Model	.86 (*.25*)	.86 (*.25*)
		Humanities Role Model	.93 (*.14*)	.83 (*.19*)
		Control	.85 (*.20*)	

Table 12

Eleven Role Model Ratings by Role Model Domain, Role Model Femininity, and STEM *Major* (*Study 3)*

Rating			Feminine	Gender-Neutral
Feminine-looking:	Non-STEM Majors	STEM Role Model	6.14 (*1.15*)	4.73 (*1.32*)
		Humanities Role Model	5.95 (*1.22*)	4.96 (*1.32*)
	STEM majors	STEM Role Model	6.22 (*.83*)	5.22 (*1.09*)
		Humanities Role Model	6.00 (*.78*)	4.38 (*1.51*)
Positivity:	Non-STEM Majors	STEM Role Model	6.56 (*.44*)	5.95 (*.72*)
		Humanities Role Model	5.81 (*.80*)	6.07 (*.77*)
	STEM majors	STEM Role Model	6.63 (*.45*)	6.13 (*.72*)
		Humanities Role Model	5.75 (*1.02*)	5.58 (*.86*)
Successful:	Non-STEM Majors	STEM Role Model	6.90 (*.30*)	6.64 (*.66*)
		Humanities Role Model	6.11 (*.94*)	6.37 (*1.01*)
	STEM majors	STEM Role Model	6.78 (*.44*)	6.33 (*.50*)
		Humanities Role Model	5.93 (*1.44*)	5.75 (*.89*)
Academic: Attainable	Non-STEM Majors	STEM Role Model	5.95 (*1.20*)	5.59 (*1.10*)
		Humanities Role Model	5.68 (*1.16*)	5.85 (*1.26*)
	STEM majors	STEM Role Model	5.89 (*1.36*)	6.00 (*1.00*)
		Humanities Role Model	5.71 (*1.73*)	6.25 (*.86*)
Attainable: Feminine	Non-STEM Majors	STEM Role Model	6.29 (*1.27*)	5.68 (*1.64*)
		Humanities Role Model	6.63 (*.68*)	5.67 (*1.47*)
	STEM majors	STEM Role Model	6.11 (*1.17*)	6.11 (*.93*)
		Humanities Role Model	6.36 (*1.08*)	5.13 (*2.17*)
Attainable: Both	Non-STEM Majors	STEM Role Model	5.68 (*1.62*)	5.64 (*1.53*)
		Humanities Role Model	6.16 (*.83*)	5.67 (*1.24*)
	STEM majors	STEM Role Model	5.78 (*1.56*)	6.11 (*.78*)
		Humanities Role Model	5.57 (*1.22*)	5.88 (*1.13*)
Similar:	Non-STEM Majors	STEM Role Model	4.57 (*1.50*)	3.86 (*1.81*)
		Humanities Role Model	3.74 (*2.05*)	4.19 (*1.73*)
	STEM majors	STEM Role Model	5.11 (*1.05*)	5.67 (*.87*)
		Humanities Role Model	3.71 (*1.82*)	3.38 (*1.51*)

Desired Similarity: Academic	Non-STEM Majors	STEM Role Model	6.71 (*.72*)	6.68 (*.57*)
		Humanities Role Model	6.74 (*.56*)	6.67 (*.88*)
	STEM majors	STEM Role Model	6.78 (*.44*)	6.44 (*.73*)
		Humanities Role Model	6.43 (*1.28*)	6.75 (*.46*)
Desired Similarity: Feminine	Non-STEM Majors	STEM Role Model	5.52 (*1.60*)	4.27 (*2.05*)
		Humanities Role Model	5.58 (*1.68*)	4.31 (*2.04*)
	STEM majors	STEM Role Model	5.33 (*1.50*)	5.33 (*1.12*)
		Humanities Role Model	5.43 (*2.03*)	4.50 (*2.51*)
Desired Similarity: Both	Non-STEM Majors	STEM Role Model	6.00 (*1.48*)	5.19 (*1.12*)
		Humanities Role Model	6.05 (*.97*)	5.30 (*1.71*)
	STEM majors	STEM Role Model	6.00 (*1.12*)	5.89 (*.78*)
		Humanities Role Model	5.86 (*1.92*)	5.63 (*1.51*)
Believable	Non-STEM Majors	STEM Role Model	6.25 (*.91*)	5.91 (*.97*)
		Humanities Role Model	5.68 (*1.25*)	5.85 (*.95*)
	STEM majors	STEM Role Model	6.11 (*.78*)	6.44 (*1.01*)
		Humanities Role Model	4.71 (*1.44*)	5.13 (*.84*)

Table 13

Bivariate Correlations Among Role Model Ratings (*Study 3)*

	1	2	3	4	5	6	7	8	9	10
1. Feminine-looking	--									
2. Positivity	.26**	--								
3. Successful	.17†	.61***	--							
4. Attainability: Academic	.16†	.01	-.01	--						
5. Attainability: Feminine	.43***	.11	.11	.25**	--					
6. Attainability: Both	.23**	.12	.05	.62***	.67***	--				
7. Similarity	.26**	.44***	.30***	-.01	.20*	.21*	--			
8. Desired Similarity: Acad.	.21*	.27**	.25**	.12	.25**	.31***	.16†	--		
9. Desired Similarity: Fem.	.40***	.08	.03	.02	.55***	.38***	.23**	.31***	--	
10. Desired Similarity: Both	.36***	.14	.12	.14	.57***	.49***	.28***	.50***	.87***	--
11. Believability	.19*	.28**	.34***	.14	.26**	.28***	.19*	.19*	.13	.19*

$^{\dagger}p \leq .10$; *$p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 14

Math Self-Ratings by Role Model Domain, Role Model Femininity, and STEM *Major* (*Study 3)*

		Feminine	Gender-Neutral
Non-STEM Majors	STEM Role Model	3.99 (*1.26*)	4.50 (*.94*)
	Humanities Role Model	3.71 (*1.26*)	3.45 (*1.57*)
	Control	4.01 (*1.37*)	
STEM Majors	STEM Role Model	5.15 (*1.50*)	5.51 (*1.37*)
	Humanities Role Model	5.11 (*.95*)	5.30 (*1.29*)
	Control	4.89 (*1.37*)	

Table 15

Science Self-Ratings by Role Model Domain, Role Model Femininity, and STEM *Major* (*Study 3)*

		Feminine	Gender-Neutral
Non-STEM Majors	STEM Role Model	4.37 (*1.35*)	4.74 (*1.14*)
	Humanities Role Model	4.39 (*1.54*)	4.77 (*1.23*)
	Control	4.50 (*1.32*)	
STEM Majors	STEM Role Model	5.28 (*1.15*)	5.56 (*.69*)
	Humanities Role Model	5.76 (*.78*)	4.72 (*1.13*)
	Control	4.92 (*1.00*)	

Table 16

English Self-Ratings by Role Model Domain, Role Model Femininity, and STEM *Major* (*Study 3)*

		Feminine	Gender-Neutral
Non-STEM Majors	STEM Role Model	4.68 (*1.13*)	4.90 (*.99*)
	Humanities Role Model	5.22 (*.96*)	5.03 (*1.23*)
	Control	5.07 (*1.07*)	
STEM Majors	STEM Role Model	4.34 (*1.17*)	4.11 (*1.09*)
	Humanities Role Model	4.32 (*1.45*)	4.05 (*1.05*)
	Control	4.86 (*1.10*)	

Table 17

English Plans by Role Model Domain, Role Model Femininity, and STEM *Major* (*Study 3)*

		Feminine	Gender-Neutral
Non-STEM Majors	STEM Role Model	5.64 (*1.24*)	4.91 (*1.53*)
	Humanities Role Model	5.21 (*1.61*)	5.09 (*1.77*)
	Control	5.38 (*1.32*)	
STEM Majors	STEM Role Model	4.39 (*1.76*)	4.06 (*1.86*)
	Humanities Role Model	3.75 (*1.92*)	4.63 (*1.55*)
	Control	5.00 (*1.78*)	

Table 18

Math Attempts and Percent of Math Attempts that were Correct by Role Model Domain, Role Model Femininity, and STEM-*Liking* (*Study 3)*

Outcome			Feminine	Gender-Neutral
Math Attempts:	Non-STEM Majors	STEM Role Model	6.38 (*4.09*)	4.18 (*2.59*)
		Humanities Role Model	5.95 (*3.91*)	5.48 (*3.41*)
		Control	4.15 (*2.30*)	
	STEM Majors	STEM Role Model	11.11 (*5.99*)	7.00 (*5.27*)
		Humanities Role Model	8.36 (*10.83*)	6.25 (*3.99*)
		Control	12.00 (*21.52*)	
Percent Correct:	Non-STEM Majors	STEM Role Model	.66 (*.29*)	.73 (*.33*)
		Humanities Role Model	.83 (*.15*)	.74 (*.31*)
		Control	.71 (*28*)	
	STEM Majors	STEM Role Model	.83 (*.18*)	.80 (*.22*)
		Humanities Role Model	.89 (*.19*)	.79 (*.34*)
		Control	.85 (*.28*)	

Table 19

Bivariate Correlations Among Individual Differences (*Study 3)*

	1	2	3
1. Implicit Unfeminine-STEM Stereotype	--		
2. Explicit Unfeminine-STEM Stereotype	-.01	--	
3. Feminine Appearance Endorsement	.08	.17†	--

†$p \leq .10$

FIGURES

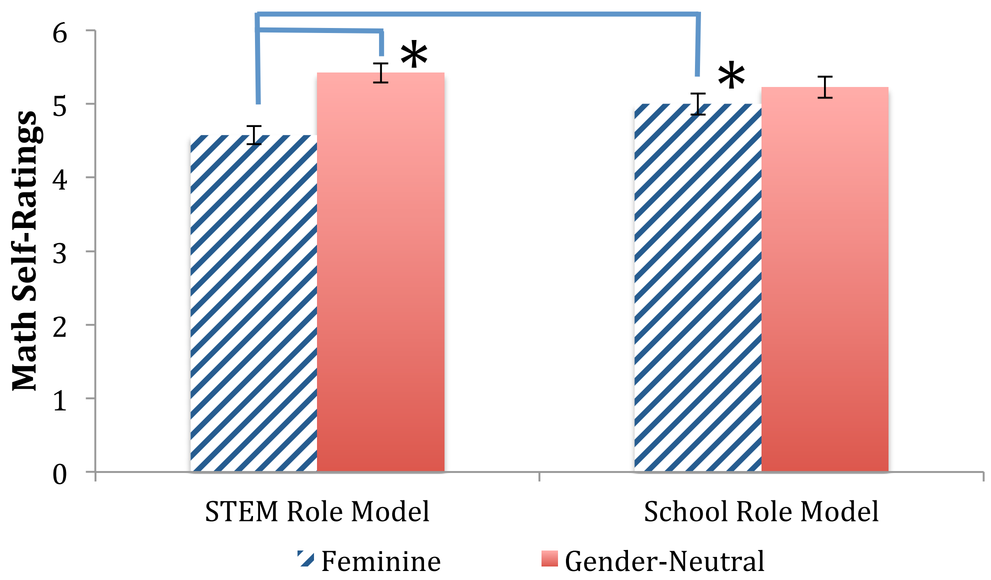


Figure 1. Mean math self-ratings by role model domain, role model femininity (Study 1a).
Note: Significant differences ($p < .05$) are indicated by "*"; marginally significant differences ($p < .10$) are indicated by "†".

