Female Science Advisors and the STEM Gender Gap*

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Abstract

Women are still largely underrepresented in many STEM fields. Providing one-on-one mentoring or advising by *female* scientists is considered key to decreasing the STEM gender gap. Yet, it is still unclear whether exposure to female mentors or advisors impacts women's participation in the sciences. This paper exploits a unique setting where students are randomly assigned to faculty advisors in their first year of college, to examine the role of advisor gender in STEM degree attainment. We find that exposure to a female rather than a male science advisor substantially decreases the gender gap in STEM enrollment and graduation, and improves female academic performance.

JEL classification: I21, I23, J16

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1 Introduction

Over the past decade, employment in the fields of science, technology, engineering and mathematics (STEM) has been growing at a substantially higher rate than most other occupations. Recent evidence further shows that there are large earnings gains from holding STEM versus non-STEM degrees (Hastings, Neilson and Zimmerman, 2013; Kirkbøen, Leuven and Mogstad, 2016). Despite these significant labor market returns, women are still underrepresented in many STEM fields. In 2013, women accounted for 31% of U.S. postsecondary graduates in the sciences and merely a quarter of all STEM jobs. This gender disparity is apparent from the early stages of postsecondary education; in 2012, 7.2% of female compared to 26.6% of male freshman college students planned on pursuing a degree in mathematics, statistics, computer sciences, physical sciences, and engineering (U.S. Chamber of Commerce Foundation, 2015).

In light of this issue, discussions among policymakers and researchers on how to improve the status of women in the sciences have become more prominent. Mentorship has emerged as an "important key to increasing and keeping women engaged in scientific and technical careers" (White House OSTP, 2011). Accordingly, a variety of mentoring initiatives have been recently put in place with the goal of promoting women's persistence in STEM fields. For example, the Department of Energy STEM Mentoring Program was launched in 2011, to provide female undergraduates with one-on-one mentoring by female scientists. The American Economic Association Committee on the Status of Women in the Economics Profession (CSWEP) also offers a mentoring and advising program to help women prepare for tenure. The program, which matches junior female faculty in economics to senior female economists, has been found to improve women's publication record and access to grants (Blau et al., 2010).

The premise for such programs is that *female science* advisors or mentors can act as role models, inspiring other women to seek and persist in STEM careers, in light of the persistent underrepresentation of women in STEM. Exposure to female mentors can also counteract negative gender stereotypes that are particularly prevalent in the sciences. Yet, despite considerable policy relevance, there is still no clear evidence on the role of mentor or advisor gender in women's decisions to pursue or persist in STEM fields.

This paper begins to fill this gap in the literature. We examine whether women's likelihood of enrolling and graduating with STEM degrees are influenced by their academic advisors' gender in the first year of college. Academic advising is provided by most U.S. colleges in order to help students set and achieve their educational goals. Advisors provide information on academic programs and majors. They monitor students' academic progress and assist them with choosing courses and developing a plan of study. The majority of advisors further report giving career advice and helping students select an appropriate major (NACADA National Survey of Academic Advising, 2011). They generally interact closely with students, meeting with them outside the classroom, individually and repeatedly throughout the academic year.

Although advising is intended to offer students information and assistance with selecting courses and fields of study, it is still unclear whether and how it impacts college major choice. This is largely due to difficulties in identifying causal effects. In most settings, the assignment of students to advisors is correlated with unobservable factors—such as student ability—that may also influence educational choices.

We use rich administrative data linking students and advisors taken from the American University of Beirut (AUB), a private 4-year college located in Lebanon. As further discussed in section 2.1, AUB is comparable to a typical private nonprofit 4-year college in the United States. Importantly, 50% of undergraduate students and 40% of faculty at AUB are female. Nonetheless, only 7.8% of female compared to 25.6% of male students enroll in STEM degrees after their freshman year. We exploit AUB's unique setting where students are randomly assigned to professorial faculty advisors at the beginning of their freshman year of college, allowing us to identify the causal effects of student-advisor gender match. Advisors meet with students one-on-one at least once at the start of each semester. They discuss students' intended majors and assist them with selecting courses and developing a plan of study. Importantly, students apply for a major at the end of their freshman year. This insures repeated interactions with their advisors prior to deciding on a major. In our main analysis, we examine whether being assigned to a female rather than a male science advisor impacts the gender gap in STEM degree attainment as well as students' academic performance. We also look at whether the gender match matters for students assigned to non-science advisors.

Our results indicate that female science advisors substantially increase female students' enrollment in STEM degrees after their freshman year. Specifically, exposure to a female rather than a male science advisor reduces the gender gap in STEM enrollment by 8.3 percentage points. These effects are long-lasting as we document a comparable decrease in the gender gap in STEM graduation. Female science advisors further improve women's academic performance. Female students experience a 7.6 percent of a standard deviation improvement in their freshman year GPA and a small increase in their overall graduation rates, when matched with a female rather than a male science advisor. While academic performance is increased for women of all ability levels, the STEM enrollment and graduation effects are strongest for students with higher math skills. This suggests that the rise in female STEM enrollment is not mainly driven by better academic performance, but rather by sociopsychological affirmation effects from repeated interactions with female science advisors. Finally, we find that the gender of a non-science advisor has no significant impact on students' major choice or academic performance. This highlights that female mentors are particularly important in the sciences, as lack of female role models and negative gender stereotypes have shown to be major barriers to women entering these fields (Blickenstaff, 2005).

To the best of our knowledge, this paper is the first to document that the gender of an advisor in the sciences significantly impacts women's chances of enrolling and graduating with STEM degrees. Our findings add to a growing body of literature aimed at identifying the academic factors that influence the STEM gender gap. Prior work highlights the importance of female peers and in-classroom role models in encouraging women to pursue STEM fields (Dennehy and Dasgupta, 2017; Fischer, 2017; Mouganie and Wang, 2017; Porter and Serra, 2017; Bostwick and Weinberg, 2018; Breda et al., 2018). Other studies show that teacher gender largely influences female students' performance in math and science courses, as well as their likelihood of graduating with STEM degrees (Bettinger and Long, 2005; Dee, 2007; Carrell, Page and West, 2010; Lim and Meer, 2017). Our study is the first to focus on the role of *advisor* gender in female STEM degree attainment. Unlike peers, teachers and in-classroom role models, an academic advisor's main role is to provide students with personalized information and assistance regarding course and major selection at a critical time in their postsecondary education. They are therefore more directly involved in major choice. Additionally, the policy implications of our study are distinct from the rest of this literature. Our findings are more suitable to inform the design of mentoring programs aimed at engaging women in the sciences. Specifically, our results suggest that providing women with close mentoring by *female scientists* can significantly reduce the STEM gender gap.

