FEMALE ROLE MODEL EFFECTS ON GENDER STEREOTYPE THREAT IN YOUNG GIRLS: THE MULTI-THREAT FRAMEWORK

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ABSTRACT

Young girls have been found to perform lower on math tests compared to young boys, and one mechanism that is associated with girls' lower performance is gender stereotype threat. The multi-threat framework suggests that gender stereotype threat may occur when young girls interact with women who display high skill in math, but this framework is yet to be tested empirically. To test this framework, I use a nationally representative panel dataset of grades K-8 US school children to examine the relationship between maternal involvement in daughter's math homework and math achievement, as well as perceived competence and interest in math. Consistent with the multi-threat framework, I find a significant negative relationship between maternal involvement in daughter's math homework and math test scores, as well as perceived competence and interest in math. However, I also find a similar pattern for boys whose mothers help them with math homework, which suggests that these results are not necessarily being driven by multi-threat stereotype threat.

The research and writing of this thesis
is dedicated to Cody Tuttle.

Thank you,
Marisa Putnam

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INTRODUCTION

Science, technology, engineering, and mathematics (STEM) are national priorities, and the development of competent and innovative STEM workers is critical for the nation's economy. In 2011, children nationwide were not meeting standards in math, with only 40 percent of fourth graders and 35 percent of eighth graders meeting their grade's proficiency standards on the National Assessment of Educational Progress (National Science Board, 2014). Girls in particular are falling behind boys in math performance (Levitt & Fryer, 2009). This may have serious implications for the development of a diverse STEM workforce in the future.

One phenomenon that has been associated with female's lower test scores is gender stereotype threat (Steele & Aronson, 1995), which occurs when a woman experiences anxiety that her performance might confirm the negative gender stereotype that girls are not good at math. In addition, contrary to findings on the protective factors of female role models for adult women, the multi-threat framework of stereotype threat suggests that female role models may in fact induce gender stereotype threat (Shapiro & Williams, 2012). It seems particularly worthy to investigate the multi-threat framework theory through the relationship between math role models and young girls, as young girls are developing their attitudes and self-concepts about gender and math during elementary school. This study aims to explore if, consistent with the multi-threat framework theory, girls who spend more time with female math experts score lower on math tests, and report having lower interest and competence in math. Women have traditionally been underrepresented in science, technology, engineering, and mathematics (STEM) professions in the United States, (The US Census Bureau, 2013) and it is vital to the future of the workforce to work towards encouraging more girls to become involved in STEM.

LITERATURE REVIEW

A gap between girls' and boys' math performance emerges in elementary school, although the exact time of emergence is debated in the literature. Analyses of the Early Childhood Longitudinal Survey (ECLS-K), a nationally representative survey of children in grades K-8, found no difference in math performance between girls and boys in kindergarten when they began school (Levitt & Fryer, 2009; Lubienski, Robinson, Crane, & Ganley, 2013). However, Levitt and Fryer (2009) find that a gender gap in math performance emerges between kindergarten and fifth grade, and Lubienski et al. (2013) found an achievement gap favoring boys among high-achieving children as early as the end of kindergarten. This gap is puzzling because Levitt and Fryer (2009) did not find evidence to support explanations of lower investment in math by girls, low parental expectations, and biased tests.

One mechanism by which female math test performance may suffer is gender stereotype threat (Steele & Aronson, 1995), or the threat that girls will confirm negative stereotypes that women are worse than boys at math. Spencer, Steele, & Quinn (1999) indeed found that women who are high in math ability score lower on difficult math tests when compared to men who are high in math ability; furthermore, women perform particularly poorly when they are told the test yields gender differences when compared to men. As early as elementary school, there is evidence suggesting that both boys and girls are influenced by gender stereotypes about gender and STEM (Farenga & Joyce, 1999; Cvencek, Melzzoff, & Greenwald, 2011). Girl's performance on tests can also be impeded when they are aware of their gender, which is associated with negative performance in math (Ambady, Shih, Kim, & Pittinsky, 2001). Young girls' attitudes about math are also shaped by the beliefs their teachers and parents hold about math and the extent to which they internalize stereotypical beliefs about math and gender (Gunderson, Ramirez, Levine, & Beilock, 2012).

Because evidence suggests that the presence of a female role model is associated with higher confidence and interest in STEM among women, and providing STEM-competent female role models for young girls has been offered as a policy solution to the math gender gap (Halpern, Diane, Aronson, Reimer, Simpkins, Star, & Wentzel, 2007). Women majoring in STEM subjects briefly exposed to STEM-competent female role models, or other women with careers in STEM fields, reported having more positive implicit attitudes about STEM, a stronger identification with STEM, greater self-efficacy in STEM, and attempted to answer more questions on a math test (Stout, Dasgupta, Hunsinger, & McManus, 2011). Marx and Roman (2002) administered math tests to college women and men in situations that were intended to induce gender stereotype threat. Women who were administered the test by a math-competent woman performed similarly to men. When women were administered the test by a math-competent man their scores were lower in comparison to men taking the test. However, the literature is lacking empirical evidence about whether women interacting with young girls about STEM subjects, potentially viewed as STEM role models by young girls, impacts young girls during the earlier developmental period in which the gender gap in math performance emerges.