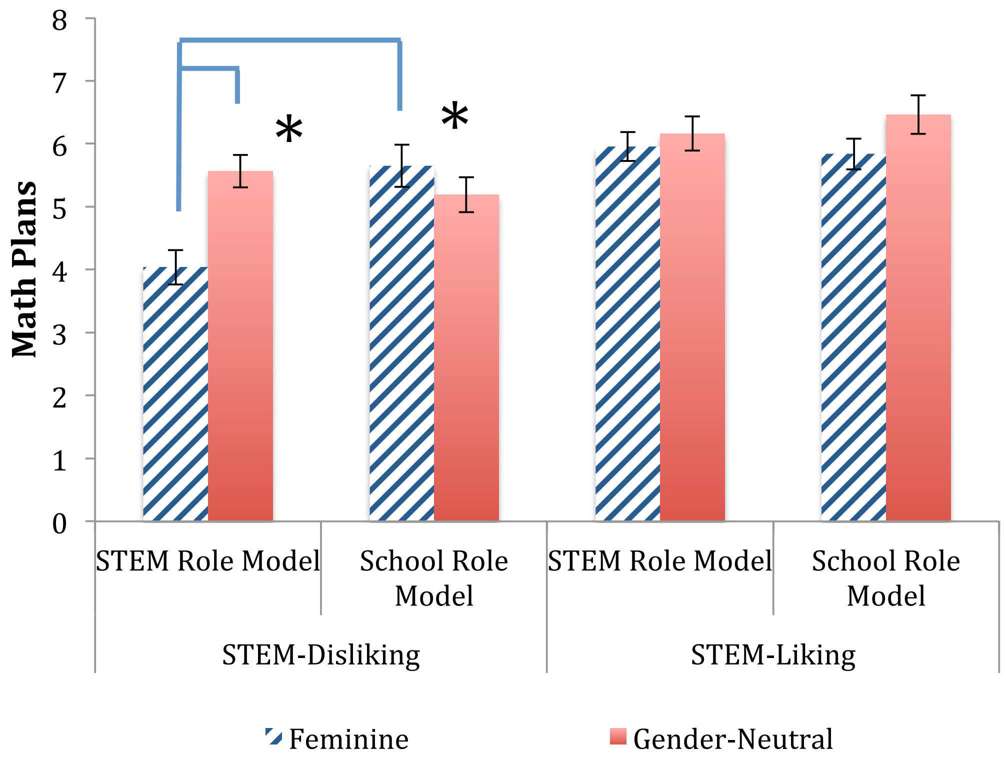


Figure 2. Mean future math plans by role model domain, role model femininity, and participant STEM-liking (Study 1a). Note: Means and standard errors for Future Plans predicted from ANCOVA with covariate “likelihood of attending college.” Significant differences (*p* < .05) are indicated by “*”.

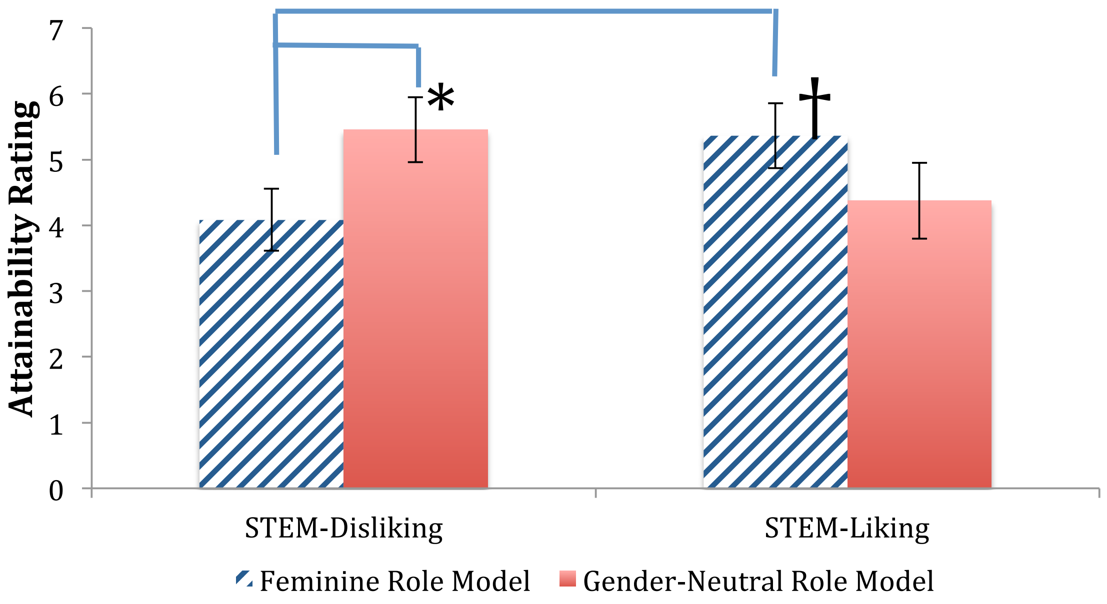


Figure 3. Mean rated attainability of combined femininity and STEM success of assigned role model, displayed by STEM liking and role model femininity (Study 1b).
Note: Significant differences ($p < .05$) are indicated by “*”; marginally significant differences ($p < .10$) are indicated by “†”.

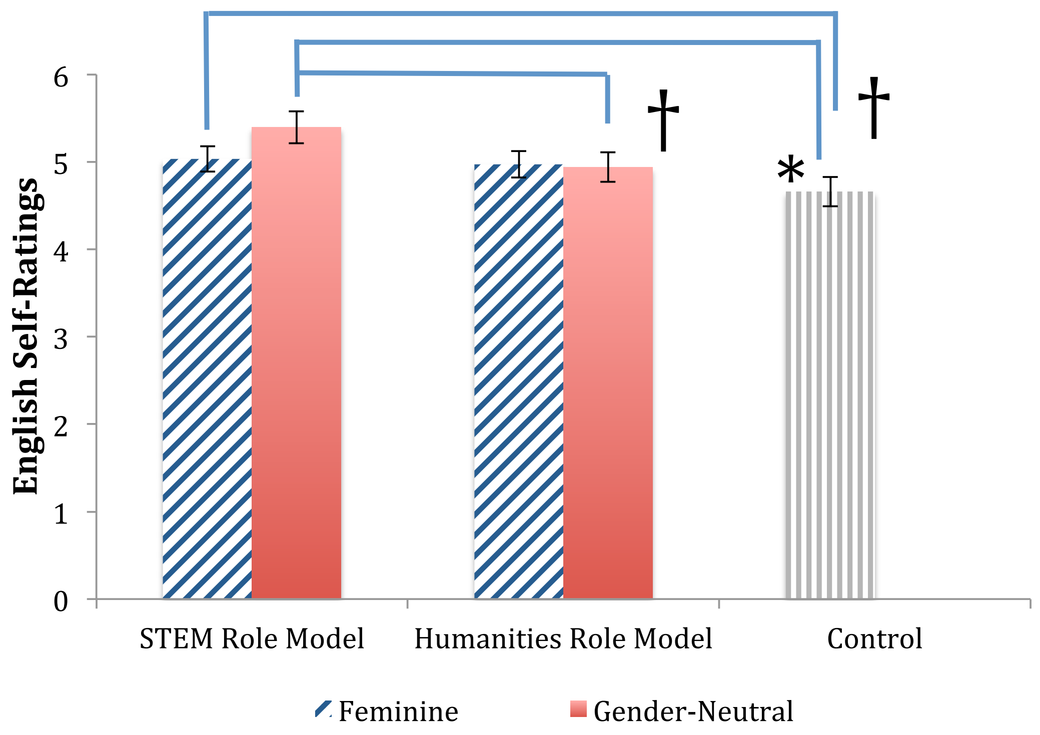


Figure 4. Mean English self-ratings, displayed by role model domain and role model femininity, with comparison to control (Study 2). Note: Significant differences ($p < .05$) are indicated by "*"; marginally significant differences ($p < .10$) are indicated by "†".

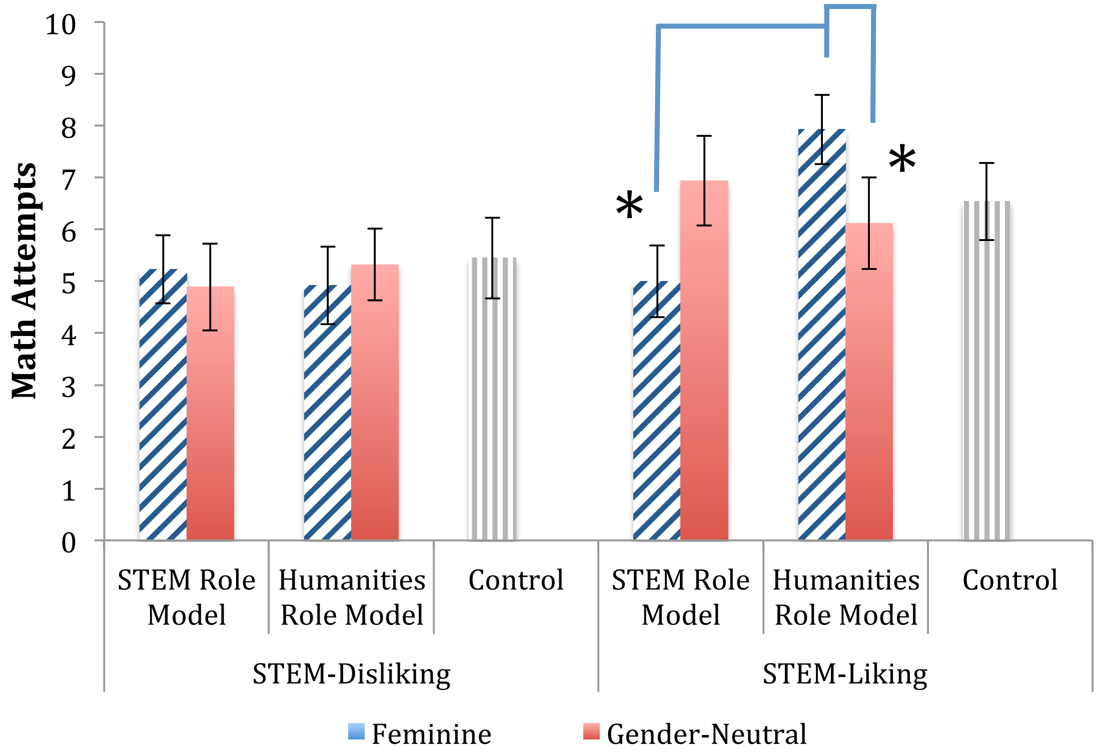


Figure 5. Mean math attempts, displayed by role model domain, role model femininity, and STEM-liking, with comparison to control groups (Study 2).
Note: Significant differences ($p < .05$) are indicated by “*”.