Our paper adds to another strand of literature which evaluates the effectiveness of individualized college counseling and advising programs. Previous studies examine programs that are aimed at increasing college enrollment (Avery and Kane, 2004; Carrell and Sacerdote, 2017; Oreopoulos, Brown and Lavecchia, 2017; Barr and Castleman, 2018; Castleman and Goodman, 2018) and persistence (Bettinger and Baker, 2014; Ellis and Gershenson, 2016; Kato and Song, 2018), as well as take-up of financial aid (Bettinger et al., 2012) among individuals who face barriers in access to higher education. Our paper is similar in its focus on personalized advising among a group of students who face educational barriers. However, advising in our case differs in its goals as it is intended to help students decide on and enroll in a specific major. Our work thus extends this literature by examining the manner in which advising impacts *major choice*, and more importantly what aspects of it can reduce the barriers to entry for women in STEM.

Finally, our results are related to a growing literature which documents that having a

PhD science advisor of the same gender is positively correlated with graduate students' productivity, graduation rates and likelihood of holding academic positions (Neumark and Gardecki, 1998; Pezzoni et al., 2016; Gaule and Piacentini, 2018). A major drawback in these settings is that students can choose their advisors. As a result, estimates from these studies are likely biased given that it is difficult to control for all factors—such as student ability or motivation—that are simultaneously correlated with the gender match and student outcomes. An advantage of our study is that students are *randomly* assigned to their advisors, allowing us to identify the causal effects of having an advisor of the same gender.

The rest of this paper is organized as follows. Section 2 provides a detailed description of our institutional setting. Sections 3 and 4 outline our data and identification strategy, respectively. Section 5 presents our randomization tests and main results. We discuss our findings in section 6 and conclude in section 7.

2 Institutional Background

2.1 The Freshman Year

In order to examine the impacts of student-advisor gender match, we focus on the advising system at the American University of Beirut (AUB). AUB is a nonprofit private university that offers a liberal arts education. The focus is mostly on undergraduate education although the university does provide a variety of master's and a few PhD programs. The average tuition for the Freshman year during the period of our study is $14,000, which is large relative to the average yearly income of $14,846 in Lebanon (UNDP, 2017). The university enrolls around 7,000 undergraduate students per year. In many ways, AUB is comparable to an average private nonprofit 4-year college in the United States. The student to faculty ratio is 11 to 1 and the average class size is less than 25. 83% of full-time faculty have doctoral degrees. Importantly, 50% of students and around 40% of full-time faculty are females.[1] AUB offers around 50 majors across a variety of disciplines such as humanities, social sciences, sciences, engineering and medicine. Most bachelor's degrees take four years to complete. The only exceptions are engineering and architecture which require five and six years, respectively.

Admission into the freshman year is based on a composite score that is a weighted average of SAT1 scores (50%) and high school GPA in grades 10 and 11 (50%). Freshman students

[1]For comparison, the average student to faculty ratio is 10 to 1 at private nonprofit 4-year colleges, and 14 to 1 at public 4-year institutions in the United States. Women account for around 55% of all undergraduate students and 44% of all full-time faculty at U.S. postsecondary institutions (National Center for Education Statistics, 2018).

are not typical Lebanese college students. Most students in Lebanon have to take national exams at the end of their last year of high school. Upon passing those exams, they are awarded a baccalaureate degree (or *Baccalauréat*) which is required to enroll in postsecondary institutions. Students who pursue a baccalaureate track in high school are not eligible to enroll in university as freshman students, as the Baccalaureate year is considered equivalent to freshman year. Instead, they apply directly to the sophomore year and simultaneously declare a specific major. Freshman students at AUB are individuals who either attended foreign high schools or went to Lebanese schools that follow the U.S. high school education system. Compared to those who are admitted directly into the sophomore year, freshman students are lower skilled.

Freshman students apply for a major at the end of their first year of college. Admission is granted based upon the fulfillment of credit and course requirements set by different departments. Table A1 gives an example of the requirements for two majors: history and mathematics. A few things are worth highlighting. First, all students have to take courses in a variety of disciplines regardless of their major choice. However, the number of courses taken within each discipline varies across majors. For example, students planning on pursuing a history major have to take two humanities courses in their freshman year, while those wishing to apply for mathematics are required to take only one. Second, some but not all departments require students to take specific courses. Many departments also impose additional grade requirements. Those requirements are not typically restrictive or necessarily difficult to meet.[2] For example, the mathematics department requires prospective students obtain a minimum grade of 70 on two relatively advanced mathematics courses (MATH 101 and MATH 102). However, students are free to select all other courses conditional on those courses meeting the credit requirements within each discipline. Third, there is substantial overlap in the requirements for different majors. As a result, many students—intentionally or unintentionally—end up fulfilling the requirements for several different majors simultaneously. This also implies that it is not costly for students to change their minds about their intended major at any point during the freshman year.

2.2 Advising during the Freshman Year

The process of selecting and matching advisors to students is coordinated by university administrators working in the advising unit. Advisors are full-time faculty chosen from

[2]The only exception are engineering majors which require that students take a specific set of science and mathematic courses and obtain a minimum GPA of 80 during the freshman year. Furthermore, admission into engineering is not necessarily granted upon the fulfillment of these requirements, as these majors are very selective. Freshman students' applications are pooled with those who are applying directly to the sophomore year, and the admission rate is around 17%.

various departments within the faculty of arts and sciences.[3] All full-time faculty are eligible to be advisors. However, preference is given to faculty who are not up for promotion and who do not have a large number of administrative duties. Advising is optional but faculty members are offered incentives to serve as advisors such as additional research funds or a course release. Faculty commit to advising for the full academic year, and many eventually advise for multiple years.

After selecting advisors, university administrators randomly assign them to freshman students. Students are first sorted by their university ID numbers or by their last names. They are then divided into equally sized groups and matched to advisors. Importantly, no student or advisor characteristic—such as intended major, past academic achievement or gender—are taken into consideration when deciding on the match. In section 5.1, we present formal evidence that the assignment of students to advisors is indeed random.

