DO STEM FIELDS NEED A MAKEOVER?: THE EFFECT OF ROLE MODEL FEMININITY ON MEN AND WOMEN’S INTEREST IN STEM

A Thesis
Presented to the
Faculty of
San Diego State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Psychology

by
Carolynn Howard
Summer 2015
SAN DIEGO STATE UNIVERSITY

The Undersigned Faculty Committee Approves the
Thesis of Carolyyn Howard:

Do STEM Fields Need a Makeover?: The Effect of Role Model Femininity on
Men and Women’s Interest in STEM

-------------------------------
David Marx, Chair
Department of Psychology

-------------------------------
Allison Vaughn
Department of Psychology

-------------------------------
Susan D. Nickerson
Department of Mathematics and Statistics

May 19th, 2015
Approval Date
ABSTRACT OF THE THESIS

Do STEM Fields Need a Makeover?: The Effect of Role Model Femininity on Men and Women’s Interest in STEM
by
Carolynn Howard
Master of Arts in Psychology
San Diego State University, 2015

Women continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields. This lack of women is problematic because it diminishes perspective, input, and expertise that women could provide. Consequently, this thesis examined the benefits of exposure to peer role models for increasing women’s interest in STEM, which may ultimately lead more women to enter STEM fields. The role model research to date has amassed considerable evidence showing that role model exposure is beneficial; yet, questions still remain about what makes these role models effective. Accordingly, this thesis investigated whether feminine female role models increase women’s interest in STEM and improve their perceptions of female STEM role models relative to “neutral” female role models. Across three experiments men and women were exposed to role models and their interest in STEM was measured. All experiments exposed participants to one of three articles about a peer role model (a female role model who embodies femininity (e.g. wears makeup), a female role model who has gender neutral qualities/behaviors [e.g., works hard], or a male role model who embodies neutral traits) and Experiments 2 and 3 had a fourth control condition in which participants read about the history of SDSU (a control condition). In the first two experiments interest in physics was measured using an adapted version of the STEM Career Interest Survey (CIS). Experiment 3 used an adapted version of the STEM CIS scale, but measured overall interest in STEM by including subscales for each of the four STEM areas with a composite score serving as the primary dependent variable. Experiments 1 and 2 demonstrated that women’s interest in physics was no different than men’s after exposure to a feminine female role model compared to a neutral female and neutral male role model. Furthermore, women’s interest in physics was greater in the feminine condition compared to all other conditions for the first two experiments, thus demonstrating that a competent feminine role model may be useful in piquing women’s interest in physics. Experiment 3, however, did not display this pattern for women’s interest in STEM overall.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Stereotypes in STEM</td>
<td>2</td>
</tr>
<tr>
<td>Role Models and Femininity</td>
<td>2</td>
</tr>
<tr>
<td>RESEARCH OVERVIEW</td>
<td>4</td>
</tr>
<tr>
<td>Research Goals</td>
<td>4</td>
</tr>
<tr>
<td>Experiment 1</td>
<td>4</td>
</tr>
<tr>
<td>Method</td>
<td>5</td>
</tr>
<tr>
<td>Participants and Design</td>
<td>5</td>
</tr>
<tr>
<td>Procedure</td>
<td>5</td>
</tr>
<tr>
<td>Manipulating Role Model Femininity</td>
<td>6</td>
</tr>
<tr>
<td>Role Model Manipulation Checks</td>
<td>6</td>
</tr>
<tr>
<td>CIS-Physics</td>
<td>7</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>7</td>
</tr>
<tr>
<td>Analytical Approach</td>
<td>7</td>
</tr>
<tr>
<td>Manipulation Checks</td>
<td>7</td>
</tr>
<tr>
<td>Primary Analyses</td>
<td>8</td>
</tr>
<tr>
<td>Experiment 2</td>
<td>8</td>
</tr>
<tr>
<td>Method</td>
<td>9</td>
</tr>
<tr>
<td>Participants and Design</td>
<td>9</td>
</tr>
<tr>
<td>Procedure and Measures</td>
<td>9</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>9</td>
</tr>
<tr>
<td>Analytical Approach</td>
<td>9</td>
</tr>
<tr>
<td>Role Model Manipulation Checks</td>
<td>9</td>
</tr>
</tbody>
</table>
Primary Analyses ........................................................................................................10
Experiment 3 ..............................................................................................................10
Method .......................................................................................................................11
Participants and Design ............................................................................................11
Procedure ...................................................................................................................11
CIS-STEM ..................................................................................................................11
Results and Discussion ..............................................................................................12
Analytical Approach .................................................................................................12
Role Model Manipulation Checks ..........................................................................12
Primary Analyses ......................................................................................................12
GENERAL DISCUSSION ............................................................................................14
Concluding Thoughts .................................................................................................16
REFERENCES .............................................................................................................17
APPENDICES