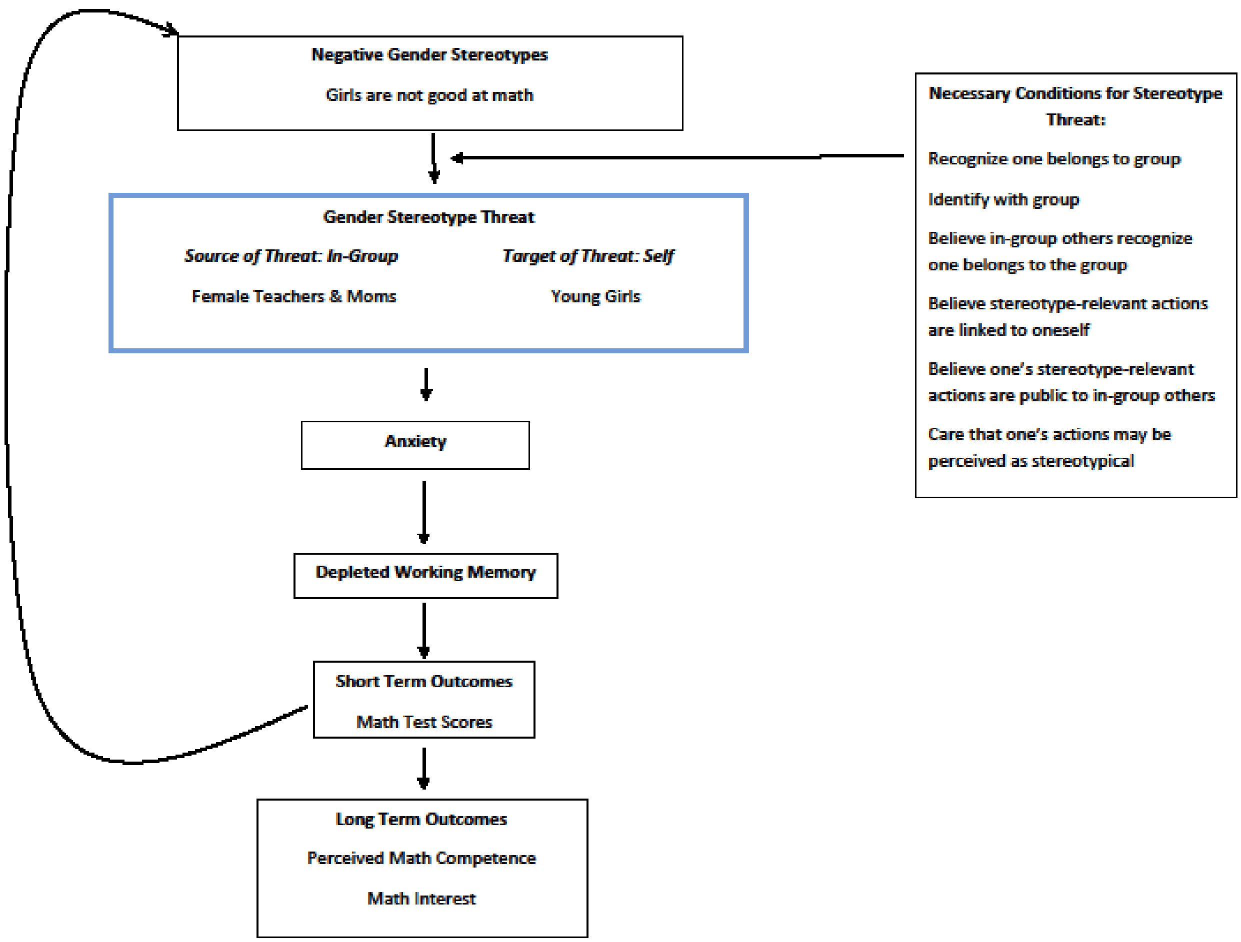
Although the evidence above suggests that female role models may serve as a protective factor for women's attitudes about math, the multi-threat framework of stereotype threat instead suggests that female role models may in fact induce gender stereotype threat (Shapiro & Williams, 2012). Stereotype threat can arise and manifest itself differently under different circumstances into six identified and unique forms of stereotype threat (Shapiro & Neuberg, 2007). One important aspect to considering the circumstance of the threat is who the target of a stereotype threat is: self or group. Another important factor is the source of the stereotype threat: in-group or out-group. The framework suggests that a woman helping or teaching math to a young girl may be viewed by that young girl as an in-group member that is competent at math. In turn, a young girl may experience gender stereotype threat as a result of this interaction with the math-competent role model; accordingly, the girl may become anxious that if they perform poorly they will confirm the negative stereotype that girls are bad at math in the eyes of the female role model. To the best of my knowledge, there have not been any direct tests of this framework in regards to gender stereotype threat.

It seems particularly worthy to investigate how role models impact young girl's STEM outcomes when they are developing their attitudes and self-concepts about gender and math during elementary school. Furthermore, it is important to understand the impact female role models in math may have on young girls before policy is put in place to increase and encourage women mentoring and serving as role models to girls in STEM. The purpose of this proposed study is to explore if, consistent with the multi-threat framework, girls who spend more time with female role models in math score lower on math tests and report lower math interest and competence.

CONCEPTUAL MODEL

Figure 1 depicts a model of gender stereotype threat, specifically, how female math role models influence fifth grade girl's math outcomes. The psychological experience of gender stereotype threat is complex, and this framework cannot capture all the elements that affect a child's experience of gender stereotype threat and math testing outcomes. However, it features key elements that have been identified in prior research (Shapiro & Neuberg, 2007).

Figure 1. Factors That Influence Long and Short Term Outcomes of Gender Stereotype Threat



The model begins with a negative gender stereotype commonly held, that girls are not good at math. This stereotype exists in and is perpetuated by society through individuals' daily interactions and primarily through media. Negative gender stereotypes have been found to influence children’s perceptions of their math ability and if math is a subject for them as early as elementary school (Farenga & Joyce, 1999; Cvencek, Melzzoff, & Greenwald, 2011). These negative gender stereotypes influence female students as well as their mothers and female role models in math; however, negative gender stereotypes may differentially affect women and girls in different developmental periods. Men and boys are not negatively influenced by this gender stereotype.

The necessary conditions that must occur for gender stereotype threat to be present, as identified by Shapiro and Neuberg (2007) are presented on the right side of the model. A girl must realize that she is part of a broader group of women, identify as female, and believe that other women see her as a female. She must believe that stereotype-relevant actions are linked to herself and are public to in-group members; therefore in this case a girl must believe her performance in math is public information to other women, such as her mom and female teachers. Finally, a girl must care about the implications of her stereotypic actions in terms of how other women think of her performance. In other words, a young girl needs to care that her performance in math may confirm the stereotype that girls are not good at math, and other women will think she is not good at math.

If the necessary conditions are present, the multi-threat framework (Shapiro & Williams, 2012) posits that in-group members that are experts in a domain, such as moms and teachers who are viewed as math competent, might induce gender stereotype threat for young girls and be the source of the threat. The target of the threat is the self for the young girls who are experiencing the necessary conditions for gender stereotype threat. The experience of gender stereotype threat is hypothesized (Schmader & Johns, 2003) to create anxiety for young girls which can lead to depleted working memory. In turn, this can lead to negative short term outcomes, such as lower math test scores. Additionally, girls may experience long term outcomes as a result of experiencing gender stereotype threat and lower test scores such as lower math confidence and lower math interest. The negative short and long term impacts may serve to reinforce the negative gender stereotype that girls are not good at math, in the minds of young girls, and act as a feedback loop contributing to furthering the negative gender stereotype. For example, when a girl performs poorly on a math test this will reinforce the culturally held negative stereotype in a small way, but with continued poor performance a girl will begin to experience long-term negative impacts like lower interest in math and lower perceived competence. Based on the conceptual model above, if the necessary conditions for stereotype threat are met, I hypothesize that fifth grade girls who spend more time with female math role models will score lower on math exams and have lower perceived competence and interest in math.

