Gendered STEM Beliefs and Major Choice

Nicole T. Cesanek
Gettysburg College

Benjamin J. Durham
Gettysburg College

Gendered STEM Beliefs and Major Choice

Abstract

Beliefs and expectations about who can and should pursue STEM careers contribute to a student's sense of STEM identity and may help to explain the gender gap in pursuing STEM in higher education. The formation of these beliefs is a long and complex process, starting very early on in an individual's life. We analyze how gendered STEM beliefs of students, parents, and teachers in ninth grade affect a female student's probability of majoring in STEM in college. We add to an analysis done by Sansone (2019) in an appendix of his paper by using actual majors instead of intended majors. We slightly alter Sansone's model and find a positive effect of beliefs in female superiority in science, both at the student and teacher level.

Keywords

STEM, higher education, gender economics

Disciplines

Economics | Higher Education | Women's Studies

Comments

Written for ECON 302: Gender Issues in Economics

Nicole Cesanek

Benjamin Durham

ECON 302

April 10th, 2023

Gendered STEM Beliefs and Major Choice

Abstract

Beliefs and expectations about who can and should pursue STEM careers contribute to a student's sense of STEM identity and may help to explain the gender gap in pursuing STEM in higher education. The formation of these beliefs is a long and complex process, starting very early on in an individual's life. We analyze how gendered STEM beliefs of students, parents, and teachers in ninth grade affect a female student's probability of majoring in STEM in college. We add to an analysis done by Sansone (2019) in an appendix of his paper by using actual majors instead of intended majors.. We slightly alter Sansone's model and find a positive effect of beliefs in female superiority in science, both at the student and teacher level.

Introduction

Women are underrepresented in most STEM occupations and in higher education, but the causes of these gaps may originate earlier on in the educational experience. Students' perceptions about STEM and their self-perceived ability to pursue STEM form very early on in their lives. These perceptions include beliefs about the relative abilities of men and women in math and science. The observed gaps likely grow as students enter formal schooling. In this paper, we will focus on how female students' self-perceptions of women's math and science ability relative to men affect these students' long-term decision-making. We extend Sansone (2019), who examined whether students' beliefs about men's and women's relative abilities in STEM affected female students' intended major in college in the appendix of his paper. We make use of more recent data including the actual majors of these students. Descriptively, as shown in Figure 1, we see that female students who believe women are better in science are more likely to end up majoring in STEM than those who believe that there is no gender difference in science ability. Students who do not believe in these differences also appear to be more likely to major in STEM than those who believe men are better at science. Our empirical findings generally align with these descriptive results.

Background Research

The development of gendered beliefs is a long and complex process. Gendered STEM perceptions observed at any given time are the product of an individual's experiences and outside influences leading up to that time. We posit that a student's decision-making is shaped by two main influences: their home environment and their educational environment. These two environments shape an individual's gendered beliefs which are then reflected in their self-perceived STEM identity.

Economics of Identity

Understanding the formation of students' STEM identity may be vital in narrowing the employment gap for women and other historically underrepresented groups in STEM. Akerlof and Kranton introduce the concepts of identity, social norms, and ideals into economics (2010). Akerlof and Kranton (2010) suggest we should consider other important aspects of individuals' behavior and how these behaviors and perspectives impact individuals' economic decision-making (Akerlof and Kranton 2010). Building on this identity utility framework, we posit that students may or may not identify as "STEM people" based on their gendered beliefs about STEM identity. As such, pursuing activities that fit into the norms and ideals that define what a "STEM person" is relatively more costly to women if they believe that women are, on average, not "STEM people."

A variety of factors in an individual's upbringing may influence women, resulting in them being less likely to select STEM courses during high school and thus make it more difficult to pursue STEM in college or university. If the cost of pursuing a STEM degree is too high, then more women will choose not to pursue STEM, which could explain part of the gender gap in STEM higher education.. As such, it is important to recognize how early these gendered beliefs emerge, since these beliefs may result in gender gaps in measured STEM ability that grow over time.

An important aspect of STEM identity lies in a student's gendered perceptions of math and science ability. For example, one reason why a female student may not identify herself as a "STEM person" may be because of accumulated beliefs and experiences that make them believe that women are not as good at math and science, which in turn influences this student's beliefs about her own ability and may result in her deciding not to pursue STEM beyond high school.

