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ANTICIPATED DISCRIMINATION AND MAJOR CHOICE

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ABSTRACT

We study whether gender differences in university major choices result from anticipated labor market discrimination. First, we document two novel facts using administrative transcript records from a large Midwestern university: women are less likely to study science, technology, engineering, and mathematics (STEM) as well as business and economics, but 1) those who do are positively selected on ability, and 2) obtain higher grades conditional on ability. Second, we show that these facts are consistent with a signaling model in which women anticipate greater labor market discrimination in STEM, business, and economics than in other fields. Third, we provide direct empirical evidence of anticipated discrimination using a student survey. The survey reveals striking patterns of anticipated discrimination by women, particularly in STEM, business, and economics, affecting both expected economic outcomes such as wages as well as expected workplace conditions. We conclude by showing that anticipated discrimination explains women's course taking and intended major choices, but not men's.

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1 Introduction

Substantial gender inequality persists in the labor market (Goldin, 2014; Blau and Kahn, 2017). A large share of it is often ascribed to two factors: (1) women sort into lower-paying occupations than men,[1] and (2) in at least some occupations, women face labor market discrimination.[2] While these two explanations have received substantial attention in the literature, they are often treated as distinct, mutually-exclusive alternatives. Discrimination is often considered a "demand-side" explanation, while sorting is often considered a "supply-side" explanation, for example arising from gender differences in preferences or constraints. In this paper, we show that the two are in fact directly linked: women's sorting partly reflects anticipated discrimination in certain occupations.

In particular, we study how anticipated gender discrimination influences college major choice. Women are well-known to be underrepresented in STEM fields, which typically lead to higher-paying jobs. Common discourse and some evidence suggests that they may also be particularly likely to face labor market discrimination in those fields, indicating that the two could be related. Since labor market outcomes depend heavily on pre-market investments like education, if women anticipate discrimination in STEM fields, they could be deterred from pursuing these majors, in turn driving differential sorting and inequality in the labor market. Despite this intuitive connection, while there is a large literature on understanding determinants of college major choice and gender gaps (Altonji, 1993; Arcidiacono, 2004; Arcidiacono, Hotz and Kang, 2012; Altonji, Blom and Meghir, 2012; Beffy, Fougere and Maurel, 2012; Zafar, 2013; Stinebrickner and Stinebrickner, 2014; Altonji, Arcidiacono and Maurel, 2016; Kirkeboen, Leuven and Mogstad, 2016; Patnaik, Wiswall and Zafar, 2020), no empirical evidence explicitly links labor market discrimination to college major choices.

We fill the gap in four steps. First, we document novel empirical facts using administrative transcript records from a large selective public university in the Midwest. Second, we show

[1] Proposed explanations for gender differences in occupational sorting include (subjective) earnings expectations, confidence and competitiveness, preferences for non-wage amenities, and a lack of representation. See Niederle and Vesterlund (2007); Fernandez and Friedrich (2011); Zafar (2013); Pan (2015); Wiswall and Zafar (2021).

[2] See Goldin and Rouse (2000); Bertrand and Duflo (2017); Sarsons (2017); Benson, Li and Shue (2024); Exley et al. (2024) for gender discrimination and Moss-Racusin et al. (2012); Reuben, Sapienza and Zingales (2014); Bohren, Imas and Rosenberg (2019); Kessler, Low and Sullivan (2019); Kessler, Low and Shan (2023) for STEM fields in particular.

that these facts are consistent with a theoretical framework in which women anticipate (more) labor market discrimination in STEM, business, and economics (STEM/BE) fields. Third, we present direct evidence of anticipated discrimination using a survey of first- and second-year students at the university. Fourth, we test whether anticipated discrimination explains students' behavior.

In the transcript analysis, we study differences in major choice and achievement, namely grades, between men and women. We document that women are underrepresented in STEM/BE, but substantially less-so among high-ability students (as proxied using standardized college entry test scores). Further, conditional on majoring in STEM/BE, women obtain higher grades than men throughout the ability distribution, but the difference is again smaller near the top of the ability distribution. Notably, this grade advantage grows in STEM/BE relative to other majors after students declare their major, suggesting that major choice partly drives the pattern.