EMPIRICAL STRATEGY

For the purpose of this study, I assume that the more time a child works with a woman on math-related material, the more they will see that woman as a math expert. Additionally, I assume that children's teachers are female in third and fifth grade. Gender of teachers is only reported in kindergarten in the dataset that I use, where over 98 percent of teachers are female. While the lack of data on teachers' gender is not ideal, this assumption for the purpose of this study may be an acceptable approximation, given that the nationally representative Schools and Staffing Survey (SASS) of 2011 reported 74 percent of third grade teachers in the United States as female, and 75 percent of fifth grade teachers in the United States as female.

I created two independent variables of interest, math active mom and math active teacher, to measure how much time a child spends with a woman working together on math subject-matter. The first variable is a measure of how active a child's mother is in helping her child with math homework in grade 3 and grade 5. I created a dummy variable, coded as a 1 if a mom is active in math homework help (i.e., reports helping her child with math 3 or more days a week). I coded the variable as a 0 if a child's mother reports helping their child with math less than 3 times a week. I summed the dummy variables created for grades 3 and 5; thus, the measure of how active a mother is in assisting their child with math homework can have a value of 0, 1, or 2. Finally, I created dummy variables for each level: mom not math active, mom math active 1 year, mom math active 2 years.

The second variable will be a measure of how active a teacher is in teaching math in their classroom across grades 3 and 5. A teacher will be defined as math active if they report teaching math in their classroom 3 or more days a week. I created a dummy variable, coded as a 1 if a teacher actively teaches math in their classroom (i.e., reports teaching math in their classroom 3 or more days a week). I coded the variable as a 0 if a teacher reports teaching math less than 3 times a week, as I will consider that teacher as not actively teaching math. I summed the dummy variables created for grades 3 and 5; thus, the measure of how active a teacher is at teaching math in their classroom can have a value of 0, 1, or 2. Finally, I created dummy variables for each level: teacher not math active, teacher math active 1 year, teacher math active 2 years.
The dependent variables of interest are standardized math test scores in fifth grade and a girl's perceived competence and interest in math in fifth grade. The math test evaluates number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics,

and probability; and patterns, algebra, and functions. The math test scores are scaled to have a mean of 50 and a standard deviation of 10. Perceived math competence and interest is measured in the data set with a math subscale that was part of the self-description questionnaire (SDQ) administered to children in third and fifth grade. The subscale included the following items: work in math is easy for me, I cannot wait to do math each day, I get good grades in math, I am interested in math, I can do very difficult problems in math, I like math, I enjoy doing work in math, and I am good at math. In the survey, each item was scored as (1) not at all true, (2) a little bit true, (3) mostly true, or (4) very true, and an average of all responses was calculated as the final math sub-scale value. For children who answered 3 (mostly true) or (4) very true on the math subscale on average, I created a dummy variable coded as a 1 to indicate this child felt competent and interested in math on average. Children who reported a (1) not true at all or (2) a little bit true on average, were coded as a 0 to indicate that this child does not feel competent and interested in math.

To examine the relationship between having female math role models, girl's math test scores, and girl's perceived math competence and interest, in my primary models I regress each outcome variable on math active mom and math active teacher. Additionally, analyses will include controls for child characteristics (racial/ethnic minority status, perceived interest and competence in all subjects), family characteristics (mom with a math occupation, one parent in the household holding a college degree or higher, how active a dad is with math homework), school fixed effects and include a random error term.

Using Ordinary Least Squares regression, I estimate the following equation:

(1) $MathTestScore = \beta_0 + \beta_1 momactive1year + \beta_2 momactive2years + \beta_3 teacheractive1year + \beta_4 teacheractive2yeas + \beta_5 childcharacteristics + \beta_6 familycharacteristics + \beta_7 schoolcharacteristics + \mu$

Using Logistic regression, I estimate the following equation:

(1) $MathCompetenceInterest = \beta_0 + \beta_1 momactive1year + \beta_2 momactive2years + \beta_3 teacheractive1year + \beta_4 teacheractive2yeas + \beta_5 childcharacteristics + \beta_6 familycharacteristics + \mu$

For all analysis with math test score as the dependent variable, the omitted reference category is a dummy variable representing moms who report not being active in helping their daughters with math homework in 3rd or 5th grade. For the analysis with math competence and interest as the dependent variable, the omitted reference category is a dummy variable representing teachers who report not being active in teaching math in 3rd or 5th grade. I expect the coefficients on β1, β2, β3, and β4 to be negative, which is consistent with the hypothesis that girls having female math role models induces gender stereotype threat and leads to lower math test scores, and lower perceived competence and interest in math. Additionally, I would expect the coefficients on β2 and β4 to be more negative and larger in magnitude than the coefficients on β1 and β3, as my hypothesis is that the more time a girl spends with a female math role model, the stronger the impact of gender stereotype threat, the lower a girl will score on math tests, and the lower their perceived competence and interest in math will be. For my regressions to yield unbiased and consistent estimates, my estimation assumptions would need to be true. One key assumption is that the gender of all teachers in the sample would truly have to be female. This is unlikely to be completely true, which may lead to measurement error in my independent variable for teacher active. Assuming this error is random, that may lead to attenuation bias in my independent variable for teacher active, shrinking it toward zero. Perhaps more importantly, girls must conceptualize female role models in math as women who spend at least 3 days a week working on math-related subject matter with them. I will discuss this further in the limitations section.

I am also interested to see if the same hypothesized pattern of women math role models negatively influencing math scores occurs not only for girls, but for boys as well. If I can find support for this alternative hypothesis, that female math role models negatively influence all children's test scores this might suggest that girls are experiencing gender stereotype threat, but that all children regardless of gender are being influenced by negative gender stereotypes which influence their test scores. Thus, I will explore the relationship between moms that help their sons with math, and teachers who actively teach math in their classrooms to boys, and 5th grade boy's test scores.

DATA & DESCRIPTIVE STATISTICS

I use data from the Early Childhood Longitudinal Survey, Kindergarten Class (ECLS-K), a nationally representative cohort of children, surveyed from kindergarten through middle school, along with their parents and teachers. The National Center for Education Statistics (NCES) and several education, health, and human services agencies sponsored the data collection, which was conducted by trained field staff.

The panel data was collected to examine the relationships between the child, family, school, and community. The base-year data were collected in the fall and spring of the 1998–99 school year when the children (n= 21,260) were in kindergarten. Follow-up data collection occurred when children were in first (2000), third (2002), fifth (2004), and eighth grade (2007).