Students are assigned to academic advisors at the beginning of their freshman year, and typically have the same advisor throughout the year. Advisors conduct one group advising session at the beginning of the academic year, where they introduce students to the general requirements for completing the freshman year and enrolling in majors, university resources and the code of conduct. Advisors also meet individually with students at the beginning of each semester and prior to course registration. Students have to attend the one-on-one meetings in order to receive a PIN that is required for course registration and that can only be provided by the advisor. During those meetings, academic advisors discuss and help students choose a major, select courses and develop a plan of study that will allow them to meet the requirements for their intended majors. Advisors have access to the student's full academic records allowing them to tailor their advice to the student's interests and ability. Advisors are also responsible for monitoring students' academic progress, are notified when students are placed on academic probation and have to approve withdrawal from courses. They hold weekly office hours, and students have the option of contacting them and setting up additional meetings.

[3]The faculty of arts and sciences (FAS) includes most majors in AUB. This implies that students can be assigned to advisors from humanities, social sciences, sciences, mathematics and computer science. However, freshman students cannot be assigned to an advisor from the engineering department since it is not part of FAS.

3 Data

3.1 Data Description

This paper uses student level administrative data accessed through the registrar's office at the American University of Beirut (AUB). Our data include all 3,093 incoming Freshmen students enrolled at AUB from the years 2004 to 2013.[4] For each student, we have detailed information on gender and university course grades and credits acquired. Our data also include semester GPA, class-year (Freshman, Sophomore, etc...), as well as field of study for every semester enrolled. Importantly, we also have linked information on all students' academic advisors including their gender, professorial rank, and department. These data were then matched, by the registrar's office, to student baseline information taken from the admissions office at AUB. This gives us access to students' Verbal and Math SAT scores, GPA during last two years of high school, high school location, year of birth, legacy status, and whether or not students applied for financial aid.

3.2 Summary Statistics

For our main analysis, we restrict our sample to freshmen students matched to a science faculty advisor. This leaves us with a final sample of 1,501 students enrolled in 15,988 freshmen courses. In later analysis, we also show results for the remaining 1,592 students matched to non-science faculty advisors. Summary statistics for the main sample of students used in our analysis are shown in Table 1. In column 1, we report means and standard deviations for all freshmen students matched to science advisors. We report these statistics separately for male and female students in columns 2 and 3 of Table 1 respectively. Female students constitute 49.2 percent of individuals in our main sample, compared to 50.8 percent male. Table 1 also indicates that 28.5 percent of science advisors are female. Males have a 29.4 percent chance of matching with a female science advisor and women have a 27.5 percent chance. The average Mathematics SAT score for students in our sample is 575 points with men scoring around 26 points higher than women, on average. Conversely women outscore men in the Verbal portion of the SAT exam by 7 points. In terms of overall high school GPA, reported in standard deviations, freshmen females outperform men by a significant margin.[5] Approximately 20 percent of all students in our sample have a close relative who

[4]Freshman students entering university before 2004 had a different advising system in place. We also limit our sample to students entering AUB before 2014 in order to observe on time graduation status for all students.

[5]Almost all high schools in Lebanon fall into one of two categories: the French or English high school system. High school grades are reported out of a scale of 100 for students attending high school under the English system and out of 20 for students attending high school under the French system. For comparison

attended AUB (legacy students), equally distributed across both genders. Further, around half of all Freshmen students attended high school outside of Lebanon.

The main outcome of interest in this paper is the likelihood of enrolling in a STEM major.[6] Recall, in our context, field of study is determined directly after Freshman year. Table 1 reveals that, among those declaring a major, the likelihood a female student pursues a STEM degree is 7.8 percent. This is in stark contrast to men who have a 25.6 percent overall likelihood of declaring a STEM major. Table 1 also reveals that women are only 5.5 percent likely to graduate with a STEM degree within 6 years of initial enrollment compared to 20 percent of men. Interestingly, this disparity exists despite women outperforming men during Freshman year; the average GPA for women is around 3 points higher—out of a scale of 100—than that of men during Freshmen year. Finally, 80.7 percent of all students transition to sophomore year and 46 percent graduate within 4 years of initial enrollment, with women graduating at a substantially higher rate (53%) than men (39%). The 6-year graduation rate is higher at 55% for the overall sample and 49% and 63% for males and females, respectively. Summary statistics for all freshmen students, including those matched to non-science advisors, are similar in composition to our main sample and are summarized in Appendix Table A2.

In Table 2, we summarize information on all freshmen science faculty advisors in our sample. Overall, our data contain 50 distinct academic advisors, 15 of whom are female. Approximately 83 percent of male science advisors are full professors and 16.6 percent are associate professors. For female science advisors, 66 percent are full professors and around 34 percent are associate professors. Female science advisors have, on average, 15.5 female students and 32.5 students overall. Male advisors have 17.2 female students and 34.8 total students each. Finally, the baseline academic performance of students, measured by average SAT scores, are equally distributed across advisor gender. Students matched to female science advisors score 575.5 and 476.3 points on the Math and Verbal SAT exam respectively. Students matched to male science advisors score a similar 574.76 and 473.6 points on both portions of the exam.

4 Identification Strategy

Our empirical strategy exploits the random assignment of advisors to students in their freshman year at college. Our main focus is on how female students' STEM outcomes are

and interpretation, we standardize these grades to have a mean of zero and variance of one.

[6] We define the following majors as STEM: Math, Physics, Statistics, Computer Science, Chemistry, and all branches of engineering (Computer, Electrical, Chemical, Mechanical, etc...)

affected by being matched to a female advisor in the sciences. To capture these effects, we focus our analysis on incoming freshmen students matched to advisors working in science departments. Importantly, whether a student is matched to a faculty advisor in a science or non-science department is random and does not depend on students' preferred future major or academic ability, a result we confirm in section 5.1. Formally, we run the following linear regression model for students matched to faculty advisors in science departments:

$$Y_{iat} = \beta_0 + \beta_1 Femadv_a + \beta_2 Femst_i + \beta_3 Femst_i * Femadv_a + X_i'\gamma + A_a'\delta + \sigma_t + \epsilon_{iat} \quad (1)$$

where Y_{iat} refers to the outcome of interest for student i matched to advisor a in academic year t. $Femadv_a$ is a dummy variable that takes on values of 1 if an advisor a is female and 0 otherwise. $Femst_i$ is another indicator variable for whether freshman student i is female. β_1 measures the average impact of female science advisors relative to male science advisors for male students. β_2 is the average difference between female and male students matched to male science advisors. β_3 is our main parameter of interest and captures the relative change in the gender gap between girls and boys when matched to a female freshman advisor as opposed to a male advisor. Our simplest specification includes only these variables. Due to the random nature of student-advisor assignment, all β coefficients should be unbiased and can be interpreted as causal. Additionally, we add a rich set of controls that should not substantially affect treatment assignment due to the random nature of student-advisor matching. These include a vector of student controls X_i' that contains information on students math and verbal SAT scores, GPA in the final 2 years of high school, financial aid and legacy admission status as well as birth year fixed effects. The vector A_a' controls for advisor level variables including academic rank and department. In some specifications, advisor controls are subsumed by advisor fixed effects. Finally, σ_t is an academic year fixed effect that controls for unobserved changes across different years and ϵ_{iat} represents our error term. Standard errors are clustered at the advisor level throughout to account for correlations among students exposed to the same advisor.