A TABLES ..................................................................................................................19
B ADAPTED CAREER INTEREST SCALE – PHYSICS .............................................20
C ADAPTED CAREER INTEREST SCALE – SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS ..............................................................21
LIST OF TABLES

Table 1. Mean (SD) Physics CIS as a Function of Condition and Participant Gender............19
Table 2. Study 2 Mean (SD) STEM CIS as a Function of Condition and Participation
   Gender..................................................................................................................19
Table 3. Study 3 Mean (SD) STEM CIS as a Function of Condition and Participant
   Gender..................................................................................................................19
INTRODUCTION

Women are outnumbered by men four to one in science, technology, engineering, and mathematics (STEM) fields (Ceci & Williams, 2010). Although progress has been made towards increasing the number of women in STEM, stereotypes that allege women’s inferior ability in math and perceptions that STEM fields are “masculine” have a negative bearing on women’s interest in STEM. In the end, awareness of these stereotypes harms women’s performance and may ultimately send the message that women do not belong in STEM fields.

Given the continuing underrepresentation of women in STEM, numerous interventions (e.g., self-affirmation, role models) have been proposed to offset negative gender stereotypes that may be hindering women from entering STEM. For instance, work on role models has found that role model exposure enhances women’s self-concept, attitudes, and motivation regarding STEM (Stout, Dasgupta, Hunsinger, & McManus, 2011). Other work by Cheryan, Plaut, Davies, and Steele (2009) found that women had an increased sense of belonging in computer science after exposure to computer science role models who did not embody stereotypic traits. Women’s math performance has also been shown to be protected from the effects of gender stereotypes after exposure to female peer role models (e.g., Marx & Roman, 2002; Marx, Stapel, & Muller, 2005). Despite their clear benefits, what remains unclear about role models is whether there are personal qualities or attributes that account for their effectiveness. Perhaps the reason female peer role models are beneficial to young women is because they embody a level of femininity not present in the stereotypic STEM persona (Cheryan et al., 2009; Johnson & Miller, 2002). In fact, research suggests that the lack of women entering STEM fields may be linked specifically to the perceptions that STEM is unfeminine (Thomas-Hunt & Phillips, 2004). Consequently, this thesis is aimed at examining the role that femininity plays in making STEM role models more effective at increasing women’s interest in pursuing STEM.
Stereotypes in STEM

The idea that men are scientists, technology professionals, engineers, and mathematicians is a strong, long-standing stereotype that is formed at a young age. For instance, the draw-a-scientist (DAS) task used with elementary school and middle-school aged students shows that, among other qualities, engineers are perceived to be men (Capobianco, Diefes-Dux, Mena, & Weller, 2011). Inevitably these stereotypes are creating a scenario in which women grow up thinking certain areas of study are not for them, but are for their male peers. Similarly, work on perceptions of individuals in the technology sector amounts to stereotypes about boring men who work alone (Thomas & Allen, 2006). And when asked about STEM environments, individuals overwhelmingly report thinking of STEM fields as being male-only, or masculine, and ones that would not fit someone who wants to have a family (Johnson & Miller, 2002). The mere presence of these stereotypes may have adverse impacts on young women. For example, recent research shows that even one time exposure to STEM individuals who embody stereotypic traits can have lasting, harmful effects for women (Cheryan, Drury, & Vichayapai, 2013). Furthermore, research by Steele, James, and Barnett (2002) suggests that continuous exposure to stereotypes may cause women to disidentify with STEM. One way to encourage women to break free from ongoing perceptions of STEM being a “boy’s only club” could be to expose women to peer role models who express femininity.

Role Models and Femininity

Because perceptions of STEM and perceptions of femininity are considered distinct from one another (Hall, 2010) women’s interest in STEM fields may be further hindered by a conflict in identities. In other words, identifying with STEM is associated with being unfeminine and identifying as a woman encompasses a number of feminine traits that make it seemingly impossible for women both to maintain their feminine identity and concomitantly identify with STEM. A feminine female peer role model could provide a helpful, counter-stereotypic example for young women.