The data is at the student level, with teacher and parent questionnaires being linked to each student. Children began reporting in third grade on their perceptions of abilities and achievement, interest and enjoyment in subjects, peer relationships, and problem behavior. This study will utilize data from the third and fifth grade waves of data collection. The key independent variables used to create composite variables are how many days a week a mom helps their daughter with math (grades 3 and 5) and how many days a week a teacher teaches math in the classroom (grades 3 and 5). The key dependent variables studied include (1) standardized math test scores administered by the ECLS-K in 5th grade that are normed with a mean of 50 and a standard deviation of 10; and (2) girls' perceived math competence and interest in 5th grade. I plan to focus my analysis primarily on the subgroup of girls (n= 10,448) in the sample that have complete data for both my dependent variables (n=5,674).

Table 1 presents descriptive statistics on girls' and boys' 5th grade test scores, perceived competence and interest in math, and all independent and control variables. Girls scored slightly higher (52.2) than boys (50.1) on the math assessment, and a higher percentage of girls reported a high perceived interest and competence in math (71.0%), when compared to boys (63.5%). A larger percentage of girls were more likely to have a mom that was active in their math homework (13.0%) when compared to boys (11.9%) for at least one year in 3rd or 5th grade; however, girls and boys were similarly likely to have a mom that were math active for both 3rd and 5th grade. Furthermore, girls and boys were similarly likely to have a mom that was not math active (48.9%) in either 3rd or 5th grade. However, a larger proportion of boys were more likely to have a teacher that actively taught math for both 3rd and 5th grade (73.03%), compared to girls (71.5%).

In addition, similarly to previous research, girls are less likely to report high interest and competence in all subjects studied in school (56.3%) when compared to boys (63.7%). Girls are 2.65 percentage points more likely to have a father with a math-related occupation than a mother with a math-related occupation. Most girls did not have a father that actively helps with math homework, with less than 10% of the sample having a father that reported helping with math homework in 3rd and 5th grades.

Girls that were not included in the sample differ significantly compared to the girls that were included in the sample on all nearly key independent variables, and all control variables. However, girl's mothers and teachers were highly statistically significantly less likely to report on math activity generally, which may explain the significant differences between girls in the sample receiving homework help from their mothers and being actively taught math in their classrooms and girls that were not included in the sample. Girls included in the sample were significantly less likely to be a minority race or ethnicity as well as significantly less likely to have a father that did not report on their math involvement. Furthermore, girls in the sample were significantly more likely to have a mother or father with a math occupation, have at least one parent holding a bachelor's degree. The significant differences between those included in the sample and those not included in the sample are important to consider while interpreting the analysis below.

RESULTS

The results of my regression analyses are presented in Tables 2 and 3 for girls' math scores and girl's perceived competence and interest in math. In Table 2 model (1) presents the relationship between standardized math test scores, normalized to have a mean of 50 and a standard deviation of 10, and independent variables of interest. The independent variables of interest are dummy variables representing levels of active involvement in math homework by mothers (0 involvement in grades 3 and 5, 1 year of involvement during 3rd or 5th grade, or 2 years of involvement in 3rd and 5th grade), and dummy variables representing levels of active involvement in teaching math across 3rd and 5th grade by female teachers (0 teachers involved, 1 teacher involved during 3rd or 5th grade, or teacher involved in 3rd grade and teacher involved in 5th grade) without any control variables; model (2) regresses variables in model (1), and includes controls for child characteristics (minority status of child, high interest/competence in all subjects), family characteristics (mom math occupation, at least one parent holds at least a bachelor's degree or higher, how active a dad is in math homework), and school fixed effects.

Table 3 displays the results of a logistic regression, displaying the relationship between a girl reporting a high perceived interest (coded as 1 if a girl reported a high competence and interest, and 0 if they reported low competence and interest) and competence in the subject of math and the same independent and control variables in Table 2. The models in Table 3 also follow the same specifications as the models in Table 2.

Female Role Models in Math and Girl's Math Test Scores

Table 2 reports the results from a regression with standardized math test scores as the dependent variable with and without control variables. I find partial support for my hypothesis that women helping and teaching math to young girls will induce gender stereotype threat in young girls, and young girls will score lower on math exams. Model (1) show that if moms actively help their daughters with math homework for one year in the 3rd or 5th grade, their daughter will score approximately 2.4 points lower on a math test compared to girls who receive no math homework help from their mothers. Additionally, if a mom helps her daughter in both 3rd and 5th grade, her daughter will score approximately 6.2 points lower on a math test. This means that the more a mother helps her daughter with math homework, the lower her daughter will score on the math assessment of the ECLS-K in 5th grade than a girl who has no math help from their mother in 3rd or 5th grade. Contrarily to my hypothesis, a girl with a math teacher who actively teaches math in the classroom in either 3rd or 5th grade will score 1.7 points higher on the math assessment, and a girl with a math teacher who actively teaches math in both 3rd and 5th grade will score approximately 3.4 points higher on the math assessment when compared to teachers who do not actively teach math. This means that the more years a girl has a math teacher who actively teaches math in their 3rd or 5th grade classroom, the higher a girl will score on the ECLS-K math assessment in 5th grade. Generally, this model suggests that moms helping their daughters with math homework will decrease their 5th grade daughter's test scores, and a teacher actively teaching math in their classroom will increase 5th grade girl's scores relative to girls who have no math help from their mothers or teachers. However, this model is potentially upwardly biased as it does not control for child, family, or school characteristics.

Model (2) reports results from a regression including controls for school fixed effects, student characteristics, and family characteristics. This model also partially supports my hypothesis, similarly to model (1). A highly statistically significant relationship remains between the dummy variables representing mother's active help with math homework, and the coefficients on math active mom 1 year and math active mom 2 years remain relatively unchanged between the two models. Relative to a mother who does not help her daughter with math homework, a mother who helps her daughter with math homework in one year has math scores lower by 2.2 points on average. This is a minimal reduction in test score points when considered on one test; however, if this test score deficit accumulated over years it could become a larger issue for a young girl. When controls are added to this model, the significant positive impact of female teachers actively teaching math in their classrooms in 3rd and 5th grade disappears, and teachers are no longer a significant predictor for 5th grade girl's math scores.