Our theoretical framework builds on the model of signaling and statistical discrimination from Lang and Manove (2011). Students decide how much to invest into an observable signal of ability (i.e., grades) and in which major to invest in. Two primary assumptions regarding anticipated discrimination are necessary for the framework to predict the facts we document in the transcript analysis. First, one group of students (i.e. women) anticipates more labor market discrimination in one category of majors (i.e. STEM/BE) than the other. This implies that discrimination can distort women's incentives to invest in those majors, affecting both major selection and grades. In particular, it incentivizes investments into signaling, such that women in STEM/BE obtain higher grades conditional on ability, but since investment is costly, they are less likely to select STEM/BE in the first place. The second assumption is that (anticipated) discrimination decreases with investment, such that it can be partly overcome by high-ability students. This implies that the distortionary effects of discrimination are concentrated in lower parts of the ability distribution.

Our student survey has two main components: a vignette experiment eliciting beliefs about hypothetical students and a counterfactual choice experiment eliciting respondents' own expectations about graduating in different majors. It has three main goals: (1) testing whether students anticipate discrimination and whether it is consistent with our framework's assumptions, (2) testing what type(s) of discrimination students anticipate, and (3) testing whether anticipated discrimination relates to students' behavior. The survey uncovers stark patterns of anticipated discrimination, reported almost exclusively by women, particularly in STEM/BE.

In the vignette experiment, respondents were less likely to recommend STEM/BE for female students, perceiving these fields as harder for women to have a successful career in, even controlling for characteristics like interest and ability. These differences arise before introducing discrimination or gender inequality in the survey. When asked to explain their recommendation through an open-ended question, many referred to some notion of discrimination towards women in STEM/BE, without prompt or explicit priming about gender or discrimination. Afterwards, directly inquiring about expectations of discrimination confirms that women are anticipated to face labor market discrimination, particularly in STEM/BE, while men are not anticipated to face nearly as much discrimination in either major category. These findings directly support the first assumption from our theoretical framework: one group (women) is anticipated to face discrimination particularly in one category of majors (STEM/BE). We then document that women, in particular high-ability ones, are expected to be able to overcome some discrimination they will face through hard work and excelling, though substantial anticipated discrimination remains across the ability distribution. These findings are consistent with our framework's second assumption: anticipated discrimination decreases with investment/ability.

In the counterfactual choice experiment, we document that women expect some discrimination during their study, but more in the labor market, especially in STEM/BE. They anticipate discrimination in the form of classical economic outcomes, namely lower pay and fewer job offers compared to equally-qualified male candidates. They also expect to face worse workplace conditions in STEM/BE, including underestimation of their competence, hostility, and sexual harassment. These concerns are weaker in other fields but remain substantial, painting a bleak picture of the workplace conditions women expect to face. In contrast, men anticipate facing little discrimination across the board.

Using our survey measures combined with the transcript data, we show that anticipated discrimination relates to women's intended major choice and course taking. Higher anticipated discrimination in the labor market is associated with a decreased likelihood of women intending to major in STEM/BE by about 9 percentage points, controlling for differences in interest, ability, and other perceived differences between STEM/BE and other fields. In contrast, men's intended major choices are unaffected by anticipated discrimination. Overall, accounting for differences in anticipated discrimination across men and women can close 30-45% of the gender gap in STEM/BE, substantially more than accounting for differences in interest or ability. We also find that a one standard-deviation increase in anticipated discrimination is associated with a 10% lower share of STEM/BE courses taken by women in their first term at the university, with again little impact for men.

It is worth noting that anticipated discrimination in STEM/BE by women is widespread. All groups of women – those with high and low self-assessed ability in STEM/BE, those with high and low levels of interest in STEM/BE, those with high and low intended probability of pursuing STEM/BE, and those intending to select majors with relatively high and low shares of women – anticipate substantial discrimination in STEM/BE. Moreover, the impact of anticipated discrimination on intended major choice is stronger for first-year students, for whom major choice is presumably less settled (relative to second-year students). These findings support the interpretation that anticipated discrimination affects major choice, rather than the other way around. In particular, they suggest that our results are unlikely to be driven by ex-post rationalization of women who decide not to pursue STEM/BE or by anticipated discrimination only being reported by subsets of women who are less informed or avoid STEM/BE for other reasons.