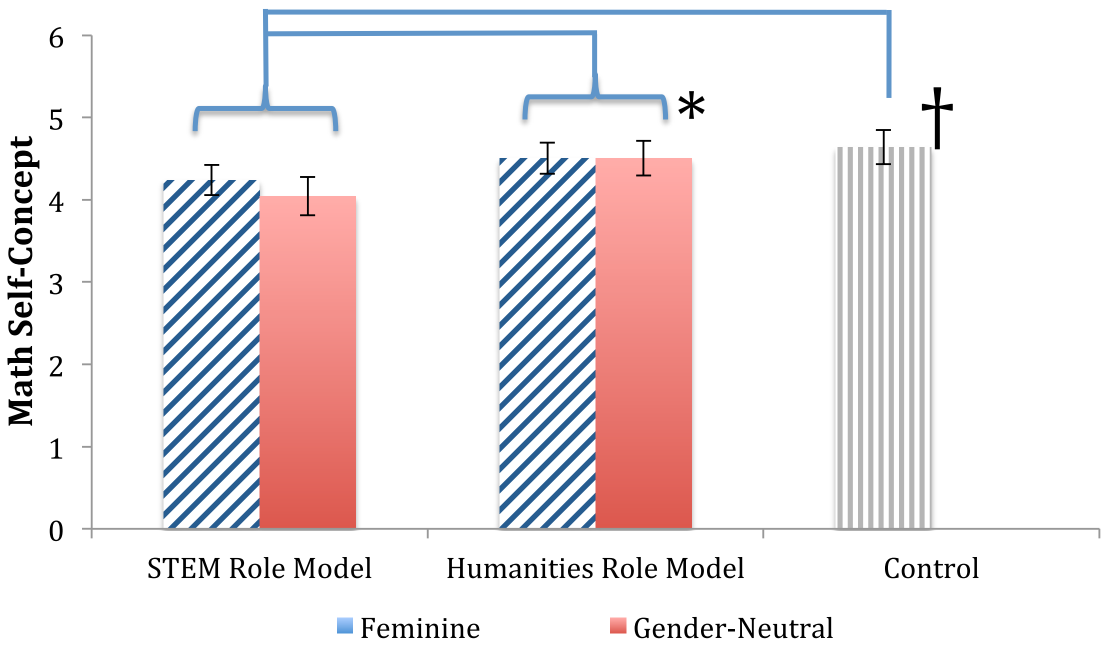


Figure 6. Mean math self-concept (subscale of math self-ratings), displayed by role model domain and role model femininity, with comparison to control (Study 2).
Note: Significant differences ($p < .05$) are indicated by “*”; marginally significant differences ($p < .10$) are indicated by “†”.

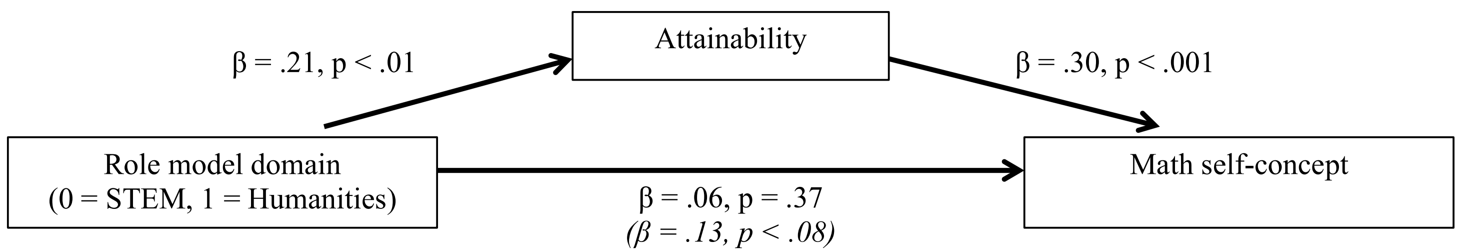


Figure 7. Mediation model showing indirect effect of role model domain on math self-concept via attainability ratings (Study 2).

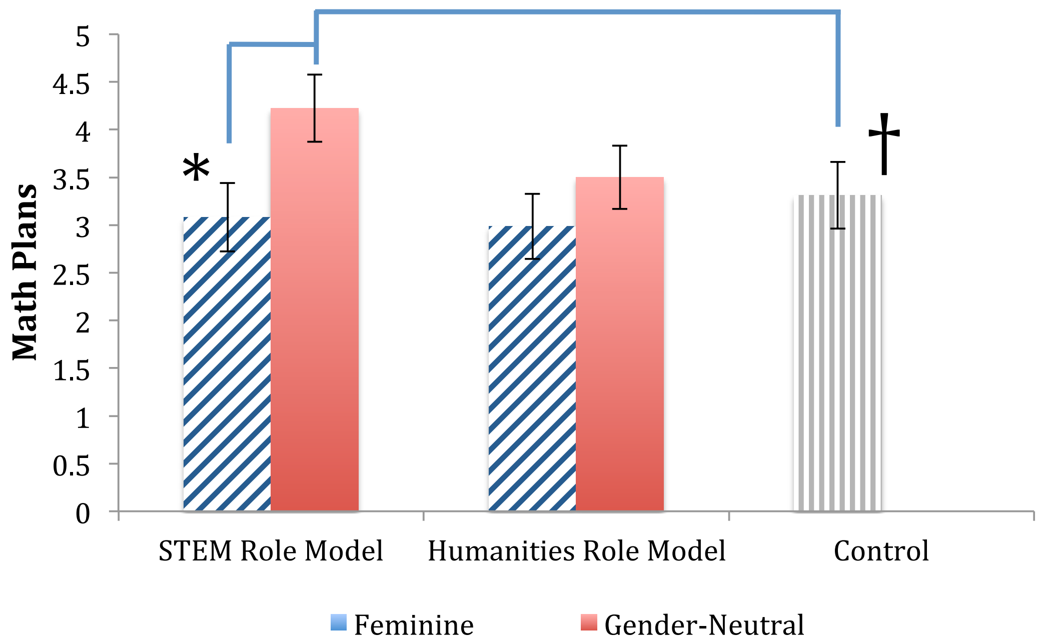


Figure 8. Mean math plans displayed by role model domain and role model femininity, with comparison to control (Study 3). Note: Solid red columns differ from blue striped columns (representing a significant effect of role model femininity), and simple effects and post-hoc contrasts are denoted with “*” ($p < .05$) or “†” ($p < .10$).

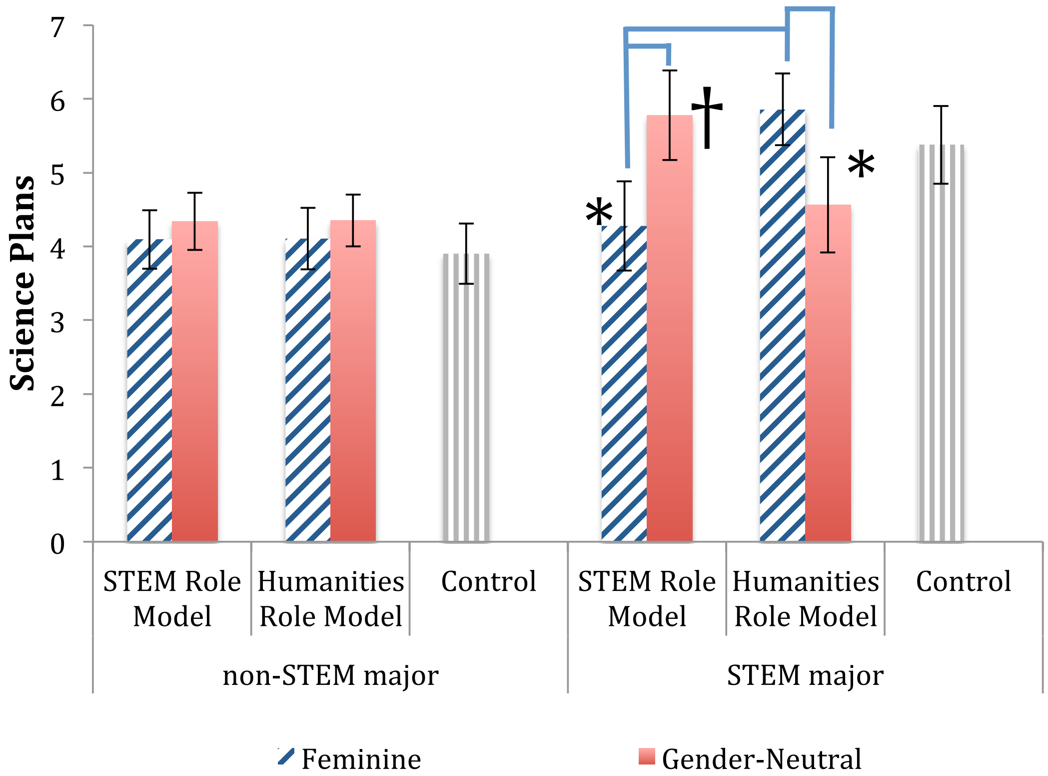


Figure 9. Mean science plans displayed by role model domain, role model femininity, and STEM major, with comparison to control groups (Study 3).
Note: Significant differences ($p < .05$) are indicated by “*”; marginally significant differences ($p < .10$) are indicated by “†”.