Female Role Models in Math and Girl's Perceived Interest and Competence in Math

Table 3 reports the results from logistic regression analyses with a girl's perceived interest and competence in math (high=1; low=0) as the dependent variable with and without any control variables. My hypothesis that women helping and teaching math to young girls will induce gender stereotype threat in young girls, and young girls will have lower perceived math competence and interest in 5th grade is supported, in part, by this analysis. A mom's active help with math homework is statistically significantly and negatively associated with a girl's interest and competence in math both when a mom helps for one year in 3rd or 5th grade and when a mom helps with homework in both 3rd and 5th grades when compared to girls with no math homework help from their mothers. A girl having a math active mom for one year, versus girls with math active moms for no years, decreases the log odds of having high perceived interest and competence in math by .383. Girls' having a math active mom for two years, versus girls with math active moms for no years, decreases the log odds of having high perceived interest and competence in math by .732. My hypothesis that female teachers actively teaching math in their classrooms will induce stereotype threat similarly to moms and negatively influence girls' competence and interest in math is not supported by this model.

Model (2) includes controls for child and family characteristics. My hypothesis continues to be partially supported by the statistically significant, negative, association between a mom actively helping their daughter with math homework and girl's lower perceived competence and interest in math. The statistically significant association between girls's perceived interest and competence in math in 5th grade and mom's active math homework help remains strongly negatively associated. A girl having a math active mom for one year, versus girls with math active moms for no years, decreases the log odds of having high perceived interest and competence in math by .416. Girls' having a math active mom for two years, versus girls with math active moms for no years, decreases the log odds of having high perceived interest and competence in math by .694. Analogues estimations were found with a probit regression.

Do Female Role Models in Math Influence Boy's Test Scores Similarly to Girl's?

Next, I wanted to test whether my hypothesis that female role models in math will induce gender stereotype threat in young girls is a function of gender stereotype threat, or a function of how all children will be influenced by female role models in math. Table 4 reports the analogous results to Table 2 for boys only. I find partial support for the alternative hypothesis that women helping and teaching math to young boys will negatively influence boy's test scores.

Model (1) show that if moms actively help their sons with math homework for one year in the 3rd or 5th grade, their son will score approximately 3.7 points lower on a math test compared to boys with no math help from their mother. Additionally, if a mom helps her son in both 3rd and 5th grade, her son will score approximately 5.5 points lower on a math test. This means that the more a mother helps her son with math homework, the lower her son will score on the math assessment of the ECLS-K in 5th grade than a boy who has no math help from their mother in 3rd or 5th grade. No significant associations between how active a female teacher is teaching math in their classroom and boy's math test scores. Generally, this model suggests that moms helping their sons with math homework will decrease their 5th grade son's test scores compared to boys who receive no math homework help from their moms on average, which is a similar effect found with moms and 5th grade girls. However, this model is potentially upwardly biased as it does not control for child, family, or school characteristics if the controls are significantly and positively associated with test scores or perceived competence and interest in math.

Model (2) reports results from a regression including controls for school fixed effects, student characteristics, and family characteristics. This model also partially supports the alternative hypothesis, similarly to model (1). A highly statistically significant relationship remains between the dummy variables representing mother's active help with math homework, and the coefficients on math active mom 1 year and math active mom 2 years. A mother helping with math homework in either 3rd or 5th grade will decrease her son's math score by 3.86 points, and a mother helping with math homework in both 3rd and 5th grade will decrease her son's math score by 4.43 points, both compared to boys who receive no homework help from their mothers. Generally, model (2) displays an increasingly negative relationship between amount of time mom spends helping her son with math and her son's math test scores. However, no statistically significant relationship exists between how often a female math teaches covers math material in her classroom and 5th grade boy's test scores.

Does a Composite Variable of Female Role Models in Math Yield a Decrease in 5th Grade Girl's Math Test Scores?

The next sensitivity check was to make a continuous composite variable (range: 0-6) for all female role models to test if an aggregation of female role models would yield the same results as the models in Table 2. However, mother having a math occupation was not controlled for in Table 5. The composite of all female role models in math was created by adding 1 point to the composite variable if a woman reported each of the following: mom helping daughter with math homework in 3rd grade, mom helping daughter with math homework in 5th grade, teacher actively teaching math in 3rd grade, teacher actively teaching math in 5th grade. Additionally, 2 points were added to the composite variable if a mother had a math occupation. Moms having a math occupation was given more weight than a woman helping or teaching a young girl with math in one year because young girls will not only see the woman that helps them with math as a math role model while working together, but will receive the message that their mother is not only viewed as competent in math by them but by the world as well.

Table 5 reports the results from a regression with standardized math test scores as the dependent variable with and without control variables using a composite measure of female role models as the independent variable of interest. I find support for my hypothesis that women helping and teaching math to young girls will negatively influence girl's scores, presumably through gender stereotype threat as a mechanism. Model (1) displays that as the composite increases, or for each additional female role model a girl has, test sores decrease by 1.2 points on average.

Model (2) reports results from a regression including controls for school fixed effects, student characteristics, and family characteristics. This model also supports my hypothesis. A highly statistically significant negative association remains between the composite female role model in math and girl's math test scores. Generally, this model shows a similar negative effect of female role models in math on girl's test scores as the models in Table 2.

Does a Composite Variable of Female Role Models in Math Have a Negative Association with Girl's Perceiving Their Competence and Interest in Math as High?

The composite variable for all female role models was tested in a logistic regressions model with 5th grade girl's perceived competence and interest in math as the dependent variable in Table 6. Similarly to the models in Table 5, mother having a math occupation was not controlled for in Table 6.

Table 6 reports the results from logistic regression analyses with a girl's perceived interest and competence in math (high=1; low=0) as the dependent variable with and without any control variables. My hypothesis that women helping and teaching math to young girls will induce gender stereotype threat in young girls, and young girls will have lower perceived math competence and interest in 5th grade is supported, by this analysis. The relationship between a composite measure of female role models and girl's perceived competence and interest in math is highly statistically negatively associated. For every additional role model a girl has the log odds of having high perceived competence and interest in math, versus low perceived competence and interest in math, decreases by .189.

Model (2) includes controls for child and family characteristics. My hypothesis continues to be supported by the statistically significant, negative, association between female role models in math and girl's lower perceived competence and interest in math. The statistically significant association between girls' perceived interest and competence in math in 5th grade and female role models in math remains strongly negatively associated. For every additional role model a girl has the log odds of having high perceived competence and interest in math, versus low perceived competence and interest in math, decreases by .226. Analogues estimations were found with a probit regression.