This could in part be the result of stereotype threat if women like this underperform solely because they have a belief that women are less able than men in these subjects (Smith and Hung 2008). In fact, there is some research showing that women are at least as able as men in STEM, if not more able. Ceci et al. (2014) finds that female PhD applicants in quantitative fields perform just as well as men, if not better. Therefore, such stereotypes are not founded, and may even contradict reality. Eroding these stereotypical beliefs may play a role in getting more women into STEM fields.

Home Environment

There are many aspects to an individual's home life that can impact her STEM identity, such as the views and actions of an individual's parents or guardians. Sansone (2019) assesses parental gender attitudes in math and science stating that 30 percent of parents believed men were better than women in math and 21 percent believed the same in science. Conceivably, parents' beliefs influence the beliefs of their children. If parents express gender stereotypes in their interactions with their children, these children may internalize their parents' beliefs and contribute to the formation of gender stereotypes.

Other factors in the home can contribute to a student's STEM readiness and preparation. Speer (2013) argues that skill differences that are developed by the time of college entry are caused by factors such as parental investment and parental expectations. This means that the more time parents spend with their child outside of the typical school day to build their academic skills, the better they will do in school. However, depending on several different factors, this is not always feasible for some parents for reasons such as time limitations, which may be more prominent in lower-income families where both parents must work. Supporting this line of reasoning, Ware and Lee find that high SAT math scores and highly educated parents are positive predictors of majoring in science (1985). One possible explanation for this finding is that a child from a household with parents who work in STEM may have extra support and encouragement to pursue STEM which could allow them to get better grades and perform better on standardized tests. Evidently, this parental support may be conditional on a parent's gendered beliefs about STEM careers, which could result in more men expressing the characteristics that are used to measure STEM readiness. These grades and test scores are often used as proxies of ability to explain gender gaps in STEM, when they may better assess the availability of support and resources.

Finally, household demographics and income may also affect an individual's upbringing, therefore impacting her preconceived notions of gender as well as their STEM identity. For example, if an individual comes from a white, upper-class family, they are most likely going to have the resources and support to pursue degrees that require higher levels of prior preparation, such as STEM degrees. Conversely, if an individual comes from a low-income neighborhood and is a member of a marginalized group, they might not have the resources and support to take on these academic challenges.

Educational Environment

A student's educational environment also plays a role in the formation of her STEM identity. This effect may be largely driven by teachers, as students interact extensively with their teachers on a daily basis. For this reason, teachers may significantly influence their students' decision whether or not to pursue higher education and if so, what major they will choose. One way this occurs is through teacher demographic characteristics. Egalite and Kisida (2018) find that there is a negative relationship between teacher–student gender mismatch and student self-reported academic perceptions and attitudes. These attitudes may include feeling cared for, interest and enjoyment of classwork, level of happiness in class, and college aspirations. If students do not enjoy their classwork or feel happy in class, this could discourage them from pursuing similar course content in college. There is also an argument that demographic characteristics affect expectations in the classroom. Sanone (2019) notes that there are increases in STEM expectations when students and teachers share the same demographic characteristics.

Further, supplementing Sansone's findings, Bottia et al. (2015) finds that having more female STEM faculty increases female students' likelihood of pursuing STEM opportunities beyond high school. When young individuals see people that look like them represented in different fields, it could inspire and encourage them to also pursue those fields through role model effects. Beyond the encouragement to enter into the field, Sansone (2019) also finds that teacher gender can also impact student motivation and overall academic outcomes. This is also supported by the findings of Carrell et al. (2010) who found a small positive effect of female teachers on female student performance. In addition, Sansone (2019) finds male students were less likely to express biased beliefs about gendered STEM ability when matched with female teachers , showing teachers' power over student beliefs and identity.

However, not all of the evidence on role model effects is positive or significant. Griffith and Main (2021) did not find a significant impact of female teaching assistants on female students' persistence in engineering majors. In addition, Price (2010) finds that female students were less likely to persist in STEM when paired with female instructors. Overall, the impact of female role models is far from settled, and thus requires further research.