Gender discrimination in the labor market has been extensively discussed in both public and academic discourse.[3] It is thus unsurprising that students are exposed to these concerns - over two-thirds of women in our survey report exposure to information suggesting STEM/BE may be less suitable or more challenging because of their gender. Yet, this paper is the first to explicitly document how women internalize such concerns and account for them when making high-stakes decisions (while men do not). Our findings contribute to growing evidence that uncertainty and subjective expectations influence education decisions and economic inequality (Patnaik, Wiswall and Zafar, 2020).

This paper contributes primarily to the literature on discrimination, education, and gender inequality. Theoretical work often posits that agents are aware of and adapt to future discrimination they will face (Arrow, 1973; Lundberg and Startz, 1983; Coate and Loury, 1993; Lepage, 2024). Empirical tests are scarce, because they typically require data linking

[3] See Gould, Schieder and Geier (2016) and Hill (2017) for examples of popular discourse on the gender pay gap and discrimination against women. Surveys also report high rates of workplace discrimination experienced by women (Funk and Parker, 2018; Pew Research Center, 2018).

pre-market investments to (expectations of) labor market discrimination. Some studies on race provide evidence that schooling and wage patterns align with models of anticipated discrimination (Lang and Manove, 2011; Batistich et al., 2022). Other evidence largely comes from experiments, documenting that individuals alter their behavior when facing potential discrimination (Zussman, 2013; Alston, 2019; Charness et al., 2020; Exley and Kessler, 2022; Gagnon, Bosmans and Riedl, 2022; Kudashvili and Lergetporer, 2022; Angeli, Matavelli and Secco, 2023; Ruebeck, 2024). We instead measure subjective beliefs about anticipated discrimination and relate them to real, high-stakes education decisions. To our knowledge, only Ugalde (2022) and Exley et al. (2024) follow a similar approach, providing evidence that concerns of discrimination influence how women perceive and respond to their grades.[4] In contrast, we focus on anticipated discrimination and differences in major choice, a key determinant of gender inequality.

Our results provide an explanation for why women who appear qualified and interested in STEM/BE fields may not pursue a career in those fields at various stages of the process if they experience or anticipate discrimination, contributing to the "leaky pipeline" of women in STEM/BE fields. By overlooking expectations of discrimination, prior work may overstate the importance of preferences versus (perceived) opportunities in driving gender differences in education choices (Zafar, 2013; Wiswall and Zafar, 2018). Recent work documents that students value educational and career satisfaction when selecting fields, contributing to the under-representation of women in traditionally male-dominated fields (Hansen et al., 2024). Our findings highlight that this likely arises in part because women expect discrimination in those fields, both in university and the workplace. They also align with evidence that individuals attempt to sort in order to avoid hostility and harassment in the workplace and are willing to pay to avoid negative workplace conditions (Fortin, Lemieux and Rehavi, 2021; Folke and Rickne, 2022; Collis and Van Effenterre, 2024).

Our findings have important implications for understanding gender inequality. They show that the range of decisions and outcomes distorted by discrimination is broader than often considered.[5] By acting as a barrier to women's entry in certain fields, discrimination contributes to the misallocation of talent in the economy (Ashraf et al., 2024; Lubczyk and

[4]Existing work also studies how female students respond more strongly to their grades, contributing to the gender gap in STEM when grading is harsher for those courses (Ahn et al., 2024).

[5]Similarly, research on bargaining and negotiating documents that gender disparities arise in part from women anticipating backlash. See Recalde and Vesterlund (2022) for a review.

Moser, 2024). We show that discrimination also affects which women enter certain fields, namely creating positive selection of women in STEM. Whether men and women appear evenly balanced in terms of productivity-relevant characteristics is often used as a test of bias, for example regarding an employer's hiring and promotion decisions (e.g. the Becker outcomes test). Our results indicate that the presence of more qualified women in certain fields or at certain firms may in fact not arise from contemporaneous biased decisions of employers, but sorting of women based on the anticipation of bias, even before market entry.