LIMITATIONS

There are several limitations that should be taken into account when interpreting these results. One limitation is that there may be measurement errors in my key independent variable that are biasing my results such as their older siblings. Siblings may be even more important than parents when helping with math homework, as they may better understand new approaches to learning and have more free time to help their younger siblings with math. Controlling for direct sibling involvement on math homework, or a general measure of total family involvement in math homework would be helpful in accounting for this potentially omitted variable. If the measurement error of not including sibling involvement in math homework is randomly distributed in my sample, random measurement error will occur. I would expect in this case the results to be biased towards zero. Alternatively, if siblings are more active in math homework when parents are active in math homework, then the measurement error may make the impact of role models appear smaller than it is in truth. Another explanation is that siblings might help more with math homework when parents are not present in helping with math homework, and they may be serving as a substitute. This measurement error may make the impact of role models appear larger than it is in truth. It is unclear which of these explanations may be true, so the direction of the bias in this case.

Additionally, an issue of potential measurement error is that children may conceptualize math experts differently than measured here, and there could be an issue with my construct validity. A child may not equate more time with an adult working on math with how knowledgeable they are in math. Perhaps children view adults as math experts when they quickly solve a problem for the child, rather than using scaffolding techniques to support a child's personal math expertise. If children are judging who is and is not a math expert using information other than time spent on math, the measure of children's conceptualization of math experts will be in the error term, rather than picked up by my independent variables of interest.

A third issue of measurement issue with my independent variable of interest is that it might be identifying other phenomenon unrelated to gender stereotype threat or role models and addressing a different research question altogether. Perhaps children who are struggling with math, and would get lower test scores regardless, get more math help at home from their mothers. This is supported by evidence in Table 2 and Table 4 suggesting that both boys and girls both perform increasingly lower on math exams the more math help they get from their mothers. Controlling for previously math test scores in future work would help to elucidate if this might be an explanation for my findings.

Other instances of measurement error might also be occurring. Teacher gender is not reported in the 3rd and 5th grades, so I have imputed it as female for the purposes of this study. Although the Schools and Staffing Survey (SASS) of 2011 reported 74% of third grade teachers in the United States to identify as female, and 75% of fifth grade teachers in the United States to identify as female, the 25% of the sample that may have a true gender of male in my sample may be exerting important influences on the outcome variables. If my sample contains approximately 25% men, as the SASS survey indicates is nationally representative, and my hypothesis that women reduce girls' test scores and perceived competence and interest in math, then the girls taught by male teachers the true effect of having a female teacher would be lower than I observed in this study. Essentially, those girls' test scores would be more negatively impacted than the current analysis predicts.

Discussion

Young girls are entering school in kindergarten scoring similarly to boys on math assessments, and falling behind quickly by the time they are in fifth grade (Levitt & Fryer, 2009). Scoring lower on math assessments may lower confidence and interest in math, and other STEM fields among young girls, which ultimately may have negative impacts for America's STEM workforce and limit diversity. Factors that may negatively influence girl's math test scores, interest, and perceived competence are essential to understand in order to craft policies that will support young girls in STEM. The present study examines the relationship between female role models in math and girl's short and long term outcomes related to math. The relationship is studied using girl's math test scores and girl's perceived competence and interest in math.

This study finds that mother's involvement in girl's math homework, but not teacher's active teaching of math in their classroom has a highly statistically significant and negative relationship with girl's math test scores in 5th grade and girl's perceived competence and interest in math in 5th grade. The more a mother is involved in helping with math homework in 3rd and 5th grades, the stronger the negative statistically significant relationship becomes. To my knowledge, this study is the first to provide potential support for the multi-threat framework's hypothesis that young girls may experience in-group threat to self when working with mother's as roles models in math on their math homework.

Female role models have been found to boost confidence and interest in math for adult women (Halpern, Diane, Aronson, Reimer, Simpkins, Star, Wentzel, 2007); however, little is known about the effect of female role models on math performance for young girls. Perhaps female math role models can bolster young girl's performance, but I argue here that mothers may in fact hinder performance. The policy implications of such a finding are important to consider carefully and critically. Previous research finds that STEM is a field where women and girls do not feel they belong (Farenga & Joyce, 1999), which is a contributing factor to gender stereotype threat. A potential policy that could attempt at reducing the negative impact this study finds on moms helping their daughters with math, is to increase efforts to reduce negative gender stereotypes. If negative gender stereotypes surrounding women, girls, and math can be reduced or eliminated, then the relationship between negative math test performance for young girls and moms helping with math homework may be reduced to zero, or perhaps become a positive relationship. This could work towards closing the gender gap in math achievement, and potentially reducing the gender gap in STEM employment.

Table 1. Descriptive Statistics by Gender Using Data from the 3rd and 5th Grade Waves of the ECLS-K

Variable	Girls (N=5,674) In Sample	Girls (N=5, 276) Dropped From Sample	*T*	Boys (N=5,596)
	M			*M*
Key Dependent Variables[1]				
Math Score[2]	52.2			50.1
High Math Interest/Competence (%)[3]	71.0			63.5
Key Independent Variables[4]				
	M	*M*		*M*
Math Active Mom 0 Years (%)	48.9	2.5	64.47***	48.9
Math Active Mom 1 Year (%)	13.0	0.6	25.98***	11.9
Math Active Mom 2 Years (%)	1.3	0.09	7.42***	1.3
Did Not Report Mom's Math Activity (%)	36.8	96.7	-84.96***	37.9
Math Active Teacher 0 Years (%)	.09	0.02	1.54	.05
Math Active Teacher 1 Year (%)	6.0	0.08	18.10***	5.65
Math Active Teacher 2 Years (%)	71.5	0.63	112.44***	73.03
Did Not Report Teacher's Math Activity (%)	22.4	99.3	-130.00***	21.27
Control Variables[5]				
Child Characteristics				
Minority Race (%)	42.2	46.9	-5.02***	43.1
High Interest/Competence in All Subjects (%)	56.3	27.3	1.94*	63.7
Family Characteristics				
Mom Has Math Occupation (%)	1.1	0.06	7.06***	0.79
Dad Has Math Occupation (%)	3.75	0.17	13.43***	3.72
At Least One Parent Holds a Bachelor's Degree	47.0	2.20	48.61***	46.8
Math Active Dad 0 Years (%)	53.14	2.90	69.53***	51.82
Math Active Dad 1 Year (%)	8.41	0.36	20.61***	8.90
Math Active Dad 2 Years (%)	0.74	0.00	6.27***	0.52
Did Not Report Dad's Math Activity (%)	37.72	96.74	-83.35***	38.76

p<.001***, *p*<.05**, *p*<.10*

Notes: Sample size displayed here is based on the sample for which all cases had non-missing values on both dependent variables (N = 11,270). The original sample consisted of 21,409 children, and 10,139 observations were dropped. 5, 276 girls were dropped for this analysis; 5, 269 were missing test score data, 6 were missing both test score and perceived interest and competence data, and 1 was missing just perceived interest and competence data. The majority of dropped observations for both boys and girls were missing data on both math test scores and math competence and interest scores (N= 10,115), 24 cases were dropped because they were missing one or the other.