In addition to the potential effects of teachers, the school environment and opportunities could also contribute to the formation of STEM identity. Equitable access to extracurricular STEM programs could help to close gender gaps by encouraging both male and female students to get involved in STEM at an early age. Further, schools with content-area specialization or departmentalization may increase access to teachers with specialization in STEM fields. Darolia et al. (2020) suggest that STEM interventions could play a role in a student's future decision to major in STEM. This could mean that school activities like science fairs or school programs that pair students with math or science mentors could have long-term positive impacts.

Taken together, these findings suggest that factors during high school including classroom environment and teacher characteristics including race and gender all may play important roles in a female student's choice to major in STEM. These characteristics contribute to a student's sense of STEM identity which in turn determines how costly it is for a student to pursue a STEM major in college.

Data

Following Sansone (2019), we use the High School Longitudinal Study (HSLS). The HSLS is a longitudinal, nationally representative study that first observed students in ninth grade in 2009 and followed up with these students several times between 2009 and 2018. The HSLS captures not only student characteristics through questionnaires administered to students, but also includes information gathered during the earlier waves of the study from parents, teachers, and school administrators. These surveys contain information about various aspects of the student's life, the school the student attended, the student's home environment, and the student's classroom experiences in ninth grade. For our purposes, we use data from the first wave and the most recent wave, which includes these student's college majors. We follow Sansone (2019) in our selection of control variables for our model. Table 1 contains the summary statistics for our explanatory variables and select control variables.

The questionnaires administered to students, parents, and teachers all contained questions about how each of these people perceived women's ability in math and science relative to men's ability in math and science. These questions typically stated a sentence like "men are better than women at science" and then asked the respondent to gauge how much they agree or disagree with the statement on a Likert scale ranging from "strongly agree" to "strongly disagree." For the purposes of this paper, we code responses of individuals who agree or strongly agree with the statement that "men are better than women at science" as 1 for the variables indicating if respondents believe men are better at science. We construct variables for parents' and teachers' perceptions in the same way. We introduce an alternative version of our outcome variable in a later section.

Questionnaires administered to students also gauged how students assessed their teachers and classroom environments on a variety of dimensions. From this, we draw several controls, including whether the student believes that the teacher values and considers student ideas, the teacher treats male and female students differently, the student believes that the teacher thinks every student can succeed in the relevant subject, and the teacher makes the subject interesting. Evidently, these are subjective measures collected from the student's point of view, so this must be considered when interpreting our results. Student questionnaires also provide one of our school-level controls, namely whether or not the student feels safe at school. We also have data about the student's score on a standardized math test in ninth and eleventh grade, which we use as a proxy for "STEM ability."

Teacher questionnaires also provide a variety of information about a student's ninth grade math and science teacher. This information includes the teacher's highest level of education, whether the teacher majored in STEM for their bachelor's degree and the number of years the teacher has taught either math or science at the student's school. The administrator questionnaires provide more information about some relevant aspects of the school environment, including the availability of remedial math courses, whether or not the school hosted a math science fair, and if students are paired with a math or science mentor.

Parent questionnaires also include information on demographics, household income, and other aspects of the parent-child relationship that could be relevant to a child's decision-making about whether to major in STEM. These include the child's mother's and father's education, whether each parent works in a STEM field, whether the parent helps their child with homework, and whether the parent engages in other out-of-school intellectual activities with their child.

A follow up questionnaire to the student includes information on each student's major, if applicable. For our analysis, we choose to only include students who attend college. Therefore, the Major STEM variable is set to 1 if a student attended college and majored in STEM, and set to 0 if the student attended college and did not major in STEM.

Methods

As stated above, we follow the approach of Sansone (2019), who analyzed how gendered STEM beliefs and student-perceived teacher characteristics affect the probability of a female student expressing intent to study STEM in college, assessed early on in a student's college career. Following this, we build on the study using the same approach, but now with the updated outcome variable of whether or not the student actually studied STEM during college.