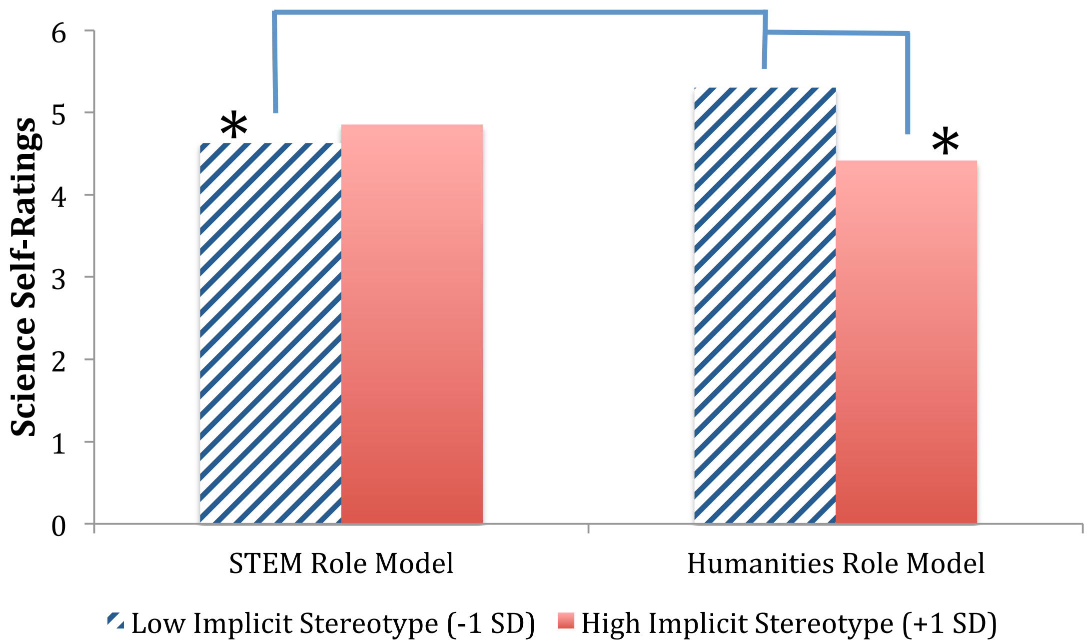


Figure 10. Science self-ratings predicted at one standard deviation above and below mean implicit stereotype scores, displayed by role model domain condition (Study 3).

Note: Significant differences ($p < .05$) are indicated by "*".

Note: The mean reported science self-ratings in the control condition was 4.66 (*1.21*).

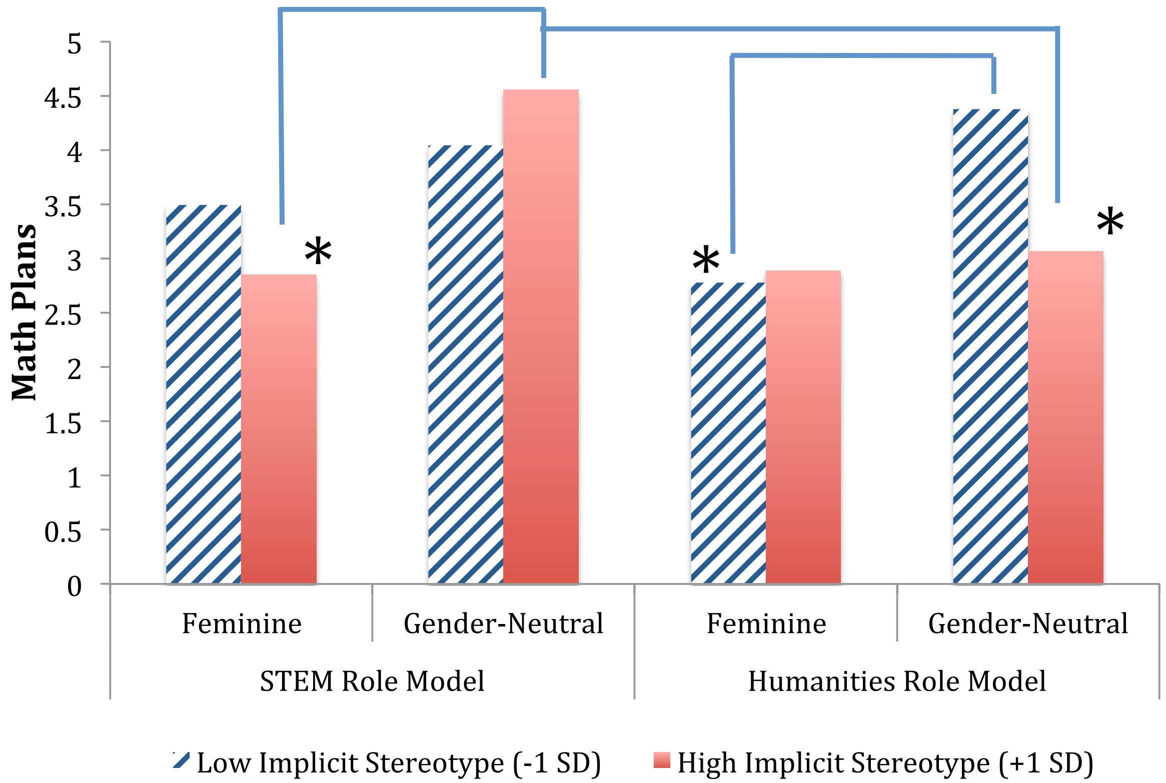


Figure 11. Math plans predicted at one standard deviation above and below mean implicit stereotype scores, displayed by role model domain and role model femininity condition (Study 3).
Note: Significant differences ($p < .05$) are indicated by "*".
Note: The mean reported math plans in the control condition was 3.31 (*2.01*).

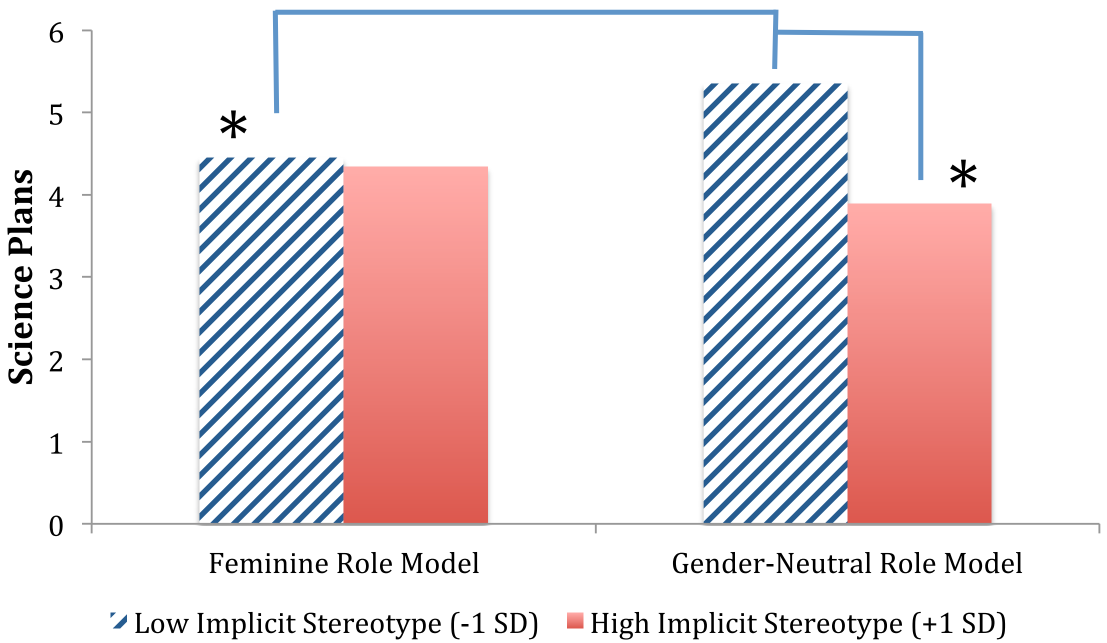


Figure 12. Science plans predicted at one standard deviation above and below mean implicit stereotype scores, displayed by role model femininity condition (Study 3).

Note: Significant differences ($p < .05$) are indicated by "*".

Note: The mean reported science plans in the control condition was 4.45 (*1.97*).

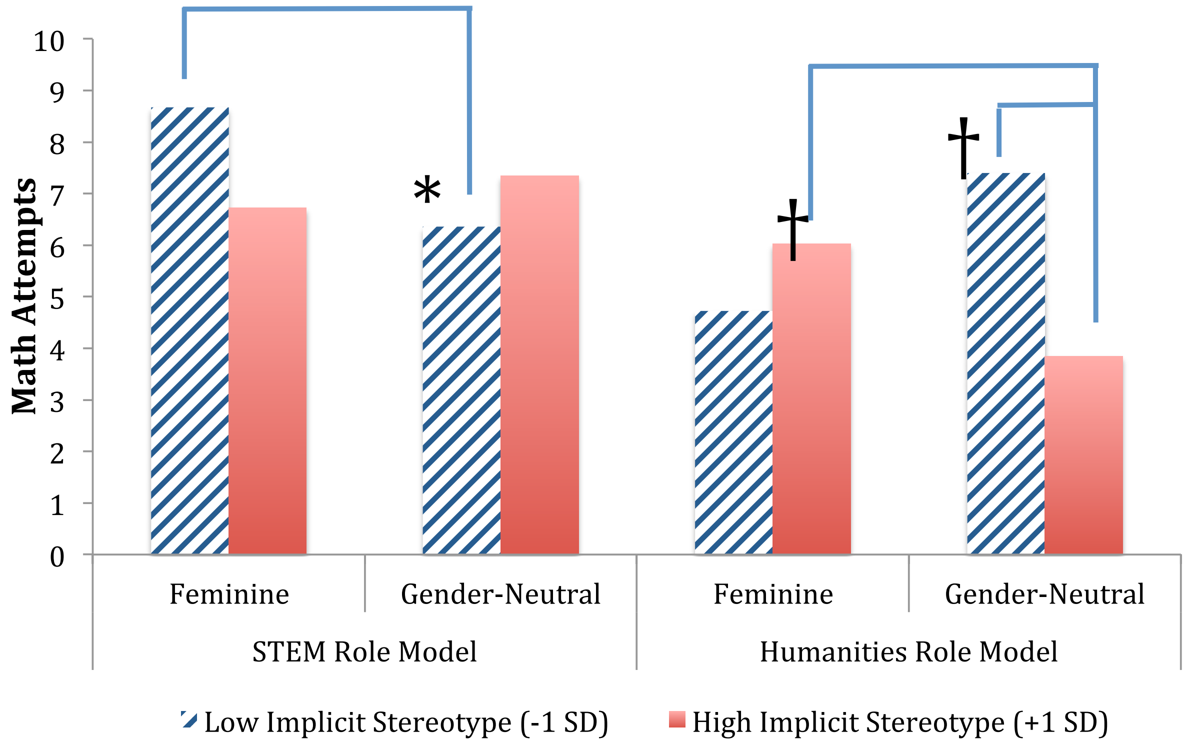


Figure 13. Math attempts predicted at one standard deviation above and below mean implicit stereotype scores, displayed by role model domain and role model femininity condition (Study 3).