One speculation for why female peer role models have been effective for young women in the past is because these role models share a social identity with women. While research has shown that sharing an identity with role models is critical (Marx & Goff, 2005;
Marx & Roman, 2002), women report finding it difficult to relate to stereotypic STEM role models (e.g., “geeky” males; Cheryan, Plaut, Handron, & Hudson, 2013; Cheryan et al., 2009). This may be directly linked to a lack of femininity given that STEM women often disassociate themselves from feminine characteristics, such as wearing makeup, wanting to have children, and gossiping as a way to cope in a “man’s world” (Pronin, Steele, & Ross, 2003).

Women in STEM share a social identity with other women, yet disavowing feminine characteristics may be decreasing their effectiveness as role models. A shared identity establishes a connection between an individual and a role model, and perhaps sharing an identity while maintaining a feminine identity would create an even stronger connection between women and female STEM role models (see also, Marx & Ko, 2012). Therefore, if STEM role models express their femininity then they can increase their connection with women who also express feminine characteristics and serve as more optimal role models.

The current research focuses on emphasizing feminine attributes by highlight traits counter-stereotypic to STEM fields to increase a sense of connection women feel towards role models and ultimately pique their interest in STEM fields. The work by Cheryan et al. (2009) demonstrates that role models who oppose the traditional STEM persona may be the most optimal role models for women. Additionally, Pronin and colleagues (2003) demonstrated that certain attributes of femininity were linked highly to negative stereotypes about women in STEM (e.g., wearing makeup, flirting, gossiping), while other feminine qualities (e.g., nurturing, empathy) were not. The present research used attributes linked highly to negative stereotypes and the feminine qualities that were weakly associated with negative stereotypes about women in STEM in order to create a role model who fully captured the characteristics not currently present in the stereotypic STEM role model. This was done to inspire young women through exposure to a competent female peer role model with whom they could feel a connection.
RESEARCH OVERVIEW

The research on role models presents strong evidence that role models can be useful in both protecting women from the negative effects of stereotype threat, as well as increasing their interest and sense of belonging in areas in which they are stereotyped. However, gaining a deeper understanding of why role models are effective could prove to be vastly beneficial in the effort to decrease the gender gap within STEM fields. The current research was designed to do just that by targeting femininity as an attribute of role models that may be used to make role models optimally effective at increasing women’s interest in STEM. The current research is guided by the general hypothesis that role models, who are portrayed as feminine, will be the most effective at piquing women’s interest in STEM compared to role models who are not portrayed as feminine (i.e., male role models and “neutral” female role models).

RESEARCH GOALS

In Experiment 1, men and women were exposed to one of three role models (feminine female, neutral female, and neutral male) and then interest in physics was measured. In Experiment 2 men and women were exposed to one of the same three role models as in Experiment 1, or a no role model (control) condition to assess the directionality of effects. Experiment 3 was designed to replicate and extend the finding from Experiments 1 and 2 using the four conditions from Experiment 2 and overall interest in STEM as the dependent variable.

EXPERIMENT 1

Women’s representation in certain areas of STEM fields is particularly low. For instance, recent statistics showed that women only earned 20% of doctoral degrees in physics awarded in 2013 (National Science Foundation [NSF], 2013). Differences between men and women’s performance in physics are seen at the high school level as well as within the higher
education sector (Sadler & Tai, 2001; Taasoobshirazi & Carr, 2008). The lack of interest in physics is likely a contributing factor to women’s underperformance and thus their underrepresentation. Therefore, I used interest in physics as the dependent variable for Experiment 1. This allowed me to test the effect that role model femininity would have on young women in an area where they are vastly underrepresented. The primary focus of Experiment 1 was to show that women’s interest in physics would increase as a result of exposure to a feminine female role model. Thus, I expected that men would report greater interest in physics than women after exposure to a neutral female or a neutral male role model. I also expected that there would be no differences in reported interested between men and women after exposure to a feminine female role model. Furthermore, I predicted that women’s interest in physics would be higher after exposure to the feminine female role model compared to women’s interest in physics after exposure to the neutral female or neutral male role model.

Method

Participants and Design

Two hundred sixty nine San Diego State University (SDSU) undergraduates (103 men) participated in this experiment for partial course credit. Participants were recruited from the Psychology 101 pool and participants from all racial and ethnic backgrounds were included. I used a 2 (Participant Gender: male, female) x 3 (Role Model Condition: feminine female, neutral female, neutral male) between-participants design.