To do this, we estimate linear probability models (LPMs) with the key outcome measure as a binary variable indicating whether the student majored in STEM in college:

$$STEM_i = \beta_0 + \beta_1 C_i + \beta_2 T_i + \beta_3 S_i + \beta_4 P_i + \beta_5 I_i + \beta_6 A_i + \epsilon_i$$

We first test our base model, which includes student-perceived teacher characteristics, classroom environment variables, and the science teacher's gendered STEM beliefs in the vector $\boldsymbol{C_i}$. The base model also includes math and science teacher characteristics in the vector $\boldsymbol{T_i}$ including a quadratic in years of experience teaching in math or science at the current school, indicator variables for the teacher's highest level of education, and an indicator for whether the teacher majored in STEM for their bachelor's degree. Next, we add student controls, including race and ethnicity indicators, whether the student's closest friend had good grades, if the school district was located in an urban area, and regional indicators. After this, we add parent-level control variables $\boldsymbol{P_i}$, including binned household income in ninth and eleventh grade, whether the mother and father work in STEM occupations, if the mother and father majored in STEM for their bachelor's degree, the responding parent's gendered STEM beliefs, whether the parent helped the student with homework, and if the parent did any intellectual activities with the student outside of school. Then, we add school controls in the vector $\boldsymbol{I_i}$ including whether the student felt safe at school, whether the school offered remedial algebra 1 courses, whether the school had a math or science fair, and whether the school had a program pairing students with mentors in math or science. Our last model adds controls for student ability in the vector $\boldsymbol{A_i}$ as measured by two standardized math tests administered in ninth and eleventh grade, respectively.

Results

Column 1 of Table 2 reports the results of the base model, with all of the key explanatory variables along with controls for characteristics of both the ninth grade math and science teachers. Notably, this model doesn't identify any significant impact of whether or not the student's ninth grade perspective on the relative abilities of men and women in science on the student's probability of majoring in STEM in college. This model also does not find significant effects of a student's science teacher's beliefs or the (student-perceived) teacher characteristics on the probability of a student majoring in STEM in college, except for one. The model predicts that students who perceive their science teacher as making science interesting will be 0.79 percentage points (p.p.) more likely to major in STEM than students who do not believe their teacher makes science interesting ($p < 0.1$).

In column 2, we add student-level controls including demographic, urban, and regional indicators. The results are mostly consistent with the results found in column 1, in that a student's beliefs about the relative abilities of men and women in science and most teacher characteristics do not affect a student's probability of majoring in STEM in college. The magnitude of the coefficient on the binary indicator of whether or not the student believes that his or her science teacher makes science interesting increases slightly to 0.82 p.p ($p < 0.05$).

We then introduce several parent-level and household-level control variables in column 3, including household income in ninth and eleventh grade, the education level and occupation of the child's parents, whether or not the parent helped the child with homework, and the responding parent's beliefs on the relative abilities of men and women in math and science. After introducing these controls, the model now predicts that students with a female science teacher are 1.1 p.p ($p < 0.05$) less likely to major in STEM in college than students with a male science teacher. This result should be interpreted carefully, as it could be driven by non-random sorting into classes if, for example, "low-ability" students non-randomly sort into female science classrooms. However, this is the only characteristic the model predicts has a significant effect on the probability of majoring in STEM in college. These results are robust to the introduction of school-level controls and student ability controls in columns 4 and 5 respectively, but the magnitude of this coefficient increases slightly to about 2 p.p. ($p < 0.5$).

Alternate Specifications and Robustness Checks

All of the following models are modifications or extensions of our full model, as specified in column 5 of Table 2. We first introduce an alternate model specification which includes all students, instead of just those who attend college. As such, we code our outcome variable as zero if the student attended college and did not major in STEM or if the student did not attend college. The results of this model are reported in column 1 of table 3. Our results do not change significantly, as the only significant coefficient of our coefficients of interest is the coefficient on the variable denoting that the student had a female science teacher. The magnitude of this coefficient drops slightly to 1.87 p.p. ($p < 0.05$). Perhaps more interestingly, our sample sizes in these two models are not so different, indicating that students who didn't attend college were often missing at least one of our other control variables.

Next, we introduce an alternate version of the model where we do not exclude students with missing values for any of the variables drawn from the parent interviews. To be clear, this has our original outcome measure, which excludes students who did not end up going to college. Instead, we include categories for "no parent interview" or "not applicable," instead of marking these as missing. As a result, we include students even if their parents didn't respond to the survey or if there was no applicable mother figure or father figure for the parental education and occupation variables. The results of this regression are shown in column 2 of Table 3. Our sample size increases, but our results stay largely the same, with the only significant key explanatory variable being the science teacher's gender. This model predicts that female students paired with a female science instructor will be 1.80 p.p. less likely to major in STEM than if they were paired with a male science instructor.