To analyze potential mechanisms, we run a modified version of equation (1) to examine the effect of advisor-student gender match on course level outcomes:

$$Y_{iatc} = \beta_0 + \beta_1 Femadv_a + \beta_2 Femst_i + \beta_3 Femst_i * Femadv_a + X_i'\gamma + A_a'\delta + \alpha_{ct} + \sigma_t + \epsilon_{iatc} \quad (2)$$

where Y_{iatc} refers to course level achievement outcomes for student i matched to advisor a in academic year t enrolled in course c. In these specifications, interpretation remains largely unchanged except for the fact that we are looking at student-course level outcomes which results in an increased number of observations. Another significant difference is that we include course-by-semester (α_{ct}) fixed effects in equation (2) to control for unobserved mean differences in academic achievement or grading standards across courses and time. As in equation (1), β_3 is our main parameter of interest and measures the change in the course level achievement gap between female and male students when moving from a male to a female science advisor.

5 Results

5.1 Tests of the Identifying Assumption

To identify causal effects, we require the random assignment of freshman students to advisor gender. While our institutional setting provides for random variation in student-advisor match, we perform a series of tests to confirm that our data are consistent with such a process. First, in order to alleviate concerns over sample selection, we check whether the likelihood of students being matched to a faculty advisor in a science versus non-science department is consistent with random student-advisor matching. To do so, we regress a dummy variable for science advisor on predetermined student baseline characteristics. Column 1 of Table 3 summarizes the results of this test. We find no significant relationship between the likelihood of having a science advisor and student gender. We also find no statistical relationship between advisor department and student ability, proxied by SAT scores and high school GPA. Finally, other student characteristics such as legacy status, high school location, and financial aid status are also statistically unrelated to advisor department. Further, these variables are jointly insignificant, as indicated by a p-value of 0.52 for tests of joint significance. These results confirm that freshman students assigned to a science versus non-science department are similar in observable characteristics, consistent with random student-advisor matching.

We next test whether freshmen advisor assignment is random with respect to gender—our main identifying assumption. To do so, we regress advisor gender on individual student characteristics. Column 2 of Table 3 summarizes results with respect to all freshman students, i.e. those assigned to science and non-science advisors. We find that students' gender, ability as well as legacy, international and financial aid status are individually and jointly unrelated to advisor gender. Finally, column 3 of Table 3 presents results for our main sample —freshmen students assigned to science faculty advisors. Consistent with results from column 2, we find no statistically significant relationship between advisor gender and students' predetermined characteristics. Combined, these results are in line with our institutional setting which involves the random assignment of freshmen students to faculty advisors regardless of advisor department or gender.

5.2 STEM Enrollment and Graduation

We start by examining whether student-science advisor gender match impacts the likelihood of pursuing STEM fields. As previously discussed, advisors help students decide on a field of study, and guide them on how to meet the requirements for admission into their chosen majors. Additionally, students declare a major at the end of their freshman year, thereby interacting repeatedly with their advisors before deciding on a field of study. We first look at the effect of science advisor gender on men and women's likelihood of enrolling in STEM majors following the freshman year. Column (1) of table 4 displays the results from our most basic specification that includes no controls. The estimate on the female advisor indicator (β_1) is statistically insignificant, though not small in magnitude, and suggests that male students are 3.9 percentage points less likely to enroll in a STEM major when they are assigned to a female rather than a male science advisor. The estimate on the female student dummy (β_2) is even larger and statistically significant, and indicates that female students are 9.5 percentage points less likely than males to enroll in STEM degrees when matched to a male science advisor. The coefficient on the interaction term (β_3), our main parameter of interest, reveals that switching from a male to a female advisor narrows the gap in STEM enrollment between female and male students by 8.3 percentage points. This implies an 87.3 percent (β_3/β_2) reduction in the gender gap in STEM enrollment. Part of this decrease is driven by a drop in male students' STEM enrollment decisions when matched to a female advisor. However, the absolute benefit for female students matched to a female as opposed to a male advisor is a statistically significant (p-value=0.043) 4.4 percentage points (β_1+β_3). In column (2), we add year fixed effects to control for any unobserved time-varying shocks that are common to all students, as well as advisor fixed effects allowing for identification from within-advisor variation in the gender match. In column (3), we additionally control for students' baseline characteristics. Consistent with random assignment of students to advisors, estimates for both the female student indicator and the interaction term are still statistically significant and similar in magnitude to the ones from column (1).

Given that female students are more likely to declare a STEM major, it is important to understand whether these benefits persist. Column (4) reports estimates for the likelihood of graduating with a STEM degree within 4 years of university enrollment, without the inclusion of controls.[7] This measure can be interpreted as on-time STEM degree completion.

[7] Most degrees at AUB require 4 years to complete. However, Engineering and Architecture degrees require 5 and 6 years respectively, so we define "on time" graduation for these majors as 5 and 6 years respectively.

Compared to men, women are 7.4 percentage points less likely to graduate with a STEM degree when matched to a male advisor. However, this gap is completely closed when women switch from a male to female science advisor. Furthermore, the absolute gain for female students from having a female advisor is on the order of 4.2 percentage points (p-value=0.083). As expected, the addition of year fixed effects, advisor fixed effects and student controls in columns (5) and (6) does not significantly alter these estimates.

In columns (7) through (9), we show results for the likelihood of graduating with a STEM degree within 6 years of initial enrollment without and with controls, respectively.[8] The results are similar to the 4-year STEM graduation rate. Specifically, the gender gap almost completely disappears when the advisor is female, and the absolute gain for women is 4.4 percentage points (p-value=0.069).