Procedure

Up to six participants were run in a single session. Upon arrival, a research assistant asked each participant to take a seat in one of the separate cubicles that contained a desktop computer. Participants were then asked to read over and sign a consent form. Afterwards, participants were told the experiment consisted of a series of tasks that would be completed on the computer. All remaining instructions were presented on the computer. The experiment began by having participants read about the underrepresentation of women in physics and continued by randomly assigning participants to one of the three role model conditions. After reading about their respective role models participants were instructed to complete an
adapted version of the Career Interest Survey (CIS; Kier, Blanchard, Osborne, & Albert, 2014) tailored to directly ask about interest in physics. Participants then completed a series of measures that assessed their attitudes and opinions of the role models as well as basic recall information from the articles. In addition, participants were asked to provide basic demographic information including age, gender, and major. After providing their demographic information participants were thanked and debriefed.

**MANIPULATING ROLE MODEL FEMININITY**

The role models were presented to participants in the form of a fictitious newspaper article. All role models were described as being seniors at SDSU who were majoring in physics. Additionally, each role model was portrayed as being competent in physics, as evidenced by being physics majors who had taken a number of difficult physics courses and offered an internship working at NASA. The feminine role model was described with attributes and activities known to reflect to femininity (e.g., wears makeup, gossips, soft). The feminine role model was thus designed to highlight feminine characteristics that are likewise counter-stereotypic to the STEM environment. The neutral male and neutral female role models were described in more abstract terms (e.g., works hard, has similar interests as other physics students). Thus, the neutral role models served as someone more representative of the typical STEM persona. After the articles were presented to participants they then were asked a series of questions about the role model followed by the CIS.

**ROLE MODEL MANIPULATION CHECKS**

*Competence.* To verify that the role models were perceived as competent in physics, participants responded to the following statement: “The student in the article is competent in physics.” Responses were recorded on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. Higher numbers indicate higher role model competence.

*Likeability.* To demonstrate that role model femininity did not affect role model likeability, participants responded to the following statement: “I like the student in the article.” Responses were recorded on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. Higher numbers indicate greater liking of the role model.
Femininity. To ensure that the feminine role model was perceived as more feminine than the neutral female and male role models, participants responded to the following statement: “I would consider the student in the article to be feminine.” Responses were recorded on a 1 (strongly disagree) to 7 (strongly agree) scale. Higher scores would indicate that the role model was seen as highly feminine.

CIS-PHYSICS

The CIS measure used in this experiment was an adapted version of the science subscale from the STEM CIS (Kier et al., 2014). It consisted of eight questions focusing on six different social cognitive theories (self-efficacy, personal goals, outcome expectation, interest, contextual support, and personal input) linked to interest in a career field (α = .85). Participants responded to statements such as, “I feel confident that I would be able to do well in activities that involve physics” by indicating their agreement on a 1 (strongly disagree) to 7 (strongly agree) scale. (See Appendices for all items). Higher scores indicate greater interest in physics.

Results and Discussion

ANALYTICAL APPROACH

Simultaneous linear regression was used for all analyses. Mean CIS scores were regressed onto participant gender, condition, and their interaction. Simple effects tests were then used to investigate my hypotheses.

MANIPULATION CHECKS

Competence. Analyses revealed no main or interactive effects (Fs < 1), indicating that role model competence was not influenced by role model gender or femininity.

Likeability. Analyses of role model likeability showed no main effect for gender or condition, or their interaction, all ps > .11. These null effects demonstrate that role model likeability was not influenced by role model gender or femininity.

Femininity. Analysis of the role models’ femininity showed a significant main effect for condition, \( F(2, 263) = 92.06, p < .001 \). As expected, both men and women rated the feminine role model as more feminine (\( M = 5.82 \)) than the neutral female (\( M = 5.04 \)), \( F(1, 263) = 23.52, p < .001 \).
263) = 21.07, \( p < .001 \), \( R^2 = .07 \), or neutral male \( (M = 2.40), F(1, 263) = 202.78, \ p < .001 \) \( R^2 = .43 \).

**PRIMARY ANALYSES**

Results revealed a significant main effect of gender \( F(1, 263) = 16.00, \ p < .001, \ R^2 = .06 \), such that men \( (M = 3.77) \) were more interested in physics than women \( (M = 3.21) \). The interaction involving participant gender and role model femininity approached significance \( F(2, 263) = 2.82, \ p = .06, \ R^2 = .01 \). In order to interpret this marginal interaction I conducted simple effects tests according to my hypotheses.