We also extend Sansone's analysis by trying an alternative model specification which codes the student science beliefs more granularly. Here, the base category is the belief that men and women are equally capable, but we have two more categories. One denotes a belief that women are better at science, and the other denotes a belief that men are better at science. The results of this model are shown in column 3 of Table 3. In this model, our results are similar in some ways, as women who believe that men are better at math are no more likely to earn a STEM degree than women who say men and women are equally capable. However, this model finds that female students who believe that women are better at science are 2.45 p.p. more likely to earn a STEM degree than women who think men and women are equally capable ($p < 0.05$). In addition, the model now finds a significant positive impact of being taught by a teacher who believes that women are better at science, as students paired with a teacher with such a belief are predicted to be 2.91 p.p. more likely to earn a STEM degree than those paired with a teacher who has neutral beliefs ($p < 0.05$). In each of these cases, having a belief that males were better at science did not have a significant difference than a neutral belief. This model also still predicts that female students paired with a female science instructor are 2.29 p.p. less likely to earn a STEM degree than students paired with a male science instructor ($p < 0.05$).

The results of this model are not directly comparable to Sansone's (2019) results because of our different outcome measure, but these suggest that beliefs that women are better at science can strongly influence a female student's decision-making. This reconciles the mismatch in our descriptive findings and our main model findings, showing that positive female science beliefs do indeed have significant positive effects on STEM degree attainment.

Discussion

Overall, we find small significant positive impacts of whether the student-perceived that the teacher makes science classes interesting on a student's probability of majoring in STEM, but these effects diminish upon the introduction of additional controls. Upon introducing these controls, we find a significant negative impact of having a female science teacher on female students' probability of majoring in STEM in college. We believe that this result should be interpreted carefully as this effect could be driven by nonrandom sorting into female-taught science classes or by systematic differences between male and female science teachers that we do not control for in our model. Several studies have found small positive effects of gender matching in short-term outcomes including Carell et al. (2010), leading us to believe that there may be more to this relationship to understand and explore. Our main model results are robust to the inclusion of students who didn't attend college and to more general specifications having to do with parent variables that are more forgiving with missing values. All of these model versions find a significant negative impact of female instructors, with all other key explanatory variables not having significant effects. In this way, our results are somewhat similar to Sansone's (2019) since Sansone didn't find significant impacts of most of the key variables on STEM degree attainment. However, our results differ from Sansone (2019) in which characteristics we do find to make a significant impact. While Sansone found that negative female science beliefs and having a teacher that treats boys and girls differently had negative effects on STEM degree attainment, we only found negative effects of female instructors (with all the caveats we have mentioned). We believe that some of this could be due to differences in expressed intent as opposed to actual behavior, given our different outcome measures. Further, our small differences in model specification may also have an effect on our results.

However, in one of our alternate versions of our model, we find significant positive impacts of positive female science ability beliefs on STEM degree attainment over students with neutral or negative beliefs. This does provide some support to the importance of STEM identity on STEM outcomes, but only after these students start to believe women are better than men. We are not sure how practically relevant this is, as telling female students that they are better than men might have a positive impact on women, but we think this also might have a significant negative impact on men. Given that this idea is to equalize the accessibility of STEM education, pulling down men for the sake of advancing women does not seem like the right approach.

Our research has several shortcomings, most of which come from the limitations of the dataset. Several of our key explanatory variables are subjective because they come from surveys administered to students, which could mean these measurements are unreliable if students do not view the surveys as important or if they answer the surveys haphazardly. Also, since we used the publicly available version of the HSLS, we did not have access to one of the control variables used in Sansone (2019), so our study is not a perfect replication. We were not able to access the HSLS variable indicating whether or not the student was born in the United States. If students from immigrant families are on average more or less likely to major in STEM than students born in the United States, this could bias our results. Further, the public use data does not include school identifiers, so we were not able to calculate cluster-robust standard errors clustering on schools.