Finally, our findings have implications for the empirical literature that investigates gender gaps. While the gender wage gap typically shrinks substantially when controlling for field of study or occupation, the appropriateness of these controls hinges on why men and women select different fields in the first place.[6] This paper makes clear that field choices and grades can be endogenous to discrimination, relating to a literature on inequality and "bad" controls (Neal and Johnson, 1996; Neal, 2004; Lang and Manove, 2011; Carlana, 2019).

2 Data

We analyze administrative transcript records for 39,650 undergraduate students first enrolled between fall 2013 and fall 2020 at a large, 4-year Midwestern public university. In fall 2020, the university had slightly over 30,000 on-campus undergraduates, 50.4% of whom were female. Students admitted in that year, on average, had a 3.9 high school GPA and a 1,430 SAT score. The data consist of student-term transcripts (grades, courses, declared majors) and admission information (residency, standardized test scores, and demographics). Column 1 of Table 1 presents summary statistics on the student population.

Around 20% of students first declare a major in their first year, 40% in their second, and 90% by the end of their third. Students can switch majors without a fixed deadline, but we focus on the final major declared (i.e., the graduation major), since we are interested in labor market expectations related to graduating with a given major.

Our analysis examines gender differences over the ability distribution. We use standardized college entry test scores (SAT/ACT) as a proxy for ability, reflecting skill and

[6] Previous work has argued that differences in education fields could constitute both a cause and a consequence of gender inequality, if they arise from norms or stereotypes (Bertrand, 2020).

preparedness at college entry.[7] These test scores were mandatory for admission during the period. We do not assume that they necessarily capture a student's true underlying ability in the absence of potential biases or earlier-stage discrimination (Cvencek, Meltzoff and Greenwald, 2011), but they serve as a pre-determined skill measure at the time when students choose a major.[8]

In our analysis, we categorize majors into two broad groups: STEM, business, and economics (STEM/BE) and all other majors (non-STEM/BE), namely humanities and other social sciences. These groups account for 58% and 42% of total enrollment, respectively. Gender composition differs substantially: women comprise 41% of STEM/BE majors and 68% of non-STEM/BE majors. While gender distribution may vary across individual majors within those categories, this dichotomy is useful for consistency with the survey, which we wanted to remain parsimonious. The two categories also have salient differences in terms of labor market outcomes an gender associations. In the transcript analysis below, we investigate the robustness of our results to alternative categorizations.

2.1 Student survey

In early winter 2024, we conducted an online survey via Qualtrics with first- and second-year students at the same university. A random sample of students was invited, and those who completed the survey received a $20 Amazon gift card, a potential $1 bonus based on specific answers, and entry into a drawing for one of 25 $75 Amazon gift cards. A total of 2,133 students completed the survey, corresponding to a response rate of approximately 16%. Table 1 compares the survey sample to the transcript data population, showing slight over-representation of female and high-achieving students, consistent with other student surveys. The survey questionnaire is available in the Online Appendix.

Women in the survey were less likely than men to intend majoring in STEM/BE. As shown in Figure 1, while a majority of both male and female respondents intend to major in STEM/BE, the proportion is substantially higher for men, resulting in a gap of nearly 20 percentage points.[9] Respondents are largely aware of this gender gap. In 2022, the ratios

[7] ACT scores were converted to SAT-equivalent scores for comparability. For students reporting both SAT and ACT scores, we use the average of the SAT and (converted) ACT scores.

[8] The scores are also plausibly known privately by students and not available to employers, consistent with the notion of ability in the model outlined in Section 4.