Note: Significant differences ($p < .05$) are indicated by "*"; marginally significant differences ($p < .10$) are indicated by "†".

Note: The mean reported math attempts in the control condition was 7.09 (*13.51*), or 4.74 (*2.37*) with the removal of one outlier (80 attempts).

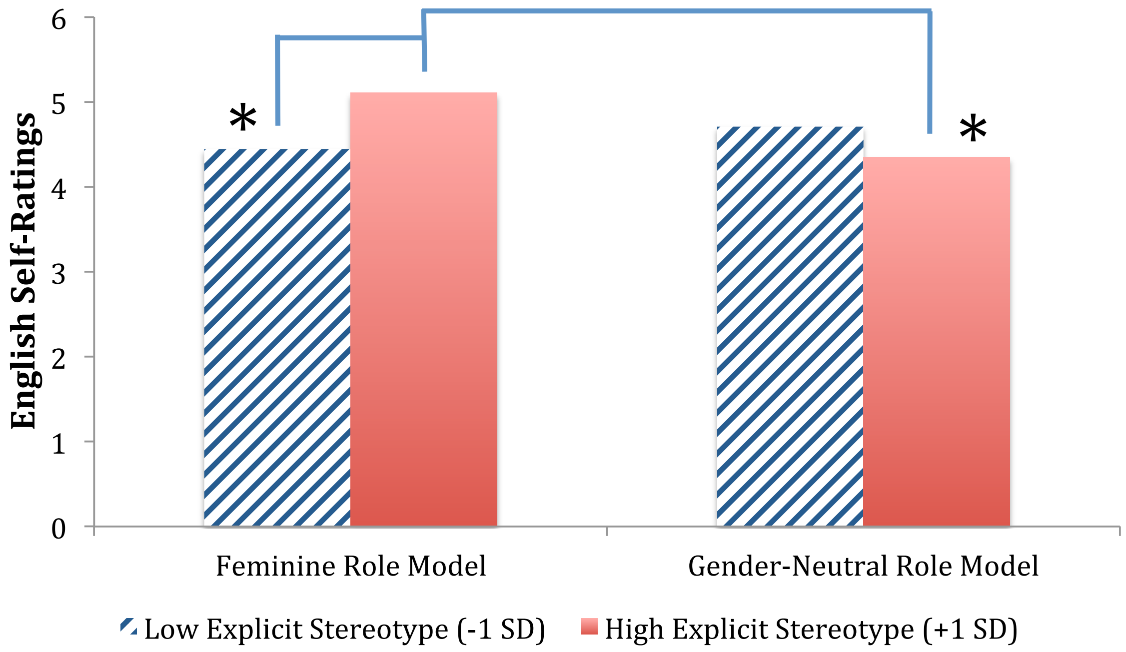


Figure 14. English self-ratings predicted at one standard deviation above and below mean explicit stereotype scores, displayed by role model femininity condition (Study 3).

Note: Significant differences ($p < .05$) are indicated by "*".

Note: The mean reported English self-ratings in the control condition was 4.66 (*1.21*).

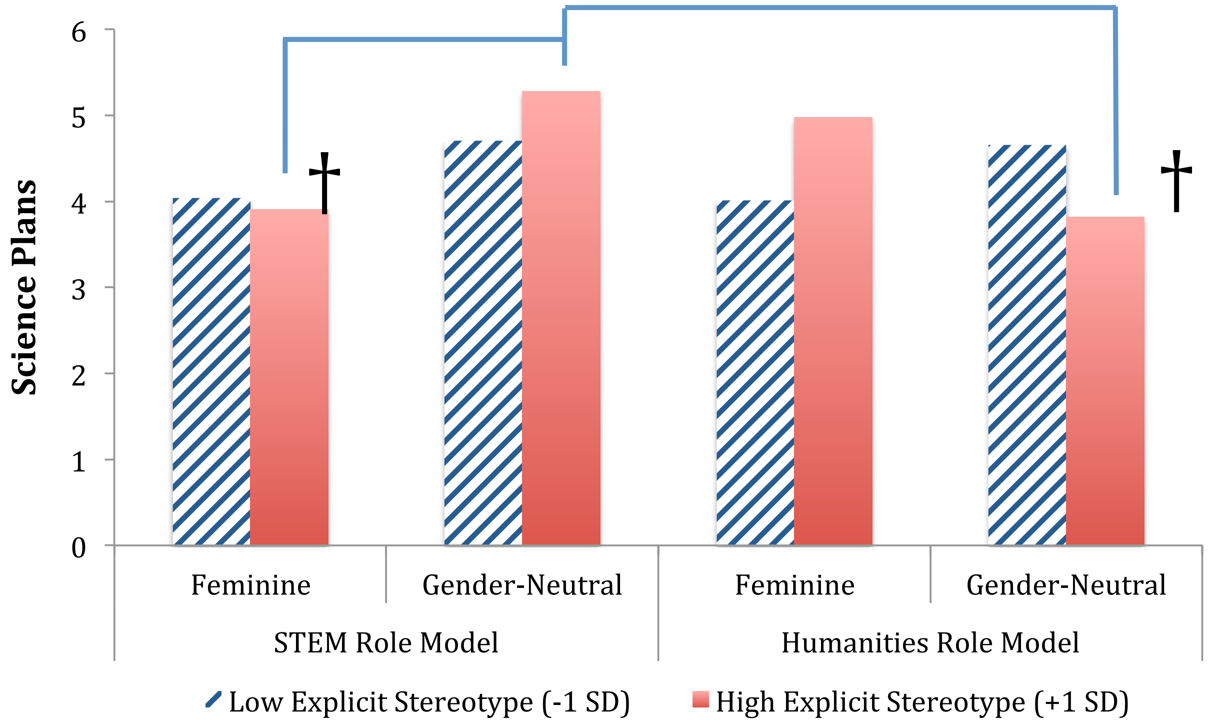


Figure 15. Science plans predicted at one standard deviation above and below mean explicit stereotype scores, displayed by role model domain and role model femininity condition (Study 3).

Note: Marginally significant differences ($p < .10$) are indicated by "†".

Note: The mean reported science plans in the control condition was 4.45 (*1.97*).

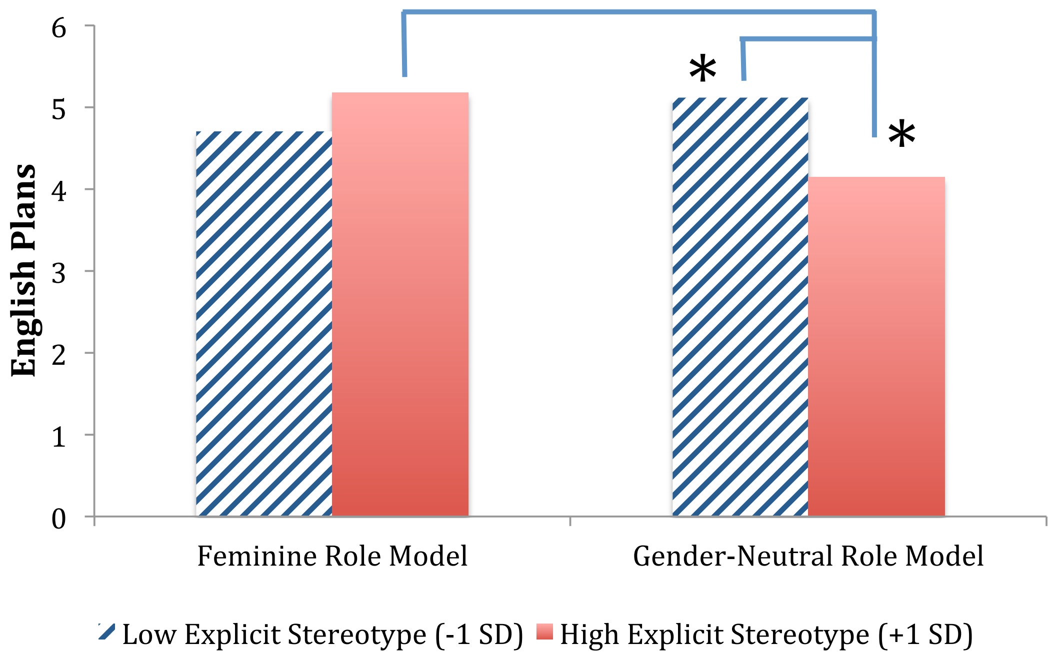


Figure 16a. English plans predicted at one standard deviation above and below mean explicit stereotype scores, displayed by role model femininity condition (Study 3).
Note: Significant differences ($p < .05$) are indicated by "*".
Note: The mean reported English plans in the control condition was 5.23 (*1.49*).