5.3 Academic Performance and Graduation

We next examine whether assigning students to advisors of the same gender impacts their academic performance. Advisors are responsible for monitoring students' academic progress during the freshman year. Exposure to a female advisor can thus influence female students' motivation and academic performance. Column (1) of table 5 reports the impact of student advisor gender match on GPA at the end of freshman year. Female students outperform males by 22% of a standard deviation even when matched to male science advisors. This gap increases by 17.6% of a standard deviation when the science advisor is female rather than male. Part of this increase is driven by male students performing worse when matched to a female rather than a male advisor. Nonetheless, the absolute benefit for female students exposed to a female rather than a male advisor is on the order of 7.6 percent of a standard deviation but it is not statistically significant (p-value of significance of $\beta_1+\beta_3= 0.16$). The addition of student controls and year and advisor fixed effects in columns (2) and (3) does not alter the estimates in a significant way.

We next look at the effect of female advisors on longer-term outcomes. Columns (4) and (7) respectively show the impacts of the gender match on the likelihoods that students graduate on time—i.e. within 4 years—and within 6 years of initial college enrollment. Female students with male advisors graduate at a significantly higher than men. Female science advisors widen the 4-year and 6-year graduation gaps by 8.3 and 7 percentage points, respectively. However, most of this increase in the gender gap is driven by male students doing worse with female advisors, and the absolute gain for female students in on time graduation is 2.3 percentage points (p-value= 0.65) and a mere 0.9 percentage points (p-

[8] This allows more time for students to complete their degrees. However, one drawback of this measure is that students entering AUB in the year 2013 can only be observed for 5 years after initial enrollment.

value=0.81) for 6-year graduation. Column (5), (6), (8) and (9) show comparable estimates from specifications with student controls and advisor fixed effects.

5.4 Course Selection and Performance

One of the main tasks of an academic advisor is to assist students with course selection. Furthermore, students wishing to enroll in STEM fields are required to take a higher number of mathematics and science courses compared to students wanting to pursue non-science majors.[9] Accordingly, in table 6, we examine whether having a female science advisor encourages women to take more science courses, and improves their performance in these courses. Column (1) shows that compared to male students, women are 10.3 percentage points less likely to take science courses when matched to a male science advisor. However, when moving to a female science advisor, this difference is reduced by around 36 percent (β_3/β_2). Column (2) to (4) further indicate that women are substantially less likely to fail and withdraw from science courses, and have higher grades in these courses when assigned a female science advisor. Columns (5) to (7) examine how performance on non-science courses is impacted by gender match. Female students are also less likely to fail non-science courses and also experience an improvement in their grades when matched to female rather than male advisors. However, the gender match has no impact on the likelihood that students withdraw from non-science courses.

The documented improvement in students' performance could indicate that female students work harder in order to meet the requirements for entry into science majors, which are typically more selective than non-science fields. It could also suggest that female students are simply more motivated when exposed to a female science mentor.

The results for course withdrawal are more striking. Students have to decide on whether or not to withdraw from a specific course before sitting for the final exam. Having to make a decision before knowing their final performance on the course might make students more likely to seek advice and follow their advisor's recommendation on the matter. More importantly, advisors can directly influence whether students withdraw from courses since they have to provide written consent and a valid reason for course withdrawals. The fact that we observe a decrease in withdrawal from science but not from non-science courses highlights the importance of female mentors in influencing women's persistence in the sciences.

[9] Specifically, all STEM majors require that students take at least half of their courses during the freshman year in math or sciences. Humanities and social sciences only require 30% of all courses to be in math and sciences. However, students can take additional math and science courses as electives.

5.5 Heterogeneous Effects

Given that exposure to a female rather than a male science advisor increases women's STEM degree attainment, we next examine whether these effects are more salient for students who have higher math abilities. We consider students to be highly skilled in math if their SAT math score is greater than or equal to 600. This typically corresponds to the 75th percentile of the distribution of scores among all SAT-takers (College Board, 2012). Table 7 displays heterogeneous effects for our main outcomes. Columns (1) and (2) show that the gender gap in STEM enrollment and graduation is larger among high ability students. Specifically, women are around 10 percentage points less likely than men to enroll in and graduate with STEM degrees when assigned a male science advisor. For low ability students, these differences are around 3 to 3.5 percentage points. Although precision is reduced due to the smaller sample size, the estimate on the interaction term (β_3) is still large for high ability student—and significant at the 10% level. In fact, the gender gap in STEM enrollment and graduation is completely closed when switching from a male to a female science advisor. In contrast, the estimates on the interaction term for low ability students are statistically insignificant and small in magnitude, indicating that exposure to a female advisor does not improve lower ability women's likelihood of STEM investment.

Columns (3) and (4) show heterogeneous impacts on GPA at the end of the freshman year and college graduation. In both the high and low ability samples and for both outcomes, female students outperform males when assigned a male science advisor. Switching from a male to a female science advisor widens the gender gap in academic performance and graduation for both groups. These results suggest that all women experience some educational benefits from being matched to female rather than male science advisors. However, in terms of increasing STEM degree attainment, science advisor gender is more likely to impact female students who are already skilled in the sciences. This suggest that these women are possibly mis-optimizing with respect to major choice when exposed to a male science advisor.

5.6 The Impact of Non-Science Advisor Gender

So far, we have documented the importance of advisor gender among students who are assigned to science advisors. We next turn to whether being exposed to female rather than male *non-science* advisors has similar impacts on students' performance and their decision to pursue STEM fields. Table 8 presents the corresponding estimates for our main outcomes of interest, controlling for students and advisor characteristics and year fixed effects. Similar to our science advisor sample, female students matched to male advisors are 6.4 percentage points less likely than male students to enroll in STEM fields, as shown in column (1).

However, the estimate on the interaction term is negative, relatively small in magnitude and not statistically significant, suggesting that exposure to a female rather than a male non-science advisor potentially slightly widens the initial STEM enrollment gap. The estimates for STEM graduation in column (2) are consistent with those for STEM enrollment. Furthermore, advisor gender does not seem to be an important determinant of female academic performance when an advisor is not a scientist. In column (3), female students matched to male advisors perform better than their male counterparts at the end of the freshman year, consistent with our previous results. In contrast to the science advisor sample, this gap is not influenced by moving from a male to a female non-science advisor. Furthermore, non-science advisor gender has no effect on the likelihood of graduating from college.