Results revealed that men’s interest in physics in the neutral male condition \( (M = 3.88) \) was higher than women’s \( (M = 2.88), F(1, 263) = 9.36, \ p = .002 \) \( R^2 = .03 \). Men’s interest in physics in the neutral female condition \( (M = 3.73) \) was higher than women’s \( (M = 3.18), F(1, 263) = 7.90, \ p = .01, \ R^2 = .03 \), but men and women’s interest did not significantly differ in the feminine role model condition \( (M = 3.71 \text{ vs. } M = 3.56), F < 1.00 \). Furthermore, simple effects tests showed women’s scores in the feminine condition \( (M = 3.56) \) were significantly higher than women’s scores in the neutral female \( (M = 3.18), F(1, 263) = 5.02, \ p = .03, \ R^2 = .02 \) or neutral male \( (M = 2.88), F(1, 263) = 8.01, \ p = .001, \ R^2 = .03 \) condition.

These findings demonstrate, as predicted, that women’s interest in physics is piqued following exposure to a feminine female role model, such that they have equivalent interest compared to men. Although the effects from Experiment 1 were consistent with my hypotheses the direction of effects remains unclear. In other words, does the effect of role model femininity enhance or simply maintain women’s baseline interest in physics? Accordingly, Experiment 2 included a baseline/no role model control condition to examine this question.

**EXPERIMENT 2**

The goal of Experiment 2 was twofold. I first wanted to replicate the results from Experiment 1, and second I wanted to determine if women’s interest in physics is higher after exposure to a feminine female role model compared to a no role model control condition. I made the same prediction as in Experiment 1 regarding the role model conditions. I further
predicted that women’s interest in physics after exposure to a feminine female role model would be higher than women who are not exposed to a role model.

**Method**

**PARTICIPANTS AND DESIGN**

Two hundred and ninety one SDSU undergraduates (110 men) participated in the experiment for partial course credit. Participants were recruited from the Psychology 101 pool and participants from all racial and ethnic backgrounds were included. For this experiment I used a 2 (Participant Gender: male, female) x 4 (Condition: feminine female role model, neutral female role model, neutral male role model, control) between-participants design.

**PROCEDURE AND MEASURES**

The same procedure from Experiment 1 was used with the addition of the control condition. I used the same eight-question CIS-Physics measure as in Experiment 1 ($\alpha = .82$) as well as the same manipulation checks.

**Results and Discussion**

**ANALYTICAL APPROACH**

Simultaneous linear regression was used for all analyses. Mean CIS scores were regressed onto participant gender, condition, and their interaction. Simple effects tests were then used to investigate my hypotheses.

**ROLE MODEL MANIPULATION CHECKS**

*Competence.* Analyses on role model competence revealed no main or interactive effects ($Fs < 1$), thus indicating, as expected, that role model competence was not influenced by role model gender or femininity.

*Likeability.* Analysis of role model likeability showed no main effect for gender, condition, or their interaction, all $ps > .10$, thus showing that role model likeability was not influenced by role model gender or femininity.
Femininity. A significant main effect was found for condition, $F(2, 207) = 73.79, p < .001$. Both men and women rated the feminine role model as significantly more feminine ($M = 5.81$) than the neutral female ($M = 5.25$), $F(1, 207) = 7.84, p = .01, R^2 = .04$, or the neutral male ($M = 2.64$) role model, $F(1, 207) = 153.02, p < .001, R^2 = .42$

**PRIMARY ANALYSES**

Results revealed a main effect of participant gender, $F(1, 283) = 11.92, p = .001, R^2 = .03$, such that men’s interest in physics ($M = 3.73$) was higher than women’s ($M = 3.31$). The gender by condition interaction was also significant, $F(3, 283) = 4.89, p = .002, R^2 = .08$. As expected, simple effects tests revealed that men’s interest in physics in the neutral female condition ($M = 3.70$) was higher than women’s ($M = 3.25$), $F(1, 283) = 4.58, p = .03, R^2 = .02$, and men’s interest in physics in the control condition ($M = 4.17$) was higher than women’s ($M = 3.00$), $F(1, 283) = 25.91, p < .001, R^2 = .08$. Importantly, men’s interest in the feminine condition ($M = 3.84$) did not significantly differ from women’s ($M = 3.75$), $F(1, 263) = .15, p > .05$. Also as hypothesized, women in the feminine condition had significantly higher scores ($M = 3.75$) than women in the control condition ($M = 3.00$), $F(1, 283) = 15.60, p < .001, R^2 = .05$, women in the neutral male condition ($M = 3.22$), $F(1, 283) = 5.29, p = .02, R^2 = .02$, and women in the neutral female condition ($M = 3.25$), $F(1, 283) = 6.92, p = .01, R^2 = .02$.