[9] The fraction of respondents reporting being likely to major in STEM/BE exceeded the university's

of graduating women to men were 41% in STEM/BE and 68% in non-STEM/BE, while respondents believed these ratios to be 43% and 61%.[10]

Table 2 presents an overview of students' perceptions about studying and working in STEM/BE versus non-STEM/BE, focusing on aspects other than discrimination. Students expect higher salaries in STEM/BE, but women anticipate earning less than men in both categories — 14% less in STEM/BE and 7% less in non-STEM/BE. Students also expect better job prospects within six months of graduating in STEM/BE, with minimal economic differences by gender. Expectations about non-monetary benefits are similar across major categories, though women anticipate slightly better benefits in non-STEM/BE. Students believe STEM/BE requires substantially more weekly study hours to succeed, with women perceiving a slightly larger workload. Men expect to rank 34th out of 100 in ability in both major categories, while women expect to rank lower, particularly in STEM/BE. This self-assessed ability gap exceeds the gender gap in SAT scores, aligning with evidence on gender differences in confidence (Möbius et al., 2022). Finally, women report greater interest in non-STEM/BE subjects, whereas men express the opposite.

While the survey focuses on STEM/BE versus other majors, we also asked respondents which specific major they would be most likely to select within each broad category. This allows us to investigate below whether anticipated discrimination varies based on a major's characteristics (for example, proportion male) within STEM/BE and non-STEM/BE.[11]

3 Empirical facts on major choice and achievement

We examine gender differences in the likelihood of majoring in STEM/BE versus non-STEM/BE over the ability distribution in panel (a) of Figure 2. We characterize ability

2022 STEM/BE graduating share. This is likely due to three factors: (1) a steady increase in STEM/BE enrollment over the past years which is expected to continue as our survey respondents graduate, (2) women switching out of STEM/BE while in university (Figure B.1), and (3) a slight over-representation of STEM/BE students in the survey.

[10] For half of respondents, these questions were incentivized ($0.5 per answer within 1 percentage point of the true ratio), but there was little difference in belief accuracy across the two groups (p-value = 0.81 for the null that incentivized and non-incentized respondents have the same accuracy).

[11] To the extent that women within STEM/BE intend to sort into specific majors in which they anticipate less discrimination and anchor their expectations on those majors, then beliefs in the survey would tend to underestimate the true average difference in anticipated discrimination between STEM/BE and other majors.

using deciles of overall standardized test scores, but results are similar using SAT math scores instead (Figure A.1). Negative values throughout indicate that women are less likely than men to major in STEM/BE, consistent with prior research.[12]

On average, the share of men graduating in STEM/BE is 40–45 percentage points higher than for women. However, the "missing mass" of women is unevenly distributed across ability. The gender gap is narrower in the top quartile and widens down the ability distribution. Interestingly, the gap is smaller in the first decile than the rest of the bottom of the distribution, which we omit from the fitted line due to implications of the model discussed in the next section.

Next, we compare gender differences in university grades over the ability distribution in panel (b). Women obtain higher average grades in both STEM/BE and non-STEM/BE, across the entire ability distribution. To the extent that anticipated discrimination incentivizes students to perform well in order to signal their ability, as formalized in the model below, this pattern is consistent with women potentially anticipating discrimination in both major categories.[13] In STEM/BE, there is also evidence of an ability gradient, with grade differences being smallest at the top of the ability distribution. In contrast, there is little evidence of a gradient for non-STEM/BE.

The first two panels of Figure 2 suggest that women in the lower ability ranges are especially less likely to major in STEM/BE, but those who do are particularly likely to obtain higher grades relative to men of similar ability. To isolate whether these differences appear influenced by major choice, we examine the evolution of grades before and after students declare their major. Consistent with major choice playing a role, panel (c) shows that after majors are declared, women's grade advantage grows sharply in STEM/BE but shrinks in non-STEM/BE.[14] Appendix Table A.1 shows that these patterns are robust to including controls for the timing of major declaration, major fixed effects, and restricting

[12] Appendix Figure A.2 shows that the relative likelihood of choosing STEM/BE increases with ability for men and women, but more steeply for women. Figure A.3 shows that the pattern is broadly robust to omitting female-dominated STEM majors, omitting business and economics from STEM/BE, and omitting engineering which requires applying to a different school within the university.

[13] Consistent with this, Ugalde (2022) provides evidence that female students appear to value grades more than male students specifically due to concerns of gender discrimination.