In table 9, we look at whether non-science advisor gender impacts the course-level outcomes. Columns (1) and (2) show that compared to male students, females are 8.5 and 4.5 percentage points less likely to take and fail science courses when assigned a male advisor. However, exposure to a female non-science advisor has no impact on female students' grades (in column (4)) or likelihood of taking, failing or withdrawing (in column (3)) from science courses. Indeed, the estimates on the interaction term are not statistically different from 0 and reasonably precise. Interestingly, non-science advisor gender also does not seem to influence performance in non-science courses. Compared to male students matched to male advisors, female students are less likely to fail, withdraw and have higher grades in non-science courses (columns (5) to (7)). Nonetheless, this gender gap is not impacted by switching to a female non-science advisor. These results suggest that female advisors are not better than male advisors at engaging or advising female students, in general. Instead, the gender match is important in the sciences, most likely because these fields are particularly lacking in female role models.

6 Discussion

Our results indicate that science advisor gender is an important determinant of female students' academic performance and STEM degree attainment. In contrast, non-science advisor gender has no impact on students' outcomes. A natural question is whether students benefit from being matched to a science instead of a non-science advisor, regardless of advisor gender. Table A3 reports the impact of having a science versus a non-science advisor on our main outcomes of interest for all students, as well as for female and male students separately. Columns (1) and (2) show that exposure to science advisors does not increase the likelihood of either enrolling in or graduating with STEM degrees. The estimates for the entire sample but also for female and male students are statistically insignificant and relatively small in magnitude. Similarly, columns (4) and (5) indicate that science advisors do not influence students' GPA at the end of the freshman year nor college graduation likelihood.

In section 5.3, we find that exposure to a female advisor not only impacts major choice but also academic performance in the freshman year. A key question thus arises: is the increase in female STEM enrollment driven by the improvement in academic performance, or are women's decisions to pursue STEM fields directly influenced by exposure to a female science advisor?

While it is difficult to provide a definitive answer to this question, we nonetheless present suggestive evidence on what might be driving our main effects. Our heterogeneity analysis in table 7 is very revealing. Both high and low ability female students experience increases in their freshman year GPA as a result of being assigned to a female rather than a male science advisor. However, only female students with high math abilities are encouraged to enroll in and graduate with STEM degrees. Low ability students are not more likely to pursue STEM fields despite the fact that they incur even larger gains in their academic performance. This implies that women's decision to enroll in STEM is not the result of their improved academic performance, but instead it is more likely directly driven by affirmation effects due to repeated interactions with female science advisors, who serve as positive role models.

7 Conclusion

Despite the reversal of the gender gap in college attainment, females are still underrepresented in the sciences. This gave rise to numerous programs that provide women with personalized mentoring by female scientists in an effort to decrease the STEM gender gap. In this paper, we present some of the first evidence on the role of advisor or mentor gender in encouraging women to pursue STEM degrees. We utilize the unique advising system at the American University of Beirut—a private 4-year university—where students are randomly assigned to faculty advisors in their first year of college. Students apply for majors at the end of their freshman year, allowing them to repeatedly interact with their advisors prior to deciding on a major. Furthermore, advisors' main tasks are to help students choose a major and courses, as well as monitor their academic progress. We find that the gender gaps in STEM enrollment and STEM graduation are almost entirely closed following exposure to a female rather than a male science advisor. Women further see some improvements in their GPA and overall graduation rates when assigned to a female science advisor. Both high and low ability women experience increases in their academic performance, but the effect on STEM degree attainment is entirely driven by students with high math skills. Finally, we show that non-science advisor gender has no significant impact on any of our outcomes of interest.

Our findings suggest that providing one-on-one advising or mentoring by female scientists can play a key role in decreasing the STEM gender gap. This is in line with recent studies showing that intensive one-on-one mentoring and advising programs are effective in increasing college-going and breaking down educational barriers (Carrell and Sacerdote, 2017; Barr and Castleman, 2018). Our results complement these studies by highlighting how these programs can be used to influence major choice and increase the participation of women in STEM fields.

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A Tables

Table 1: Summary Statistics for Main Sample (Freshmen Students Matched to Science Advisor)

	All	Male	Female
	(1)	(2)	(3)
Female Student	0.492		
	(0.500)		
Female Advisor	0.285	0.294	0.275
	(0.452)	(0.460)	(0.442)
Math SAT Score	575.2	588.1	561.5
	(74.88)	(72.91)	(74.52)
Verbal SAT Score	473.7	470.5	477.2
	(75.23)	(76.36)	(73.87)
Standardized High School GPA	0.0567	-0.155	0.282
	(1.816)	(2.008)	(1.556)
Legacy Status	0.197	0.196	0.198
	(0.397)	(0.397)	(0.398)
Foreign High School	0.493	0.486	0.502
	(0.500)	(0.500)	(0.500)
Enroll in STEM degree	0.158	0.256	0.078
	(0.365)	(0.437)	(0.269)
Graduate with STEM degree (Within 4 years)	0.104	0.170	0.050
	(0.304)	(0.375)	(0.218)
Graduate with STEM degree (Within 6 years)	0.120	0.200	0.055
	(0.324)	(0.400)	(0.227)
Freshman GPA	75.74	74.36	77.17
	(11.02)	(11.13)	(10.74)
Likelihood of Becoming Sophomore	0.807	0.790	0.824
	(0.395)	(0.408)	(0.381)
Graduate in 4 years	0.463	0.398	0.530
	(0.499)	(0.490)	(0.499)
Graduate in 6 years	0.552	0.488	0.617
	(0.497)	(0.500)	(0.486)
Observations	1,501	762	739

Note: Means and standard deviations (in parentheses) reported. Sample includes all Freshmen students matched to a science advisor at AUB for the academic years 2004 to 2013.

Table 2: Freshman Science Advisor Characteristics

	Female Advisors	Male Advisors
	(1)	(2)
Advisor is Full Professor	0.661	0.834
	(0.474)	(0.373)
Advisor is Associate Professor	0.339	0.166
	(0.474)	(0.373)
Average Number of Students	32.42	34.89
	(5.470)	(13.43)
Average Number of Female Students	15.52	17.21
	(1.877)	(8.663)
Average Math SAT Score of Students	575.54	574.76
	(73.71)	(75.57)
Average Verbal SAT Score of Students	476.3	473.6
	(72.33)	(72.15)
Number of Advisors	15	35

Note: Means and standard deviations (in parentheses) reported. Sample includes all science advisors matched to Freshmen students at AUB for the academic years 2004 to 2013.