Also, in replicating Sansone's design, we use variables for a student's mother's and father's education and occupation. Evidently, one or both of these could be missing in a non-heteronormative or single-parent household, leading to students from some LGBTQ+ households or students who live with non-parent guardians being excluded from our analysis.

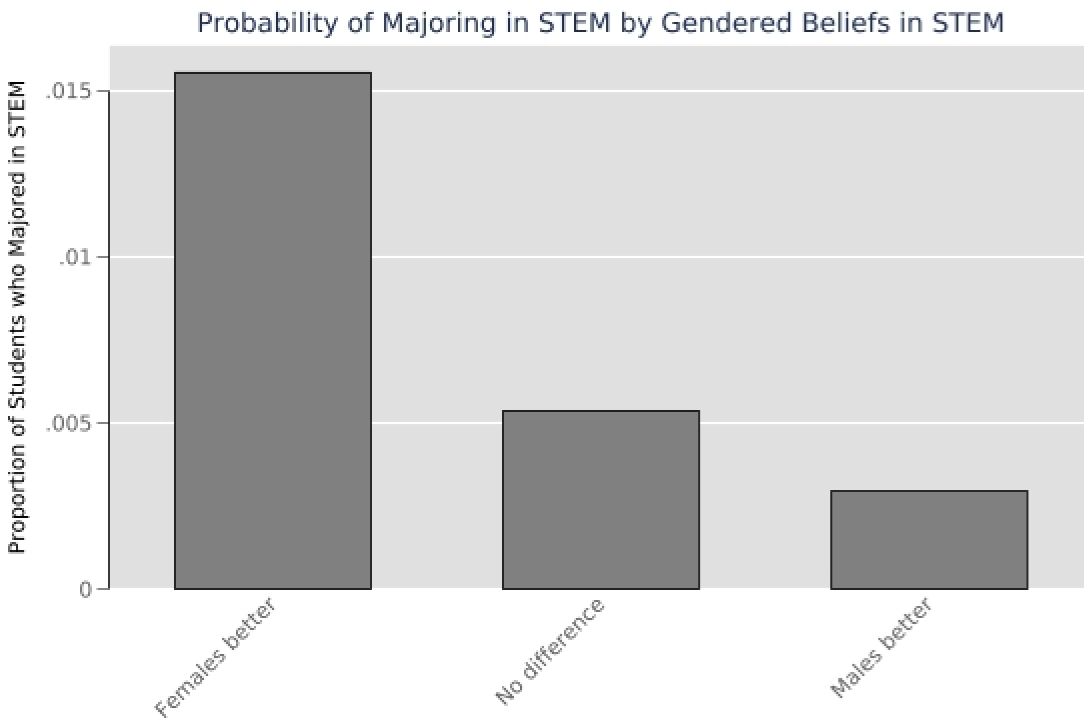
These students may systematically differ from students in their upbringing which could conceivably result in differing STEM identities in these students. Therefore, our results may not be applicable to all students, and further research is needed to understand the relationship between gendered beliefs in STEM among students from LGBTQ+ households and those who live with non-parent guardians. Further, the primary survey questions we used to define our main independent variables rely on a binary conception of gender. Therefore, additional research is needed to understand STEM beliefs in gender identities other than men and women.

Finally, we recognize that it is impossible to capture all factors that influence STEM identity and student decision-making, as with any question having to do with educational outcomes. STEM identity forms and changes over the course of decades of an individual's life, so it is impossible to capture every contributing factor. Therefore, our results should be considered as suggestive, as opposed to definitive.

Conclusion

We find that gendered beliefs in STEM as assessed in ninth grade and most teacher characteristics do not affect a female student's probability of majoring in STEM in college. Our models control for other teacher attributes, parental and household factors, student characteristics, and school characteristics. Our only statistically significant finding is that female students were about two percentage points less likely to major in STEM when paired with a female science teacher in ninth grade, but we believe this result should be interpreted with caution. For example, such a result could be driven by nonrandom sorting of low-ability students into female classrooms, or if female teachers systematically differ from male teachers in some other dimension that we cannot measure. Evidently, more research is needed to understand the true effects of female teachers on student STEM attainment, and to see if under different circumstances gendered STEM beliefs may affect long-term decision-making.