[14] One alternative explanation for the higher grades women obtain conditional on SAT scores is that they under perform on standardized tests relative to their true ability, for example due to pressure (Azmat, Calsamiglia and Iriberri, 2016), but it is less clear how this would generate the differential ability gradient in STEM/BE documented in panel (b) or the dynamic effect from declaring a major in panel (c).

the analysis to a major's core courses.

To summarize, we have documented the following two empirical results:

Result 1. *Women are underrepresented in STEM/BE, particularly in the lower portions of the ability distribution.*

Result 2. *Women in STEM/BE achieve higher grades than men of the same ability, particularly in the lower portions of the ability distribution.*

While it is well-known that women are less likely to major in STEM/BE, to our knowledge, these are new facts. Next, we show that a simple model of signaling and statistical discrimination can generate these facts. Of course, there could be other factors driving these patterns. In Section 5, we will present findings from our survey that corroborate key elements of the model and the facts presented here, lending further credence to our hypothesis that anticipated discrimination is a driver of gender gaps in major choice.

4 Model of college major choice and anticipated discrimination

We present a model in which students choose a major and a major-specific level of investment into signaling their ability through grades. The model is similar to Lang and Manove (2011), which studies the decision to invest into education to signal ability across race. We instead study major choice across gender and introduce a second dimension beyond signaling: sorting. That is, anticipated discrimination in the labor market may not only distort how much students invest into signaling, but also what they major in.

4.1 Baseline model

Students have ability a drawn from $[\underline{a}, \overline{a}]$ and preference for major O, t_O drawn from $[\underline{t}, \overline{t}]$. This preference reflects factors unrelated to ability or productivity, such as interest in the major's content. Both a and t are privately observed by students and independently drawn. Students choose one of two majors denoted by $\{0, 1\}$ and a level of investment $i = I(a)$, representing effort toward grades, which for now is assumed to be non-major-specific. A student's investment cost is $c(a,i) > 0$ and twice continuously differentiable.[15]

The choice of major does not, in itself, directly affect productivity, but the level of investment does.[16] Worker productivity P follows a normal distribution:

$$f(a,i) + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon^2).$$

Employers observe i, which in our context corresponds to grades, and a noisy signal of productivity $s = P + \mu$ with $\mu \sim N(0, \sigma_\mu^2)$.[17] s can be thought of as a direct signal of productivity employers observe about a worker, for example through an interview or pre-employment test. Workers have no outside option and we focus on separating equilibria, such that employers can infer a worker's ability from observing their investment. As in Lang and Manove (2011), we assume that neither the worker nor the employer can perfectly deduce productivity from ability and investment. Productivity also depends on a random element ε (for example match-specific effects), implying that expected productivity increases in a and i, but that firms still put nonzero weight on s in their assessment of a worker.

From an employer's perspective, a worker's expected productivity is:

$$E_{\mu,\varepsilon}[P|i,s] = \gamma f(a,i) + (1-\gamma)\hat{f}(i),$$

where $\hat{f}(i) = f(A(i), i)$ is the equilibrium inference of an employer about $f(a,i)$ after observing i with $I^{-1}(i) = A(i)$ and $\gamma = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\mu^2}$ is the weight employers attach to signal s. Accordingly, an employer's expectation of a worker's productivity is a weighted average of the direct signal of productivity s they observe about the worker and of the inference about the worker's productivity from observing their investment (i.e. grades), which in equilibrium reveals their ability.

A worker chooses investment i to maximize $[E_{\mu,\varepsilon}[P|i,s] - c(a,i)]$. Our setup accommodates various outcomes of interest for workers, such as wages or hiring likelihood, that

[15] We assume $c_i(a,i) > 0$, $c_a(a,i) < 0$, $c_{ia}(a,i) < 0$, and $c_{ii}(a,i) > 0$.

[16] We assume that the return to productivity (e.g. salary) and investment cost (e.g. course difficulty) are the same across the two majors. Since we are interested in gender differences, this simplification has no impact on predictions unless returns or costs differ by gender, which we discuss in the next subsection.