Table 3: Tests of balance of student baseline characteristics

	Likelihood of science advisor	Likelihood of female advisor	Likelihood of female advisor
	All freshman students	All freshmen students	Freshman students with science advisor
	(1)	(2)	(3)
Female Student	0.011	-0.017	-0.018
	(0.019)	(0.019)	(0.023)
SAT Math Score	-0.020	-0.013	0.011
	(0.013)	(0.012)	(0.015)
SAT Verbal Score	0.003	0.016	0.006
	(0.012)	(0.011)	(0.015)
Standardized High School GPA	-0.001	-0.002	-0.018
	(0.007)	(0.006)	(0.011)
Legacy Student	0.040	-0.004	-0.040
	(0.024)	(0.021)	(0.024)
Foreign High School	0.041	-0.044	-0.041
	(0.034)	(0.027)	(0.039)
Applied Financial Aid	0.034	0.023	0.036
	(0.048)	(0.052)	(0.073)
p-value: Joint significance of all individual covariates	0.52	0.68	0.62
Observations	2,975	2,975	1,501

Note: Coefficients in columns (1) represent estimates from a regression of the likelihood of having a science advisor on student level characteristics for all freshmen students. Coefficients in columns (2) and (3) represent estimates from a regression of the likelihood of having a female advisor on student level characteristics for all freshmen students and for students assigned to a faculty advisor in the sciences respectively. All regressions include birth year and academic year fixed effects. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 4: The effects of having a female science advisor on STEM enrollment and graduation

	Enroll in STEM			Graduate with STEM degree (within 4 years)			Graduate with STEM degree (within 6 years)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female Advisor	-0.039			-0.033			-0.034		
	(0.030)			(0.024)			(0.024)		
Female Student	-0.095***	-0.092***	-0.065***	-0.074***	-0.070***	-0.055***	-0.089***	-0.086***	-0.067***
	(0.020)	(0.020)	(0.020)	(0.014)	(0.014)	(0.015)	(0.016)	(0.017)	(0.018)
Female Advisor × Female Student	0.083**	0.085**	0.069*	0.075**	0.071**	0.065*	0.078**	0.076**	0.066*
	(0.041)	(0.039)	(0.039)	(0.034)	(0.032)	(0.034)	(0.035)	(0.034)	(0.036)
Year Fixed Effect		Yes	Yes		Yes	Yes		Yes	Yes
Advisor Fixed Effects		Yes	Yes		Yes	Yes		Yes	Yes
Student Controls			Yes			Yes		Yes	Yes
Observations	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501
R^2	0.020	0.093	0.144	0.016	0.066	0.104	0.021	0.070	0.113

Note: Dependent variable in columns 1 through 3 is the likelihood of students enrolling in a STEM major after Freshmen year. Dependent variable in columns 4 through 6 is the likelihood of graduating with a STEM degree within 4 years of enrollment. Dependent variable in columns 4 through 6 is the likelihood of graduating with a STEM degree within 6 years of enrollment. Each column represents estimates from separate regressions. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 5: The effect of having a science female advisor on GPA and overall graduation

	Freshman GPA			Graduation rate (within 4 years)			Graduation rate (within 6 years)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female Advisor	-0.100			-0.060			-0.061		
	(0.070)			(0.047)			(0.041)		
Female Student	0.222***	0.208***	0.259***	0.088***	0.081***	0.100***	0.108***	0.094***	0.112***
	(0.045)	(0.046)	(0.045)	(0.024)	(0.021)	(0.024)	(0.023)	(0.023)	(0.027)
Female Advisor × Female Student	0.176**	0.170**	0.133*	0.083*	0.105**	0.100**	0.070	0.088*	0.085
	(0.085)	(0.083)	(0.078)	(0.047)	(0.045)	(0.048)	(0.046)	(0.050)	(0.055)
Year Fixed Effect		Yes	Yes		Yes	Yes		Yes	Yes
Advisor Fixed Effects		Yes	Yes		Yes	Yes		Yes	Yes
Student Controls			Yes			Yes		Yes	Yes
Observations	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501
R^2	0.037	0.097	0.150	0.016	0.156	0.182	0.019	0.068	0.092

Note: Dependent variable in columns 1 through 3 is standardized GPA during Freshman year. Dependent variable in columns 4 through 6 is the likelihood of graduating from AUB within 4 years of enrollment. Dependent variable in columns 7 through 9 is the likelihood of graduating from AUB within 6 years of enrollment. Each column represents estimates from separate regressions. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 6: Freshman course level effects of having a science female advisor

	Take Sci. Course	Fail Sci. Course	Withdraw Sci. Course	Grade Sci. Course	Fail Non-Sci. Course	Withdraw Non-Sci. Course	Grade Non-Sci. Course
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female Advisor	-0.007	0.024	0.031**	-0.044	0.014	0.003	-0.039
	(0.025)	(0.028)	(0.012)	(0.114)	(0.016)	(0.008)	(0.052)
Female Student	-0.103***	-0.002	0.022*	0.164**	-0.026**	-0.013**	0.179***
	(0.012)	(0.022)	(0.013)	(0.068)	(0.011)	(0.005)	(0.029)
Female Advisor × Female Student	0.037**	-0.080*	-0.044**	0.240*	-0.050**	-0.006	0.149***
	(0.016)	(0.041)	(0.022)	(0.142)	(0.020)	(0.010)	(0.059)
Course-by-semester Fixed Effect	No	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Advisor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,988	3,790	3,790	3,445	12,188	12,188	11,426

Note: Each column represents estimates from separate regressions. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Advisor controls include academic rank and department. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 7: Heterogeneous Treatment Effects Based on Student Ability

	Declare STEM major	Graduate with STEM degree	Freshman GPA	Graduate university
	(1)	(2)	(3)	(4)
High ability students (Math SAT≥600)				
Female Advisor	-0.058	-0.057	-0.047	-0.087*
	(0.042)	(0.040)	(0.080)	(0.051)
Female Student	-0.103**	-0.104***	0.306***	0.106**
	(0.039)	(0.037)	(0.103)	(0.046)
Female Advisor × Female Student	0.126*	0.109*	0.090	0.051
	(0.073)	(0.064)	(0.139)	(0.074)
Lower ability students (Math SAT<600)				
Female Advisor	0.008	-0.018	-0.039	-0.063
	(0.022)	(0.020)	(0.075)	(0.043)
Female Student	-0.028*	-0.035**	0.279***	0.153***
	(0.016)	(0.016)	(0.059)	(0.038)
Female Advisor × Female Student	0.015	0.035	0.126	0.078
	(0.029)	(0.034)	(0.086)	(0.067)
Year Fixed Effect	Yes	Yes	Yes	Yes
Student Controls	Yes	Yes	Yes	Yes
Advisor Controls	Yes	Yes	Yes	Yes
Observations (High ability)	542	542	542	542
Observations (Lower ability)	866	866	866	866