These findings suggest that highlighting femininity in role models increases women’s interest in physics above and beyond that of a typical STEM persona or baseline interest.

**EXPERIMENT 3**

Across two experiments I measured men and women’s interest in physics using an adapted version of the CIS. In both experiments, women had significantly lower scores than

---

1 The denominator degrees of freedom for the role model manipulation checks for Experiment 2 are different from the primary analysis because they do not include the control condition.
men in the neutral female role model condition, and in Experiment 2 women’s interest were also lower than men’s in the control condition. Importantly, where women and men did not differ in CIS scores was in the feminine female role model condition. Given that women are even less represented in physics compared to other areas of STEM it is not entirely surprising that women’s interest was not aligned with men’s after mere exposure to a female, but neutral, role model. This suggests that a female role model alone is not enough to enhance women’s interest in physics to the level of men’s. Experiment 3’s focus is to broaden the dependent measure to encompass STEM, as a whole, in order to test whether a feminine role model can pique women’s interest in STEM.

**Method**

**Participants and Design**

One hundred and ninety two SDSU undergraduates (131 women) were recruited through the Psychology 101 pool. Participants from all racial/ethnic backgrounds were eligible to participate. Participants received course credit in exchange for participation. A 2 (Participant Gender: male, female) x 4 (Condition: feminine female role model, neutral female role model, neutral male role model) between-participants design was used.

**Procedure**

I used the same procedure from Experiments 1 and 2 with the addition of the more broadly defined STEM dependent variable. In Experiment 3 participants read one of the four fictitious articles then completed an adapted version of the CIS (Kier et al., 2014) that contained questions from all four STEM subscales (viz. science, technology, engineering, and mathematics).

**CIS-STEM**

The CIS-STEM is also adapted from the original version of the CIS measure by Kier et al. (2014), but this time contained of all four original subscales. The original scale contained a total of 44 questions and was designed to measure interest in STEM at the high school level, so three questions from each subsection were removed to condense the measure and make it more appropriate for the current college sample (e.g., the statement “My parents
would like it if I choose a mathematics career” was removed). Each subscale in the adapted
version had eight questions that related to the same six social cognitive theories from the
previous experiments. A composite score was used as the dependent measure for Experiment
3 (α = .94).

**Results and Discussion**

**Analytical Approach**

Simultaneous linear regression was used for all analyses. Mean STEM CIS scores
were regressed onto participant gender, condition, and their interaction.

**Role Model Manipulation Checks**

*Competence.* As anticipated, analyses on role model competence revealed no main or
interactive effects ($F$s < 1), thus showing that role model competence was not influenced by
role model gender or femininity.

*Likeability.* Analysis of role model likeability showed no main effect for gender,
condition, or their interaction, all $F$s < 1, thus indicating, as expected, that role model
likeability was not influenced by role model gender or femininity.

*Femininity.* A significant main effect was found for condition, $F(2, 142) = 56.36, p < .001, R^2 = .43$. Both men and women rated the feminine role model as significantly
more feminine ($M = 5.67$) than the neutral female ($M = 4.53$), $F(1, 142) = 19.18, p < .001, R^2 = .12,$
or neutral male ($M = 2.54$) role model, $F(1, 142) = 144.9, p < .001, R^2 = .51$.

**Primary Analyses**

Results revealed a main effect of participant gender, $F(1, 182) = 25.02, p < .001, R^2 = .12,$ such that men’s interest in STEM ($M = 5.37$) was higher than women’s ($M = 4.34$). The

---

The denominator degrees of freedom for the role model manipulation checks for
Experiment 3 are different from the primary analysis because they do not include the control
condition.
gender by condition interaction was also significant, $F(3, 182) = 2.85, p = .039, R^2 = .05$. Simple effects tests revealed that men’s interest in STEM in the control condition ($M = 5.36$) was higher than women’s ($M = 4.71$), $F(1, 182) = 5.38, p = .02, R^2 = .03$. However, men’s interest in STEM in the neutral female condition ($M = 4.98$) was no different than women’s ($M = 4.93$), $F(1, 182) = .04, p > .05$. Also contrary to what was hypothesized, men’s interest in STEM in the feminine condition ($M = 5.45$) was significantly higher than women’s ($M = 4.60$), $F(1, 182) = 14.90, p < .001, R^2 = .08$. Additionally, women’s interest in the feminine condition did not differ from women’s STEM interest in the neutral female, neutral male, or control condition (all $ps > .05$).
GENERAL DISCUSSION