[17] We assume that $f(\cdot)$ is twice continuously differentiable, with $f_a(a,i) > 0$, $f_i(a,i) > 0$, $f_{aa}(a,i) < 0$, $f_{ii}(a,i) < 0$, and $f_{ia}(a,i) > 0$.

increase with expected productivity. Deriving the first-order condition under the equilibrium assumptions $\hat{f}(i) = f(a, i)$ and $A(i) = a$ yields:

$$f_i(a, i) + (1 - \gamma) f_a(a, i) A^{'}(i) = c_i(a, i). \quad (1)$$

Equation (1) characterizes the optimal investment $I^*(a)$. In equilibrium, $I^*(\underline{a})$ must be efficient and unaffected by signaling, satisfying $f_i(a, i) = c_i(a, i)$. Since $(1-\gamma) f_a(a, i) A^{'}(i) \geq 0$ and given continuity and concavity conditions on $f(\cdot)$ and $c(\cdot)$, all other ability types invest more than $\underline{a}$ and $I^*(a)$ is strictly increasing in a.

Given $I^*(a)$, students select major 0 if and only if:

$$E_{\mu,\varepsilon}[P|I^*, s] - c(a, I^*) + t_0 > E_{\mu,\varepsilon}[P|I^*, s] - c(a, I^*) + t_1. \quad (2)$$

Since $I^*(a)$ does not vary across majors thus far, students simply select major 0 when $t_0 > t_1$.

4.2 Labor market discrimination

Now suppose students belong to one of two groups $g = \{M, F\}$. Both groups have the same distribution of ability and preferences.[18] We assume that group F anticipates facing discrimination in major $O = 0$ while neither group anticipates facing discrimination in major $O = 1$. Conceptually, all that is needed for discrimination to distort behavior is that it is anticipated, whether accurately or not. We can thus test some of the model's assumptions using the survey in the next section. Still, for simplicity, we assume in the model that expectations regarding labor market discrimination are rational.

Testable Assumption 1. *Group F anticipates facing (more) labor market discrimination than group M, particularly in one of the two majors.*

There are several potential ways to introduce discrimination in the model. Our focus is on documenting the existence of anticipated discrimination and its impact on behavior, rather than studying the underlying causes of discrimination in the labor market. Accordingly,

[18]Differences in ability of preferences across majors, such as those arising before college, could explain group differences in major choice. Yet, they would not generate differences conditional on ability, leaving model predictions largely unchanged.

we follow a standard approach in the statistical discrimination literature by introducing it through employers observing noisier direct productivity signals s for group F than for group M in major 0. Formally, $\sigma^2_{\mu,F,0} \geq \sigma^2_{\mu,M,0}$ leading to $\gamma_{F,0}(i) \leq \gamma_{M,0}(i)$. It implies that employers put less weight on the direct signal s they observe and therefore more weight on the investment signal of group F, incentivizing them to invest more (i.e. obtain higher grades conditional on ability).[19] This is motivated by women's underrepresentation in STEM fields, which may limit employers' familiarity with assessing female candidates. As shown below, Assumption 1 is sufficient to generate the first part of our empirical results, namely that group F is underrepresented in one major (i.e. STEM/BE) and obtains higher grades than group M when they do select that major, holding ability constant.

To introduce scope for anticipated discrimination to vary with ability, we introduce the notion that high-performing students expect to be able to overcome it, leading to a second assumption that we can test using the survey.

Testable Assumption 2. *Anticipated discrimination decreases with investment.*

Specifically, following Lang and Manove (2011), we assume that $\sigma^2_\mu(i)$ decreases with investment such that, for high enough investment (grades), employers perfectly observe productivity from the direct signal and do not rely on the investment signal.[20] That is, $\sigma^2_\mu(i) = 0$ and therefore $\gamma(i) = 1$ for $i \geq \bar{i}$. Define a^c as the cutoff ability level beyond which $I^*(a) > \bar{i}$.