Figure 1:



This figure descriptively shows the relationship between declaring a STEM major in college and a student's gendered beliefs about science ability. This is only among female students in our analytic panel. This figure includes all respondents, even those who did not attend college, hence the very small proportions of students who majored in STEM in each category.

Table 1: Summary Statistics

Variables	N	mean	sd
Men better at science	2,139	0.158	0.364
Female science teacher	2,139	0.586	0.493
Teacher values/listens to student ideas	2,139	0.856	0.352
Teacher treats boys and girls differently	2,139	0.0940	0.292
Teacher believes all students can succeed	2,139	0.921	0.270
Teacher makes science interesting	2,139	0.672	0.469
Teacher thinks men are better at science	2,139	0.0879	0.283
Friend has good grades	2,135	0.0782	0.269
Urban school district	2,139	0.317	0.465
Parent believes men are better at science	1,609	0.180	0.385
Parent helped with homework	1,705	0.801	0.400
Parent engaged in intellectual activity with child	2,139	0.780	0.414
Student feels safe at school	2,137	0.956	0.205
HS STEM GPA	2,070	2.954	0.747
HS STEM credits	2,077	7.701	1.721
Major STEM	2,139	0.00655	0.0807

This table contains our analytic sample for our least restrictive model. STEM = science, technology, engineering, and math. This table contains student, teacher, and parent information, observed at the student level. Therefore, the teacher variables represent how many students were exposed to a teacher with that characteristic. The same applies to parent-level variables.

Table 2: Results

	Major STEM				
Variables	(1)	(2)	(3)	(4)	(5)
Student					
Men better at science	-0.00449	-0.00497	-0.0111	-0.0121	-0.0154
	(0.00483)	(0.00487)	(0.00703)	(0.00754)	(0.0110)
Science Teacher					
Female	-0.00362	-0.00435	-0.0105**	-0.0123**	-0.0202**
	(0.00361)	(0.00364)	(0.00507)	(0.00555)	(0.00822)
Men better at science	-0.00228	-0.00195	-0.00989	-0.0108	-0.0125
	(0.00623)	(0.00626)	(0.00875)	(0.0100)	(0.0146)
Values/listens to student ideas	-0.00623	-0.00594	-0.00590	-0.00603	-0.00687
	(0.00571)	(0.00574)	(0.00809)	(0.00865)	(0.0128)
Treat boys and girls differently	0.00170	0.000843	-0.000809	0.000522	0.00750
	(0.00615)	(0.00619)	(0.00870)	(0.00949)	(0.0148)
Believes all students can succeed	-0.00651	-0.00790	-0.00717	-0.00545	-0.00625
	(0.00709)	(0.00713)	(0.00974)	(0.0106)	(0.0158)
Makes science interesting	0.00788*	0.00816**	0.00739	0.00842	0.0126
	(0.00409)	(0.00411)	(0.00569)	(0.00618)	(0.00907)
Math Teacher Controls	Yes	Yes	Yes	Yes	Yes
Science Teacher Controls	Yes	Yes	Yes	Yes	Yes
Parent Controls	No	Yes	Yes	Yes	Yes
Student Controls	No	No	Yes	Yes	Yes

School Controls	No	No	No	Yes	Yes
Ability Controls	No	No	No	No	Yes
Observations	2,139	2,135	1,190	1,098	713
R-squared	0.006	0.012	0.052	0.061	0.103

Standard errors in parentheses. This table shows the results of our analysis of the affect of teacher characteristics and student gendered STEM beliefs on the probability of that student majoring in STEM in college. We restrict our analysis to female students. Math and science teacher controls include a quadratic in years of experience, highest educational attainment, and whether the teacher majored in STEM in college. Parent controls include mother's and father's education and occupation, household income in ninth and eleventh grade, the gendered STEM beliefs of the responding parent, whether the parent helped the child with homework, and whether the parent participated in intellectual activities with the child. School controls include an indicator variable for whether the student felt safe at school, the availability of remedial math courses, and whether the school paired students with a math or science mentor. Ability controls include HS STEM GPA, number of STEM credits in high school, and the student's score on a standardized math test in ninth and eleventh grade.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Results of Alternate Model Specifications