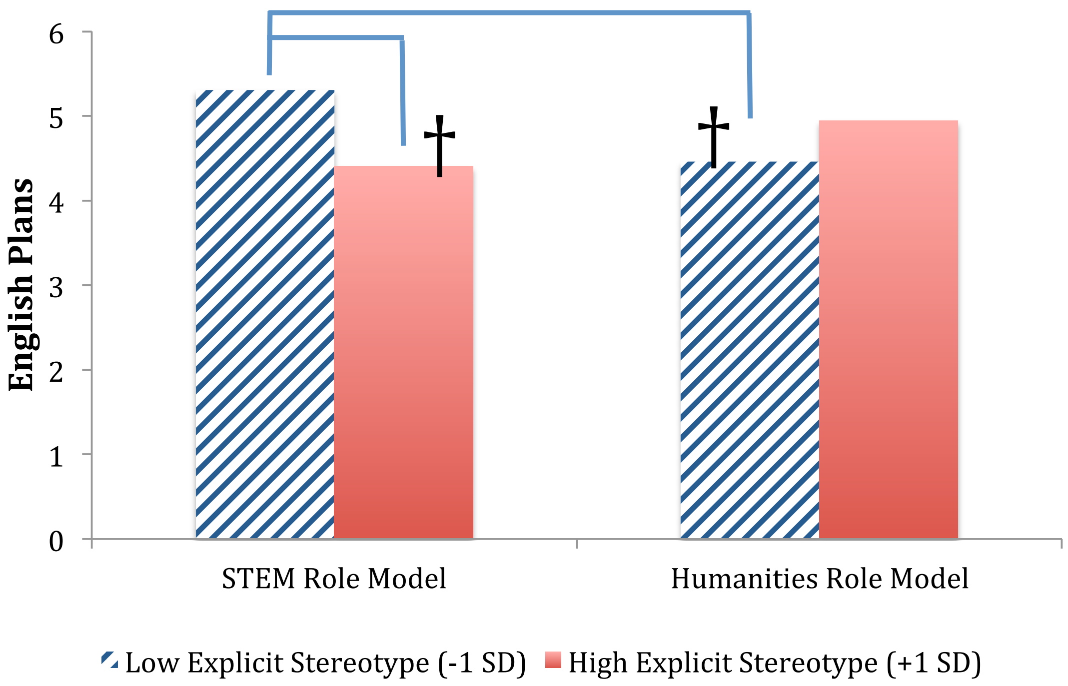


Figure 16b. English plans predicted at one standard deviation above and below mean explicit stereotype scores, displayed by role model domain condition (Study 3).

Note: Marginally significant differences ($p < .10$) are indicated by "†".

Note: The mean reported English plans in the control condition was 5.23 (*1.49*).

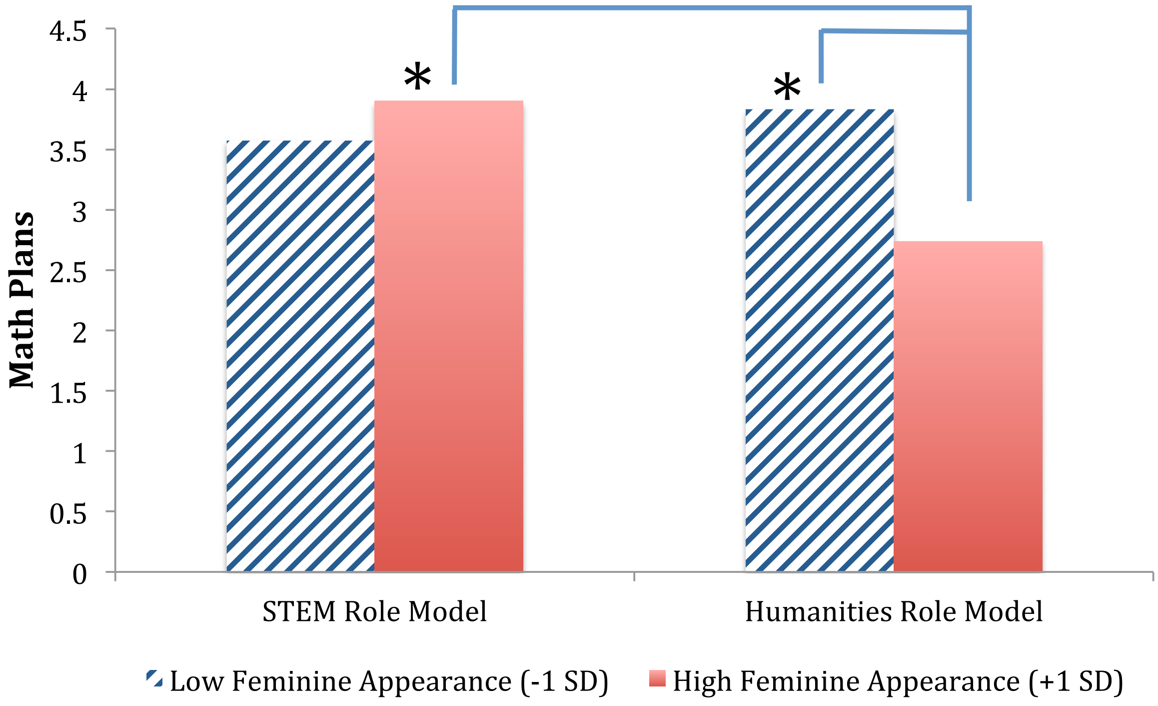


Figure 17. Math plans predicted at one standard deviation above and below mean feminine appearance endorsement, displayed by role model domain condition (Study 3).
Note: Significant differences ($p < .05$) are indicated by “*”.
Note: The mean reported math plans in the control condition was 3.31 (*2.01*).

APPENDICES

Appendix A

Role Model Stimuli (*Study 1a, 1b)*

Feminine STEM Role Models

Volume 1, Issue 1
Summer 2009

Scholastic Star

Interview

SPOTLIGHT STUDENT

Tiana

University of Michigan - Freshman

Tiana has just finished her first year at the University of Michigan. An engineering major, Tiana has been selected as a "Spotlight Student" based on her outstanding achievements. It's no surprise, as Professor Yim of the Engineering department called Tiana, "One of the hardest-working students I've met in a long time." I sat down with Tiana, and here's what she had to say:

Interviewer: So you've made it through your first year, and quite successfully, it seems. What was your favorite school memory before arriving at the University of Michigan?

Tiana: I really liked working on the Pioneer High Robotics Club . I built my own robot! It was so cool.

Interviewer: And what do you think most helped you improve in your favorite subject?

Tiana: I think I took a good mixture of classes (like pre-calculus and physics) and also outside activities (like the robotics team), which then helped me figure out what kind of job I would like – that's how I found engineering.

Interviewer: What about outside of school? What do you like to do for fun?

Tiana: After classes and on the weekends I like to work out. But fun work-outs. I used to do dance, but now I'm getting into yoga and pilates at the gym. I even bought myself a pink yoga mat!

Interviewer: Thanks for your time, Tiana, and good luck.

Tiana: Thanks, happy to do it.

"After classes and on the weekends I like to work out. But fun work-outs. I used to do dance, but now I'm getting into yoga and pilates at the gym. I even bought myself a pink yoga mat!"

Summer 2009

Chemistry major **Jennifer** is our second "Spotlight Student," chosen because she hands in work that earns praise like this: *Professor Smith* of biochemistry predicted *"great success in the field of chemistry research"* for Jennifer. Let's get to know a bit more about her...

Spotlight Student

Jennifer, University of Michigan, Freshman

> "My favorite magazines are *Glamour* and *Teen Vogue*"

Interviewer: Congratulations on finishing your freshman year. Tell me, what was your favorite school memory before arriving at the University of Michigan?

Jennifer: Probably my first day in chem lab in high school – I got to actually work with real lab equipment like burners and chemicals, which was awesome.

Interviewer: Chem lab, interesting. Was that one of the experiences that helped you improve in your favorite subject?

Jennifer: Yeah, you know, I really took any science class I could, including the hard ones like AP chemistry. I had to study more, but I found that I really liked chemistry a lot.

Interviewer: How about when studying's done--what are your hobbies?

Jennifer: I read a lot. A lot, a lot. Books, magazines, whatever. My favorite magazines are *Glamour* and *Teen Vogue*. And I recently read this book that I loved about this young girl trying to move up in the fashion world, and she winds up falling in love – I really connect with stories like that.

Interviewer: You'll have to lend it to me some time!

Jennifer: Ha, sure, definitely.

Scholastic Star

SPOTLIGHT STUDENT

Volume 1, Issue 1 Summer 2009

University of Michigan

Sonia, University of Michigan, Freshman

Now we have SONIA, a bright young U of M student who has just finished her first year as a MATH MAJOR. When I sat down with Sonia, she was just gearing up for an exclusive position as a *summer research assistant* with Professor Roman in the math department. Here's what Sonia had to say before her busy summer began:

Interviewer: Congratulations on this summer project you've got coming up.

Sonia: Thank you! I'm really excited about it.

Interviewer: Quite a way to cap off your first year. Can you tell me a bit about what school was like for you before you got to the University of Michigan? What is your favorite memory?

Sonia: I remember feeling so proud when I was on my high school's Academic decathlon team, and I helped us win the math competition. Yeah, I was really proud that day.

Interviewer: So you were on your decathalon team. Did that help you improve in math?

Sonia: You know, that was definitely part of it, but even more importantly, I had good teachers. They pushed me in my math and science classes, got me to join activities that had to do with math after school and in the summer. It made me work hard, but it was fun too, and I'm so grateful to them for encouraging me.

Interviewer: That's great. What about when math class is over? What do you do for fun?

Sonia: I like to relax by watching TV. You know, I have my schedule that I stick to every week, the shows I can't miss. I especially like Gossip Girl and Grey's Anatomy. I get together with my friends on every Monday and Thursday to watch them – we never miss an episode.

Interviewer: Sounds fun. Thanks for talking with me, Sonia.

> *"I especially like Gossip Girl and Grey's Anatomy"*

Scholastic Star

Volume 1, Issue 1

Summer 2009

Spotlight Student

Tiana: University of Michigan, Freshman

Tiana has just finished her first year at the University of Michigan. Tiana has been selected as a "Spotlight Student" based on her outstanding achievements. It's no surprise, as Professor Yim called Tiana, "One of the hardest-working students I've met in a long time." I sat down with Tiana, and here's what she had to say:

Interviewer: So you've made it through your first year, and quite successfully, it seems. What was your favorite school memory before arriving at the University of Michigan?

Tiana: I really liked working on student council. I was in charge of lots of school events! It was so cool.

Interviewer: And what do you think most helped you improve in your favorite subject?

Tiana: I think I took a good mixture of classes and also outside activities , which then helped me figure out what kind of job I would like – that's helped me decide what classes and activities to get into here.

Interviewer: What about outside of school? What do you like to do for fun?

Tiana: After classes and on the weekends I like to work out. But fun work-outs.

Interviewer: Thanks for your time, Tiana, and good luck.

Tiana: Thanks, happy to do it.

Tiana Says:

"I really liked working on student council . I was in charge of lots of school events! It was so cool"

SPOTLIGHT STUDENT

Volume 1, Issue 1 Summer 2009

Scholastic Star

Jennifer, University of Michigan, Freshman

Jennifer is our second "Spotlight Student," chosen because she hands in work that earns praise like this: *Professor Smith* predicted "*great success in her future career*" for Jennifer. Let's get to know a bit more about her.

Interviewer: Congratulations on finishing your freshman year. Tell me, what was your favorite school memory before arriving at the University of Michigan?

Jennifer: Probably the first day of every school year – I got to see what all my new classes would be like, which was always awesome.

Interviewer: First day, interesting. Tell me, what kinds of experiences helped you improve in your favorite subject?