[1] Variables from 5th grade data collection wave, one observation per child

[2]Standardized mean scores, mean of approximately 50 with a standard deviation of 10

[3]Item is coded as a 1 (high math interest) or a 0 (low math interest). This variable was created from a self-description questionnaire question about perceived competence and interest in math, scored as (1) not at all true, (2) a little bit true, (3) mostly true, or (4) very true. If children responded (3) or (4) I coded them as having high competence and interest in math, and if they responded (2) or (1) I coded them as having low competence and interest in math. The self-description questionnaire items for math consisted of the following items: Work in math is easy for me; I cannot wait to do math each day; I get good grades in math; I am interested in math; I can do very difficult problems in math; I like math; I enjoy doing work in math; I am good at math.

[4]Varibles are a composite of data collected in the 3rd grade and 5th grade wave, so each child had two observations that went into making this variable. The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. A mom is considered math active for one year if she reported helping her daughter on math homework 3 or more days a week in either 3rd or 5th grade; a mom is considered math active for two years if she reported helping her daughter on math homework 3 or more days a week in both 3rd and 5th grade. A teacher is considered math active for one year if she reported teaching math in her classroom 3 or more days a week in either 3rd or 5th grade; a teacher is considered math active for two years if she reported teaching math in her classroom 3 or more days a week in both 3rd and 5th grade.

[5]Variables from 5th grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

Table 2. Regression Results for Girls' Math Test Scores

Dependent Variable: Standardized Math Scores[1]	(1)	(2)
Math Active Mom 1 Year[2]	-2.432***	-2.224***
	(0.375)	(0.442)
Math Active Mom 2 Years[3]	-6.246***	-6.536***
	(1.063)	(1.109)
Math Active Teacher 1 Year[4]	1.710**	0.514
	(0.839)	(3.401)
Math Active Teacher 2 Years[5]	3.357***	1.333
	(0.677)	(3.387)
Child Characteristics[6]		
Minority Race		-2.325***
		(0.389)
High Interest/Competence in All Subjects		3.209***
		(0.273)
Family Characteristics[7]		
Mom Math Occupation		2.976*
		(1.657)
At Least One Parent Holds a Bachelor's Degree or Higher		3.243***
		(0.318)
Math Active Dad 1 Year		-2.571***
		(0.452)
Math Active Dad 2 Years		-5.324***
		(1.667)
Did Not Report Dad's Math Activity		-3.236**
		(1.515)
Observations	5,596	5,596
R-squared	0.063	0.544

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, model 2 controls for school fixed effects. If a cell is left blank the variable in that row was not included in the model.

[1] Variables from 5th grade data collection wave, one observation per child, standardized to have a mean of approximately 50 and a standard deviation of 10.

[2] The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping

with math homework in 3rd or 5th grade for 3 or more days a week, and teachers who reported not teaching math in their classroom more than 3 days a week in 3rd or 5th grade. A mom is considered math active for one year if she reported helping her daughter on math homework 3 or more days a week in either 3rd or 5th grade.

[3]The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week. A mom is considered math active for two years if she reported helping her daughter on math homework 3 or more days a week in both 3rd and 5th grade. Mothers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.

[4] The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week. A teacher is considered math active for one year if she reported teaching math in her classroom 3 or more days a week in either 3rd or 5th grade.

[5] The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3rd and 5th grade for 3 or more days a week. A teacher is considered math active for two years if she reported teaching math in her classroom 3 or more days a week in both 3rd and 5th grade. Teachers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.

[6,7]Variables from 5th grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

Table 3. Logistic Regression Results for Girls' Perceived Interest and Competence in Math

Dependent Variable: Perceived Interest and Competence in Math[1]	(1)	(2)
Math Active Mom 1 Year[2]	-0.383***	-0.416***
	(0.0881)	(0.0997)
Math Active Mom 2 Years[3]	-0.732***	-0.694***
	(0.235)	(0.258)
Math Active Teacher 1 Year[4]	1.299	1.028
	(1.217)	(0.876)
Math Active Teacher 2 Years[5]	1.292	1.071
	(1.211)	(0.867)
Child Characteristics[6]		
Minority Race		0.109
		(0.0678)
High Interest/Competence in All Subjects		2.068***
		(0.0638)
Family Characteristics[7]		
Mom Math Occupation		0.785*
		(0.421)
At Least One Parent Holds a Bachelor's Degree or Higher		0.0676
		(0.0701)
Math Active Dad 1 Year		0.304
		(0.322)
Math Active Dad 2 Years		-0.135
		(0.334)
Did Not Report Dad's Math Activity		-0.588
		(0.454)
Observations	5,596	5,596

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. If a cell is left blank the variable in that row was not included in the model. Analogues estimations were found with a probit regression.

[1]Item is coded as a 1 (high math interest) or a 0 (low math interest). This variable was created from a self-description questionnaire question about perceived competence and interest in math, scored as (1) not at all true, (2) a little bit true, (3) mostly true, or (4) very true. If children responded (3) or (4) I coded them as having high competence and interest in math, and if they responded (2) or (1) I coded them as having low competence and interest in math. The self-description questionnaire items for math consisted of the following items: Work in math is easy for me; I cannot wait to do math each day; I get good grades in math; I am interested in math; I can do very difficult problems in math; I like math; I enjoy doing work in math; I am good at math.