	Major STEM		
Variables	(1)	(2)	(3)
Student			
Men better at science	-0.0137 (0.0104)	-0.00937 (0.0100)	-0.0119 (0.0120)
Women better at science			0.0245** (0.0125)
Teacher			
Female	-0.0187** (0.00769)	-0.0179** (0.00765)	-0.0229** (0.00901)
Men better at science	-0.0141 (0.0138)	0.00424 (0.0135)	-0.0106 (0.0150)
Women better at science			0.0291** (0.0124)
Values/listens to student ideas	-0.00598 (0.0120)	-0.00309 (0.0120)	-0.000974 (0.0144)
Treats boys and girls differently	0.00658 (0.0139)	0.0174 (0.0141)	0.00353 (0.0162)
Believes all students can succeed	-0.00801 (0.0149)	-0.0211 (0.0147)	-0.00909 (0.0173)
Makes science interesting	0.0122 (0.00854)	0.00962 (0.00855)	0.0136 (0.00992)
Observations	754	902	653
R-squared	0.100	0.092	0.134

Standard errors in parentheses. This table shows the results of our analysis of the affect of teacher characteristics and student gendered STEM beliefs on the probability of that student majors in STEM in college. We restrict our analysis to female students. We add controls for the student's ninth grade math and science teachers, parents, student level characteristics, school characteristics, and student ability. Math and science teacher controls include a quadratic in years of experience, highest educational attainment, and whether the teacher majored in STEM in college. Parent controls include mother's and father's education and occupation, household income in ninth and eleventh grade, the gendered STEM beliefs of the responding parent, whether the parent helped the child with homework, and whether the parent participated in intellectual activities with the child. School controls include an indicator variable for whether the student felt safe at school, the availability of remedial math courses, and whether the school paired students with a math or science mentor. Ability controls include HS STEM GPA, number of STEM credits in high school, and the student's score on a standardized math test in ninth and eleventh grade. The first column includes all students, even those who did not attend college. The second column includes adds separate categories for all variables originating from parent surveys for parent-non-response, so there are fewer missing entries. The last version codes the main explanatory such that the reference category is now neutral gender beliefs, adding a new category for positive female science beliefs.

*** p<0.01, ** p<0.05, * p<0.1

References

Akerlof, G. A., & Kranton, R. E. (2010). Identity Economics. In Identity Economics. Princeton University Press.

Blazar, D., & Kraft, M. A. (2017). Teacher and teaching effects on students' attitudes and behaviors. Educational Evaluation and Policy Analysis, 39(1), 146-170.

Carrell, S. E., Page, M. E., & West, J. E. (2010). Sex and science: How professor gender perpetuates the gender gap. The Quarterly Journal of Economics, 125(3), 1101-1144.

Ceci, S. J., Ginther, D. K., Kahn, S., & Williams, W. M. (2014). Women in academic science: A changing landscape. Psychological science in the public interest, 15(3), 75-141.

Darolia, R., Koedel, C., Main, J. B., Ndashimye, J. F., & Yan, J. (2020). High school course access and postsecondary STEM enrollment and attainment. Educational Evaluation and Policy Analysis, 42(1), 22-45.

Egalite, A. J., & Kisida, B. (2018). The effects of teacher match on students' academic perceptions and attitudes. Educational Evaluation and Policy Analysis, 40(1), 59-81.

Griffith, A. L., & Main, J. B. (2021). The role of the teaching assistant: Female role models in the classroom. Economics of Education Review, 85, 102179.

Price, J. (2010). The effect of instructor race and gender on student persistence in STEM fields. Economics of Education Review, 29(6), 901-910.

Sansone, D. (2019). Teacher characteristics, student beliefs, and the gender gap in STEM fields. Educational Evaluation and Policy Analysis, 41(2), 127-144.

Smith, C. S., & Hung, L. C. (2008). Stereotype threat: Effects on education. Social Psychology of Education, 11, 243-257.

Speer, J. D. (2017). The gender gap in college major: Revisiting the role of pre-college factors.

Labour Economics, 44, 69-88.

Ware, N. C., & Lee, V. E. (1988). Sex differences in choice of college science majors. American Educational Research Journal, 25(4), 593-614.