In attempt to find a solution to the continual underrepresentation of women in STEM, this thesis investigated the role that femininity of female role models played in piquing women’s interest in STEM. In Experiment 1 it was hypothesized that women’s interest in physics would not differ from men’s after exposure to a feminine female physics role model, and that women’s interest in physics would be higher in the feminine female role model condition compared to the neutral female role model and neutral male role model conditions. In Experiment 2 the same hypothesis was made for men and women’s interest in physics after exposure to the feminine female role model; it was also hypothesized that women’s interest in physics would be greater after exposure to the feminine female role model compared to the neutral female or neutral male role models as well as the control, no role model, condition. Experiment 3 sought to replicate the findings from the first two experiments and increase the generalizability of the results to other STEM fields (e.g., engineering). In Experiment 3 the same predictions were made as in Experiment 2. There was mixed support for the hypotheses. While women’s interest was increased after exposure to a feminine female role model (described to be competent in physics) in the first two experiments when physics was the focus of the dependent measure, women’s interest was not piqued after exposure to a feminine female role model in Experiment 3 when the dependent measure was broadened to all of STEM. These results have important implications for future work on role models in STEM fields. Whereas most of the research on role models has focused broadly on characteristics of role models, such as competence and gender, this research suggests a more specific investigation into what attributes make a role model most effective.

These results suggest that femininity of a female role model may benefit women only when the role model’s area of expertise (e.g., physics) is congruent with measured interest (e.g., interest in physics as the dependent variable). This notion is consistent with past
research showing that a role model’s competence needs to match the outcome of interest (Marx et al., 2005, study 4). In the research by Marx and colleagues exposure to domain relevant female role models benefited women’s math performance compared to a domain irrelevant female role model. In the first two experiments of the current research in which the expertise of the role models was relevant to measured interest, feminine female role models were beneficial to women. However in Experiment 3 the hypothesis was not supported. Exposure to a physics competent feminine female role model did not generalize to women’s interest in STEM more broadly, likely because physics was seen as an irrelevant domain. Although the current research yielded mixed results, the findings of the three experiments may shed new light into what makes an optimal role model.

In all three experiments the same role models were used. It may have been beneficial to the research to have varied the area of expertise of the role model. Future studies could manipulate role model’s STEM expertise and then measure interest in the corresponding domain. For example, the addition of testing femininity in calculus role models on women’s interest in calculus may yield different results than testing femininity of calculus role models then asking participants about their interest in engineering. I argue that the connection between the role model’s competence and the target outcome measure must be made by the participant in order to elicit a change in perception (see Marx et al., 2005 for a similar argument). Alternatively, it could be argued that the connection between physics and science is apparent. If participants were making this connection, however, then results for the subscale of science in the CIS measure should have yielded significant results for Experiment 3, yet did not. I speculate that this lack of connection may be due to the level of underrepresentation of women in physics. With women being vastly underrepresented in physics compared to other STEM fields (Ceci & Williams, 2010; NSF, 2013), perhaps it is difficult for women to think about physics the way they think about science. Science includes areas, such as biology, a field in which women are not underrepresented (NSF, 2013), and this may differentiate perceptions of science from perceptions of physics.

Additionally, research by Steele et al. (2002) revealed that negative effects of stereotypes for women in STEM increase over time and thus may cause women to disidentify from STEM fields. Negative stereotypes about women in STEM fields are well-established and perhaps one time exposure to a feminine female role model is not enough to increase
women’s interest in STEM fields. This may be especially true for areas such as physics that have larger gender gaps. Future studies could expose women to feminine female role models in a series of experiments and measure interest levels over time. If women were exposed to feminine role models with various STEM expertise’s over time, then this could help to break down the long standing negative stereotypes about women in STEM.