Jennifer: Yeah, you know, I really took any interesting class I could, including the hard ones like AP classes. I had to study more, but I found that I really liked certain subjects a lot.

Interviewer: How about when studying's done? What are your hobbies?

Jennifer: I read a lot. A lot, a lot. Books, magazines, whatever. I recently read this book that I loved about this person's stories about growing up. I really connect with stories like that.

Interviewer: You'll have to lend it to me some time!

Jennifer: Ha, sure, definitely.

Jennifer

Spotlight Student

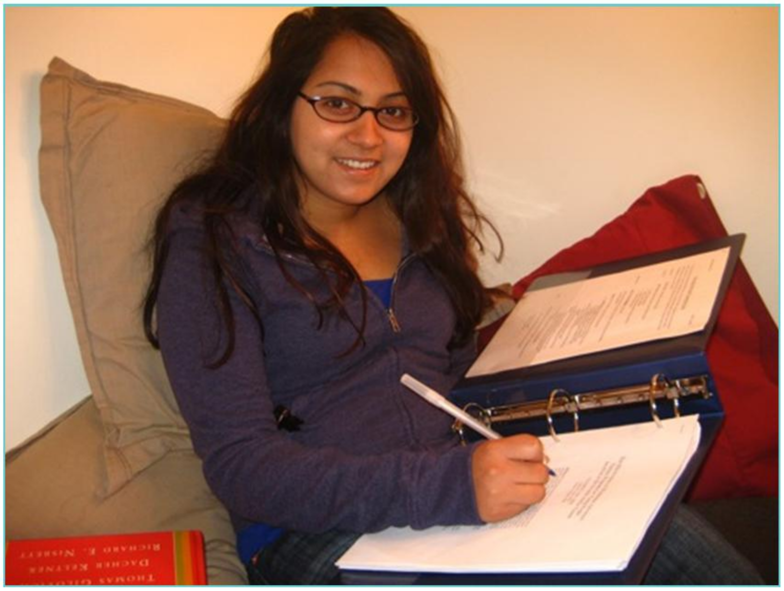
University of Michigan

Summer 2009

Volume 1, Issue 1

Sonia: University of Michigan, Freshman

Now we have Sonia*, a bright young U of M student who has just finished her first year. When I sat down with Sonia, she was just gearing up for an exclusive position as a* ***summer research assistant*** *to Professor Roman. Here's what Sonia had to say before her busy summer began:*



Interviewer: Congratulations on this summer project you've got coming up.

Sonia: Thank you! I'm really excited about it.

Interviewer: Quite a way to cap off your first year. Can you tell me a bit about what school was like for you before you got to the University of Michigan? What is your favorite memory?

Sonia: I remember feeling so proud when I was on my high school's Academic decathlon team, and I helped us win the whole competition. Yeah, I was really proud that day.

Interviewer: So you were on your decathlon team. Did that help you improve in school?

Sonia: You know, that was definitely part of it, but even more importantly, I had good teachers. They pushed me in my classes, got me to join activities that had to do with my favorite subjects after school and in the summer. It made me work hard, but it was fun too, and I'm so grateful to them for encouraging me.

Interviewer: That's great. What about when class is over? What do you do for fun?

Sonia: I like to relax by watching TV. You know, I have my schedule that I stick to every week, the shows I can't miss.

Interviewer: Sounds fun. Thanks for talking with me, Sonia.

Sonia Says:

> "I had good teachers. They pushed me in my classes."

Appendix B

Outcome Measures (*Studies 1a, 2, and 3)*

Self-Rating Items (Studies 1a, 2, and 3)

Note: Participants in Studies 1a, 2 and 3 completed the following items with 7-point scales. The endpoints of each scale are listed at the end of each item. Participants in Study 1a answered the questions as they appear. Participants in Studies 2 and 3 answered the items three times, relating to mathematics, natural science, and humanities (referred to as “math,” “science,” and “English” in this text). The items were averaged into a single self-rating composite for each subject. Participants in Studies 2 and 3 also had small changes made to the wording of the items, indicated by parenthesized additions to items 2, 4, and 9. In Study 3, item 4 was omitted.

Self-concept

1. How good at math are you? 1 = not at all good, 7 = very good
2. If you were to rank all the students in your (most recent) math class from the worst to the best in math, where would you put yourself? 1 = the worst, 7 = the best
3. Compared to most of your other school subjects, how good are you at math? 1 much worse, 7 = much better
4. How well do you expect to do in math this year (this semester or the next semester that you take this course)? 1 = not at all well, 7 = very well
5. How good would you be at learning something new in math? 1 = not at all good, 7 = very good
6. How successful do you think you'd be in a career that required mathematical ability? 1 = not very successful, 7 = very successful

Interest

7. Compared to most of your other activities, how much do you like math? 1 = not as much, 7 = a lot more
8. In general, do you find working on math assignments . . . 1 = very boring, 7 = very interesting)
9. How much do you like doing (studying) math? 1 = a little, 7 = a lot

Importance

10. In general, how useful is what you learn in math? 1 = not at all useful, 7 = very useful
11. For me being good at math is . . . 1 = not at all important, 7 = very important
12. Compared to most of your other activities, how important is it to you to be good at math? 1 = not as important, 7 = a lot more important

Future Math Plans Items (Study 1a)

Note: Participants in Study 1a completed the following items with 7-point scales (1 = not at all, 7 = very much so).

1. When you think of yourself in the future, how likely are you to take ***math*** classes in high school?
2. When you think of yourself in the future, how likely are you to take ***science*** classes in high school?
3. When you think of yourself in the future, how likely are you to take ***English*** classes in high school?
4. When you think of yourself in the future, how likely are you to attend college?
5. When you think of yourself in the future, how likely are you to take math classes in college?

Future Plans Items (Studies 2 and 3)

Note: Participants in Studies 2 and 3 completed the following items with 7-point scales (1 = disagree strongly, 7 = agree strongly).

1. I am looking forward to taking course(s) in this required category: (for natural science, social science, and humanities)
2. I will likely choose to take course(s) from this optional category: (for mathematics, creative expression)
3. If I had to take more classes for graduation, I would consider course(s) in this category: (for all five course categories)

Math Persistence Task (Studies 2 and 3)

Note: Participants in Studies 2 and 3 read the instructions below, then had a blank sheet of paper (Study 2) or a text entry box on a computer screen (Study 3) to provide as many solutions as possible. Parentheses contain alterations to the directions seen by Study 3 participants.

> For this portion of the study, you will play the **36** game**.**
>
> Use the numbers **2, 3,** and **7** to obtain the number **36** in as many ways as you can.
>
> *Rules:*
>
> - Write (type) your answers in the space below.
> - You may **add, multiply, subtract,** and **divide.**
> - You may use each number **as many times as you like.**
> - You may provide **as many solutions as you want.**
> - When you are finished, turn to the next page (click to the next screen).

Appendix C

Role Model Stimuli (*Study 2)*

Feminine STEM Role Model

Spotlight Student

Vol. 1

Jennifer Simon, University of Michigan Class of 2010

We shine our "Alumni Spotlight" on recent chemistry graduate Jennifer Simon.

Professor Smith of biochemistry, Jennifer's honors thesis advisor, predicted "great success in the field of physical chemistry research" for Jen. Jennifer takes us through her favorite UM memories and updates us on what she's been up to since her May graduation.

Jennifer fondly remembered her first chem lab here at the University of Michigan. She got to work with real lab equipment for the first time, and she loved learning how to work with volatile chemicals, and how to increase her chemistry knowledge.

Jennifer credits that chemistry lab with helping her improve in what would become her favorite subject, and her major. Concentrating in chemistry, she took tons of science classes. She remembers having to study a lot, **"especially for the killer classes like OChem,"** but she found that she loved the material.

When studying was done, Jennifer would read a lot of books and magazines for fun. Her favorite magazines are *Glamour* and *Vogue*, and she told us she recently read a book she loved. **"It was all about the author's experiences trying to move up in the fashion world, & she winds up falling in love. I really connect with stories like that."** She also liked to unwind at the gym, taking dance, yoga, and pilates classes.

She keeps up with those hobbies even as she pursues her PhD in Chemistry and Biomolecular Engineering at UC Berkeley. She relies on molecular theory and simulation to understand how various surfaces react to changes in their environment. Jennifer is doing great, and she credits the chemistry program at Michigan with helping her pursue inspiring work.

Vol. 4

Spotlight Student

Jennifer Simon, University of Michigan Class of 2010

We shine our "Alumni Spotlight" on recent English graduate Jennifer Simon.

Professor Smith of the English department, Jennifer's honors thesis advisor, predicted "great success in the field of 18th century British literary studies" for Jen. Jennifer takes us through her favorite UM memories and updates us on what she's been up to since her May graduation.

Jennifer fondly remembered her first-year writing requirement here at the University of Michigan. She got to read ancient Greek texts for the first time, and she loved learning how to analyze the difficult poetry and prose, and how to improve her writing.

Jennifer credits that writing requirement with helping her improve in what would become her favorite subject, and her major. Concentrating in English, she took tons of literature and writing classes. She remembers having to study a lot, **"especially for the killer classes like my English 450 honors seminar,"** but she found that she loved the material.

When studying was done, Jennifer would read a lot of books and magazines for fun. Her favorite magazines are *Conde Nast Traveler* and *Time*, and she told us she recently read a book she loved. **"It was all about the author's experiences growing up, funny anecdotes. I really connect with stories like that."** She also liked to unwind at the gym and on the running trail.

She keeps up with those hobbies even as she pursues her PhD in English Language and Literature at UC Berkeley. She relies on literary theory and historicism to understand how narrative styles were affected by changes in Victorian society. Jennifer is doing great, and she credits the English program at Michigan with helping her pursue inspiring work.