[2]The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week, and teachers who reported not teaching math in their classroom more than 3 days a week in 3rd or 5th grade. A mom is considered math active for one year if she reported

helping her daughter on math homework 3 or more days a week in either 3^{rd} or 5^{th} grade.
[3]The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping with math homework in 3^{rd} or 5^{th} grade for 3 or more days a week. A mom is considered math active for two years if she reported helping her daughter on math homework 3 or more days a week in both 3^{rd} and 5^{th} grade. Mothers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.
[4]The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3^{rd} or 5^{th} grade for 3 or more days a week. A teacher is considered math active for one year if she reported teaching math in her classroom 3 or more days a week in either 3^{rd} or 5^{th} grade.
[5] The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3^{rd} and 5^{th} grade for 3 or more days a week. A teacher is considered math active for two years if she reported teaching math in her classroom 3 or more days a week in both 3rd and 5^{th} grade. Teachers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.
[6,7]Variables from 5^{th} grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

Table 4. Regression Results for Boy's Math Test Scores

Dependent Variable: Standardized Math Scores[1]	(1)	(2)
Math Active Mom 1 Year[2]	-3.730***	-3.864***
	(0.392)	(0.424)
Math Active Mom 2 Years[3]	-5.483***	-4.433***
	(0.847)	(1.086)
Math Active Teacher 1 Year[4]	-1.839	4.540
	(6.774)	(4.895)
Math Active Teacher 2 Years[5]	-1.490	3.725
	(6.756)	(4.881)
Child Characteristics[6]		
Minority Race		-1.623***
		(0.437)
High Interest/Competence in All Subjects		2.620***
		(0.275)
Family Characteristics[7]		
Mom Math Occupation		1.816
		(1.220)
At Least One Parent Holds a Bachelor's Degree or Higher		3.223***
		(0.335)
Math Active Dad 1 Year		-3.372***
		(0.524)
Math Active Dad 2 Years		-3.551**
		(1.510)
Did Not Report Dad's Math Activity		-1.389
		(1.348)
Observations	5, 674	5,674
R-squared	0.066	0.535

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, model 2 controls for school fixed effects. If a cell is left blank the variable in that row was not included in the model.

[1] Variables from 5th grade data collection wave, one observation per child, standardized to have a mean of approximately 50 and a standard deviation of 10.

[2]The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week, and teachers who reported not teaching math in their classroom more than 3 days a week in 3rd or 5th grade. A mom is considered math active for one year if she reported helping her son on math homework 3 or more days a week in either 3rd or 5th grade.

[3]The variables are dummy coded as 1 if true, and 0 if not true. The reference category is moms that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week. A mom is considered math active for two years if she reported helping her son on math homework 3 or more days a week in both 3rd and 5th grade. Mothers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.
[4] The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3rd or 5th grade for 3 or more days a week. A teacher is considered math active for one year if she reported teaching math in her classroom 3 or more days a week in either 3rd or 5th grade.
[5] The variables are dummy coded as 1 if true, and 0 if not true. Gender of teachers is imputed as female. The reference category is teachers that reported not helping with math homework in 3rd and 5th grade for 3 or more days a week. A teacher is considered math active for two years if she reported teaching math in her classroom 3 or more days a week in both 3rd and 5th grade. Teachers who did not report on their math activity and had missing data were also included as a dummy variable in this regression.
[6,7]Variables from 5th grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

Table 5. Regression Results for Girls' Math Test Scores with Composite Female Role Model Measure

Dependent Variable: Standardized Math Scores[1]	(1)	(2)
Female Role Model Composite[2]	-1.201***	-2.013***
	(0.316)	(0.362)
Child Characteristics[3]		
Minority Race		-2.439***
		(0.556)
High Interest/Competence in All Subjects		3.313***
		(0.396)
Family Characteristics[4]		
At Least One Parent Holds a Bachelor's Degree or Higher		3.206***
		(0.415)
Math Active Dad 1 Year		-2.414***
		(0.537)
Math Active Dad 2 Years		-5.500***
		(1.717)
Did Not Report Dad's Math Activity		-2.003
		(2.290)
Observations	2, 847	2,847
R-squared	0.006	0.546

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, model 2 controls for school fixed effects. If a cell is left blank the variable in that row was not included in the model.

[1] Variables from 5th grade data collection wave, one observation per child, standardized to have a mean of approximately 50 and a standard deviation of 10.

[2]This variable is a composite variable for all female role models to test if an aggregation of female role models would yield the same results as the models in Table 2. The composite of all female role models in math was created by adding 1 point to the composite variable if a woman reported each of the following: mom helping daughter with math homework in 3rd grade, mom helping daughter with math homework in 5th grade, teacher actively teaching math in 3rd grade, teacher actively teaching math in 5th grade. Additionally, 2 points were added to the composite variable if a mother had a math occupation. Moms having a math occupation was given more weight than a woman helping or teaching a young girl with math in one year because young girls will not only see the woman that helps them with math as a math role model while working together, but will receive the message that their mother is not only viewed as competent in math by them but by the world as well.

[4,5]Variables from 5th grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

Table 6. Logistic Regression Results for Girls' Perceived Interest and Competence in Math with Composite Female Role Models

Dependent Variable: Perceived Interest and Competence in Math[1]	(1)	(2)
Female Role Model Composite[2]	-0.189***	-0.226***
	(0.0687)	(0.0765)
Child Characteristics[3]		
Minority Race		0.0433
		(0.0989)
High Interest/Competence in All Subjects		2.138***
		(0.0905)
Family Characteristics[4]		
At Least One Parent Holds a Bachelor's Degree or Higher		0.0618
		(0.0907)
Math Active Dad 1 Year		0.0161
		(0.392)
Math Active Dad 2 Years		-0.443
		(0.404)
Did Not Report Dad's Math Activity		-1.000*
		(0.533)
Observations	2, 847	2,847
R-squared	0.006	0.546

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. If a cell is left blank the variable in that row was not included in the model. Analogues estimations were found with a probit regression.

[1]Item is coded as a 1 (high math interest) or a 0 (low math interest). This variable was created from a self-description questionnaire question about perceived competence and interest in math, scored as (1) not at all true, (2) a little bit true, (3) mostly true, or (4) very true. If children responded (3) or (4) I coded them as having high competence and interest in math, and if they responded (2) or (1) I coded them as having low competence and interest in math. The self-description questionnaire items for math consisted of the following items: Work in math is easy for me; I cannot wait to do math each day; I get good grades in math; I am interested in math; I can do very difficult problems in math; I like math; I enjoy doing work in math; I am good at math.

[2]The reference category is no female role models for any years. This variable is a composite variable for all female role models to test if an aggregation of female role models would yield the same results as the models in Table 2. The composite of all female role models in math was created by adding 1 point to the composite variable if a woman reported each of the following: mom helping daughter with math homework in 3rd grade, mom helping daughter with math homework in 5th grade, teacher actively teaching math in 3rd grade, teacher actively teaching math in 5th grade. Additionally, 2 points were added to the composite variable if a mother had a math occupation. Moms having a math occupation was given more weight than a woman helping or teaching a young girl with math in one year because young girls will not only see the woman that helps them with math as a math role model while working together, but will receive

the message that their mother is not only viewed as competent in math by them but by the world as well.
[4,5]Variables from 5th grade data collection wave and were all dummy coded as 1 if true, and 0 if not true. High interest/competence in all subjects is created and coded equivalent to the variable perceived competence and interest in math, and math active dad is coded equivalent to the math active mom variable.

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