Note: Each column represents estimates from separate regressions. Graduating with STEM degree and graduating university defined within 6 years of enrollment. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Advisor controls include academic rank and department. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 8: The effect of having a non-science female advisor

	Declare STEM major	Graduate with STEM degree	Freshman GPA	Graduate university
	(1)	(2)	(3)	(4)
Female Advisor	0.016	0.030	0.126**	0.051
	(0.022)	(0.021)	(0.059)	(0.038)
Female Student	-0.064***	-0.023	0.404***	0.215***
	(0.022)	(0.021)	(0.057)	(0.032)
Female Advisor × Female Student	-0.028	-0.033	-0.044	-0.032
	(0.035)	(0.033)	(0.074)	(0.049)
Year Fixed Effect	Yes	Yes	Yes	Yes
Student Controls	Yes	Yes	Yes	Yes
Advisor Controls	Yes	Yes	Yes	Yes
Observations	1,592	1,592	1,592	1,592

Note: Each column represents estimates from separate regressions. Graduating with STEM degree and graduating university defined within 6 years of enrollment. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Advisor controls include academic rank and department. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

Table 9: Freshman course-level effects of having a non-science female advisor

	Take Sci. Course	Fail Sci. Course	Withdraw Sci. Course	Grade Sci. Course	Fail Non-Sci. Course	Withdraw Non-Sci. Course	Grade Non-Sci. Course
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female Advisor	-0.002	0.006	0.005	0.124	0.015	-0.003	-0.040
	(0.022)	(0.018)	(0.013)	(0.080)	(0.014)	(0.007)	(0.048)
Female Student	-0.085***	-0.045***	-0.013	0.269***	-0.063***	-0.021***	0.237***
	(0.018)	(0.016)	(0.012)	(0.099)	(0.014)	(0.008)	(0.039)
Female Advisor × Female Student	-0.006	0.021	0.011	-0.144	-0.005	0.006	0.085
	(0.022)	(0.027)	(0.019)	(0.156)	(0.019)	(0.009)	(0.059)
Course by Semester Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Advisor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,158	3,831	3,831	3,487	13,394	13,394	12,553

Note: Each column represents estimates from separate regressions. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Advisor controls include academic rank and department. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1

B Appendix Tables

Table A1: Requirements for enrolling in history and mathematics

Number of credits required in each discipline by major

Major	English Level 200	Arabic	Humanities	Math[1]	Natural Sciences	Social Sciences	Electives
History	3	3	6	3	6	3	6
Mathematics	3	3	3	6	9	3	3

Notes: The above table shows the number of credits that a student must pass during the freshman year within each discipline in order to be eligible to enroll in history (first row) or mathematics (second row). Each course is typically equivalent to 3 credits.

Additional course and grade requirements by major

History	a minimum cumulative average of 70 in English courses taken in the freshman year
Mathematics	a minimum cumulative average of 70 in MATH 101 and 102, and a minimum grade of 70 in MATH 102

Notes: The above table shows specific courses and grades that students must obtain during the freshman year to be eligible to enroll in history or mathematics. For example, the mathematics department requires that students take Math 101 and Math 102. By passing these two courses, students receive 6 credits, thus obtaining the number of math credits required to enroll in the major (the first table shows that students need 6 credits in math).

Table A2: Summary statistics for all freshmen students

	All	Male	Female
	(1)	(2)	(3)
Female Student	0.481		
	(0.500)		
Female Advisor	0.422	0.427	0.418
	(0.494)	(0.495)	(0.493)
Math SAT Score	575.2	588.1	561.5
	(74.88)	(72.91)	(74.52)
Verbal SAT Score	473.7	470.5	477.2
	(75.23)	(76.36)	(73.87)
Standardized High School GPA	0.0567	-0.155	0.282
	(1.816)	(2.008)	(1.556)
Legacy Status	0.197	0.196	0.198
	(0.397)	(0.397)	(0.398)
Foreign High School	0.493	0.486	0.502
	(0.500)	(0.500)	(0.500)
Enroll in STEM degree	0.159	0.268	0.067
	(0.366)	(0.443)	(0.250)
Graduate with STEM degree (within 4 years)	0.010	0.163	0.044
	(0.298)	(0.370)	(0.204)
Graduate with STEM degree (within 6 years)	0.114	0.191	0.048
	(0.318)	(0.394)	(0.213)
Freshman GPA	75.78	74.37	77.30
	(11.32)	(11.32)	(11.12)
Likelihood of Becoming Sophomore	0.808	0.784	0.833
	(0.394)	(0.412)	(0.373)
Graduate in 4 years	0.464	0.386	0.549
	(0.499)	(0.487)	(0.498)
Graduate in 6 years	0.558	0.488	0.633
	(0.497)	(0.500)	(0.482)
Observations	3,093	3,093	3,093

Note: Means and standard deviations (in parentheses) reported. Sample includes all Freshmen students at AUB for the academic years 2004 to 2013 academic year, i.e. students matched to both science and non-science advisors.

Table A3: The effect of having a science advisor in Freshman year

Sample	Declare STEM major	Graduate with STEM degree	Freshman GPA	Graduate university
	(1)	(2)	(3)	(4)
All Students	-0.001	0.003	0.041	-0.010
	(0.009)	(0.009)	(0.030)	(0.017)
Female Students	0.015	0.009	0.009	-0.016
	(0.013)	(0.011)	(0.034)	(0.021)
Male Students	-0.019	-0.004	0.062	-0.006
	(0.017)	(0.015)	(0.040)	(0.023)
Year Fixed Effect	Yes	Yes	Yes	Yes
Student Controls	Yes	Yes	Yes	Yes
Advisor Controls	Yes	Yes	Yes	Yes
All Observations	3,093	3,093	3,093	3,093
Female Observations	1,487	1,487	1,487	1,487
Male Observations	1,606	1,606	1,606	1,606

Note: Each column represents estimates from separate regressions. The treatment in all above regressions is the likelihood of having a science faculty advisor. Graduating with STEM degree and graduating university defined within 6 years of enrollment. Student Controls include verbal and math SAT scores, high school GPA, legacy status, financial aid application status and birth year fixed effects. Advisor controls include academic rank. Standard errors clustered at the advisor level and reported in parentheses. *** p <0.01 ** p <0.05 * p <0.1