Appendix D

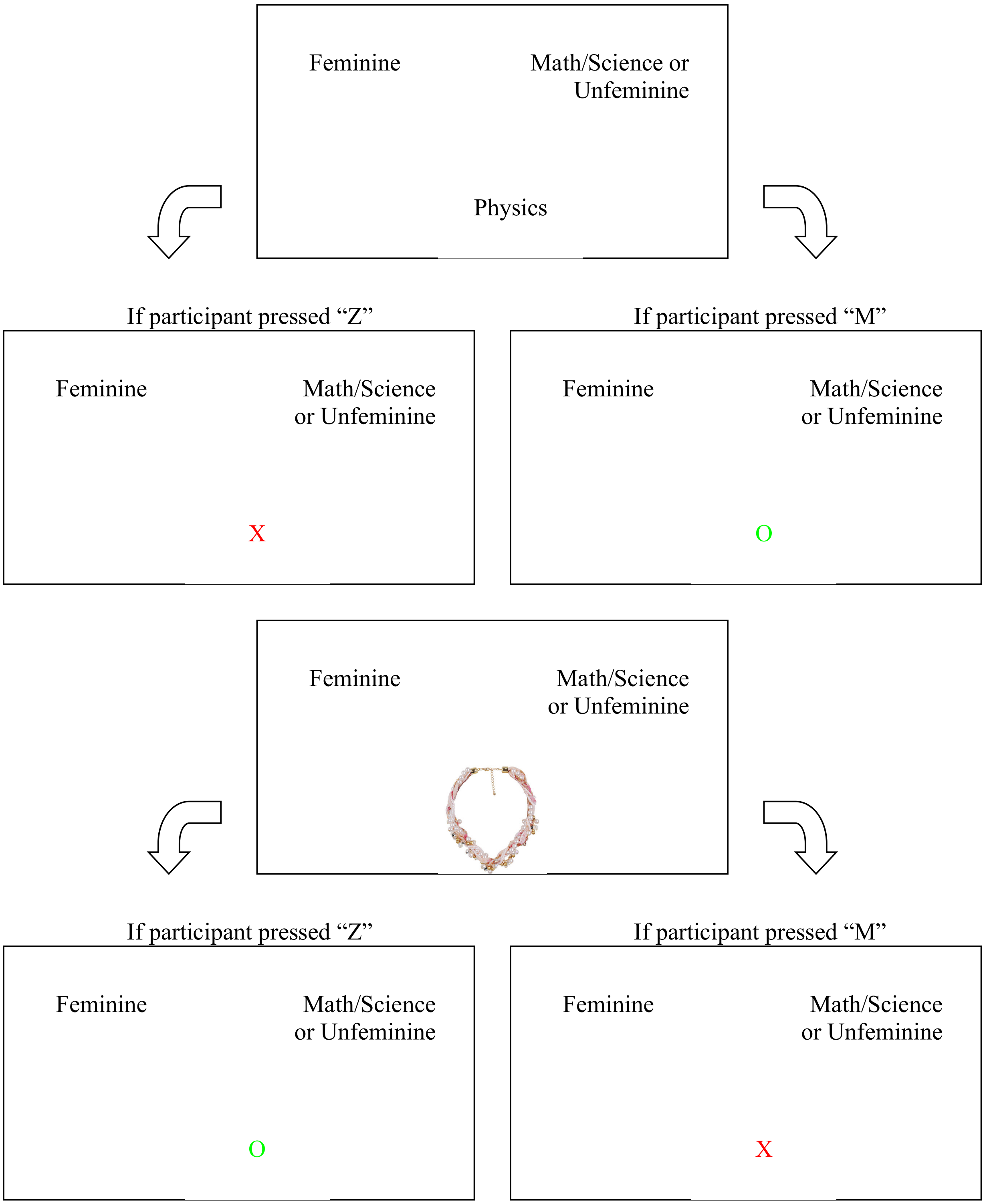
Single-Category Implicit Association Test Stimuli (*Study 3)*

Feminine SC-IAT Photographs

Unfeminine SC-IAT Photographs

Appendix E

Illustration of SC-IAT Task (*Study 3)*



Appendix F

Role Model Stimuli (*Study 3*)

Feminine STEM Role Models

Student Spotlight Vol. 1

Jennifer Simon, University Of Michigan, Class of 2011

We shine our "Alumni Spotlight" on recent Chemistry graduate Jennifer Simon.

Professor Smith of Chemistry, Jennifer's honors thesis advisor, predicted "great success in the field of chemistry" for Jen. Jennifer takes us through her favorite UM memories and updates us on what she's been up to since her May graduation.

Jennifer fondly remembered her first **chemistry lab** here at the University of Michigan. She got to work with real lab equipment for the first time, and she loved learning how to work with volatile chemicals, and how to increase her chemistry knowledge.

Jennifer credits that chemistry lab with helping her improve in what would become not just her favorite subject but also her major. Concentrating in **chemistry**, she took tons of science classes. She remembers having to study a lot, "especially for the killer classes like Organic Chem," but she found that she loved the material.

When studying was done, Jennifer would read, unwind at the gym, hang out with friends, and go to the movies. "The Michigan Theater is so beautiful," she says.

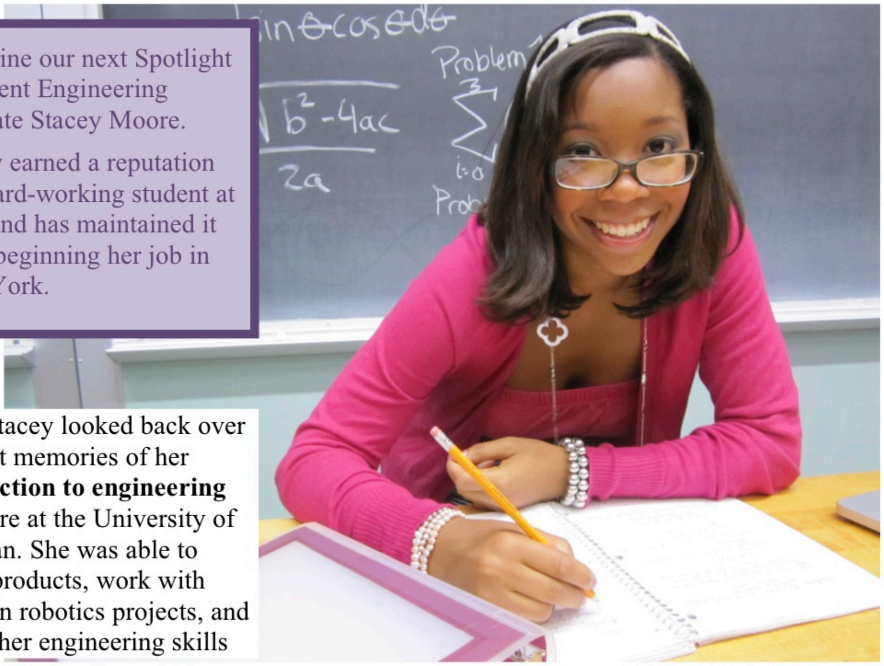
She keeps up with those hobbies even as she pursues her **PhD in Chemistry and Biomedical Engineering** at UC Berkeley. She relies on molecular theory and simulation to understand how various surfaces react to changes in their environment. Jennifer is doing great, and she credits the **chemistry program** at Michigan with helping her pursue inspiring work.

Student Spotlight Vol. 1

Stacey Moore, University Of Michigan, Class of 2009

We shine our next Spotlight on recent Engineering graduate Stacey Moore.

Stacey earned a reputation as a hard-working student at UM, and has maintained it since beginning her job in New York.



Stacey looked back over the great memories of her **introduction to engineering class** here at the University of Michigan. She was able to design products, work with others on robotics projects, and expand her engineering skills

This class made Stacey feel confident about her decision to pursue **Aerospace Engineering** as her concentration. With this major, Stacey had to take many different engineering courses. She remembers having to work very hard on her senior design class because she had to research and design a plane that would fly according to a computer program. Looking back, Stacey thought, “It was a lot of work, but a lot of fun to see the end result”.

Outside of the classroom, Stacey loved to go on bike rides and to concerts. On campus, she loved working with the Michigan Solar Car group. Stacey and the group designed solar cars to compete against other schools. Her sophomore year the team placed third, “but hanging out with all my friends and meeting people with similar interests was the best part.”

Currently, Stacey is working in New York City with **Parsons Engineering Design Firm,** which specializes in sustainable and environmentally friendly project design. She uses her knowledge from her engineering classes to work on transportation projects within the company. Stacey is thoroughly enjoying her work in New York and thanks **the engineering department** at the University of Michigan for all of their help and guidance.

Student Spotlight Vol. 4

Jennifer Simon, University Of Michigan, Class of 2011

We shine our "Alumni Spotlight" on recent English graduate Jennifer Simon.

Professor Smith of English, Jennifer's honors thesis advisor, predicted "great success in the field of literature" for Jen. Jennifer takes us through her favorite UM memories and updates us on what she's been up to since her May graduation.

Jennifer fondly remembered her **first-year writing requirement** here at the University of Michigan. She got to read ancient Greek texts for the first time, and she loved learning how to analyze the difficult poetry and prose, and how to improve her writing.

Jennifer credits that writing requirement with helping her improve what would become not only her favorite subject but also her major. Concentrating in **English**, she took tons of **literature and writing classes**. She remembers having to study a lot, "especially for the killer classes like my English 450 advanced seminar," but she found that she loved the material.

When studying was done, Jennifer would read, unwind at the gym, hang out with friends, and go to the movies. "The Michigan Theater is so beautiful," she says.

She keeps up with those hobbies even as she pursues her **PhD in English Language and Literature** at UC Berkeley. She relies on literary theory and historicism to understand how narrative styles were affected by changes in Victorian society. Jennifer is doing great, and she credits the **English program** at Michigan with helping her pursue inspiring work.

Student Spotlight Vol. 4

Stacey Moore, University Of Michigan, Class of 2009

We shine our next Spotlight on recent Art History graduate Stacey Moore.

Stacey earned a reputation as a hard-working student at UM, and has maintained it since beginning her job in New York.

Stacey looked back over the great memories of her **introduction to art history class** here at the University of Michigan. She was able to study different artists' techniques, visit museums and see wonderful art first hand, and expand her knowledge of artistic details.

This class made Stacey feel confident about her decision to pursue **art history** as her concentration. With this major, Stacey had to take many different art history courses. She remembers having to work very hard on her senior thesis class because she had to research different techniques and artists to make conclusions about a specific era of art. Looking back, Stacey thought, "It was a lot of work, but a lot of fun to see the end result".

Outside of the classroom, Stacey loved to go on bike rides and to concerts. On campus, she loved to participate in Helicon, the University of Michigan's History of Art Student Organization. Stacey and the group promoted the arts through museum visits and other art history related events on campus. Her sophomore year the group planned a trip to the different museums in Detroit; "but hanging out with all my friends and meeting people with similar interests was the best part".

Currently, Stacey is working in New York City with the **Metropolitan Museum of Art** as an expert for Renaissance period pieces. She uses her knowledge from her art history classes to guide restoration of historic pieces and give presentations on the art to local universities. Stacey is thoroughly enjoying her work in New York and thanks **the art history department** at the University of Michigan for all of their help and guidance.

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