CONCLUDING THOUGHTS

The lack of femininity in STEM fields (Cheryan et al., 2009; Johnson & Miller, 2002) and the continual misperceptions that STEM professions are feminine (Capobianco et al., 2011; Thomas & Allen, 2006) continue to be relevant issues in society. Previous work has attributed the idea of STEM being unfeminine to the underrepresentation of women in STEM (Thomas-Hunt & Phillips, 2004). The current research suggests that, under the right conditions, this disassociation that is hindering women from entering STEM fields may be reconciled through exposure to competent feminine STEM role models.
REFERENCES


### APPENDIX A

**TABLES**

Table 1. Mean (SD) Physics CIS as a Function of Condition and Participant Gender

<table>
<thead>
<tr>
<th>Participant Gender</th>
<th>Condition</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral Male</td>
<td>Neutral Female</td>
<td>Feminine Female</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.88 (1.11)</td>
<td>3.73 (1.12)</td>
<td>3.71 (1.36)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2.88 (1.01)</td>
<td>3.18 (1.04)</td>
<td>3.56 (1.11)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Study 2 Mean (SD) STEM CIS as a Function of Condition and Participation Gender

<table>
<thead>
<tr>
<th>Participant Gender</th>
<th>Condition</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Neutral Male</td>
<td>Neutral Female</td>
<td>Feminine Female</td>
</tr>
<tr>
<td>Male</td>
<td>4.17 (0.80)</td>
<td>3.23 (0.89)</td>
<td>3.70 (0.88)</td>
<td>3.84 (0.87)</td>
</tr>
<tr>
<td>Female</td>
<td>3.00 (1.11)</td>
<td>3.18 (1.02)</td>
<td>3.25 (0.99)</td>
<td>3.75 (0.98)</td>
</tr>
</tbody>
</table>

Table 3. Study 3 Mean (SD) STEM CIS as a Function of Condition and Participant Gender

<table>
<thead>
<tr>
<th>Participant Gender</th>
<th>Condition</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Neutral Male</td>
<td>Neutral</td>
<td>Feminine Female</td>
</tr>
<tr>
<td>Male</td>
<td>5.36 (0.88)</td>
<td>5.68 (0.78)</td>
<td>4.98 (0.88)</td>
<td>5.45 (0.84)</td>
</tr>
<tr>
<td>Female</td>
<td>4.17 (1.06)</td>
<td>4.72 (0.95)</td>
<td>4.93 (0.87)</td>
<td>4.56 (1.10)</td>
</tr>
</tbody>
</table>
APPENDIX B

ADAPTED CAREER INTEREST SCALE – PHYSICS

1. I feel confident that I would be able to do well in activities that involve physics.
2. I feel confident that I could get good grades in physics classes.
3. I feel that I would fit in well with my peers if I were to pursue a physics degree.
4. I would be motivated to work hard if I were taking a physics class.
5. I am interested in learning about careers that use physics.
6. I like physics.
7. I feel that I have a role model in a physics career.
8. I now would feel comfortable talking with people who work in physics careers.
APPENDIX C

ADAPTED CAREER INTEREST SCALE – SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

Science

1. I feel confident that I would be able to do well in activities that involve science.
2. I feel confident that I could get good grades in science classes.
3. I feel that I would fit in well with my peers if I were to pursue a science degree.
4. I would be motivated to work hard if I were taking a science class.
5. I am interested in learning about careers that use science.
6. I like science.
7. I feel that I have a role model in a science career.
8. I now would feel comfortable talking with people who work in science careers.

Technology

1. I feel confident that I would be able to do well in activities that involve technology.
2. I feel confident that I could get good grades in classes that use technology.
3. I feel that I would fit in well with my peers if I were to pursue degree that uses technology.
4. I would be motivated to work hard if I were taking a class that uses technology.
5. I am interested in learning about careers that use technology.
6. I like using technology.
7. I know someone that uses technology in their career.
8. I now would feel comfortable talking with people who work in technology careers.
Engineering

1. I feel confident that I would be able to do well in activities that involve engineering.
2. I feel confident that I could get good grades in engineering classes.
3. I feel that I would fit in well with my peers if I were to pursue an engineering degree.
4. I would be motivated to work hard if I were taking an engineering class.
5. I am interested in learning about engineering careers.
6. I like engineering.
7. I feel that I have a role model in an engineering career.
8. I would feel comfortable talking with people who work in engineering careers.

Mathematics

1. I feel confident that I would be able to do well in activities that involve mathematics.
2. I feel confident that I could get good grades in mathematics classes.
3. I feel that I would fit in well with my peers if I were to pursue a mathematics degree.
4. I would be motivated to work hard if I were taking a mathematics class.
5. I am interested in learning about careers that use mathematics.
6. I like mathematics.
7. I feel that I have a role model in a mathematics career.
8. I now would feel comfortable talking with people who work in mathematics careers.