For both groups, when $a = \underline{a}$ or $a \geq a^c$, the optimal investment decision is characterized by $f_i(a, i) = c_i(a, i)$, so discrimination does not distort investment decisions. For group F with $a \in (\underline{a}, a^c)$, the optimal investment decision is characterized by:

$$f_i(a, i) + (1 - \gamma(i)_{g,O}) f_a(a, i) A'(i) = c_i(a, i).$$

Since $\gamma_{F,0}(i) \leq \gamma_{M,0}(i) = \gamma_{F,1}(i)$, the group invests more in major 0 than major 1 (and invests more in major 0 than group M, whose major and investment decisions are unchanged from the baseline model for $a \in (\underline{a}, a^c)$).

[19] Similar implications could arise if signals are equally noisy but employers underestimate group F's productivity in major 0 conditional on the direct signal they observe, for example due to biases associated with gender stereotypes in STEM/BE fields.

[20] The assumption that discrimination completely disappears beyond a certain investment level is not necessary, but simplifies exposition.

Group M and group F with $a = \underline{a}$ or $a \geq a^c$ select a major according to Equation (2). For $a \in (\underline{a}, a^c)$, group F selects major 0 if and only if:

$$E_{\mu,\varepsilon}[P_{F,0}|(I^*_{F,0}, s)] - c(a, I^*_{F,0}) + t_0 > E_{\mu,\varepsilon}[P|(I^*, s)] - c(a, I^*) + t_1.$$

Additional investment yields higher (inferred) productivity, but also higher investment costs in major 0. Given decreasing (increasing) returns to i for $f(\cdot)$ ($c(\cdot)$), the expected return to major 0 is lower. Group F students are thus less likely to select it, and those who do have higher levels of investment conditional on ability, especially in the middle and bottom (excluding the very bottom) of the ability distribution.

This additional investment implies that employers infer a lower ability for these students compared to group M, for the same grades ($E_{\mu,\varepsilon}[P_{F,0}|(i, s)] \leq E_{\mu,\varepsilon}[P_{M,0}|(i, s)]$). While our model emphasizes education decisions, this has implications for labor market inequality and the returns to grades across genders. Some evidence indeed suggests that the return to GPA is lower for female students (Exley et al., 2024).

4.3 Summary

The model, when applied to discrimination faced by women in STEM/BE, generates the following predictions, consistent with Results 1 and 2 from the transcript analysis:

Prediction 1. Women are underrepresented in STEM/BE, particularly in the lower portions of the ability distribution (excluding the very bottom).

Prediction 2. Women in STEM/BE achieve higher grades than men of the same ability, with larger differences in the lower portions of the ability distribution (excluding the very bottom).

One additional model implication is thus an expected trend break and steeper ability gradient when excluding the bottom of the ability distribution. While we did not emphasize this when presenting the transcript evidence, it is consistent with patterns in Figure 2. Moreover, while the model is static, it intuitively suggests that newly-enrolled students, uncertain about their major, may experience shifts in GPA after choosing a major. Specifically, declaring a STEM/BE major could lead women to outperform men if it confirms their intent to major in STEM/BE and therefore face discrimination, consistent with panel (c) of Figure 2.

The model introduces anticipated labor market discrimination while abstracting from other factors that could contribute to the empirical patterns we document, and the transcript analysis does not allow us to explicitly distinguish between anticipated discrimination and these other factors. This motivates the student survey to which we turn next.

5 Documenting anticipated discrimination and validating model assumptions

In this section, we provide evidence from our student survey on whether students anticipate discrimination and whether it is consistent with our theoretical framework's assumptions. This evidence largely relies on our vignette experiment, which we describe first, followed by complementary evidence from our counterfactual choice experiment.

5.1 Vignette experiment and baseline differences by profile gender

The vignette experiment asked respondents questions about fictitious profiles of male and female students in a setting where we can hold constant key profile characteristics. It presented respondents with profiles varying by gender (male or female name) and ability level (bottom 20%, median, or top 20%). Several other student attributes — seniority (first-year), interest in each major category, self-perceived preparedness for studying each major, and intended full-time employment — were held constant. Vignettes were presented to respondents in a neutral way, before introducing notions of gender inequality or discrimination in the survey.

Each respondent was shown three randomly-selected profiles out of a total of six, featuring two of the three ability levels and at least one student from each gender. To emphasize comparisons between top-performing students and those lower in the ability distribution, all respondents saw one or two profiles from the top 20% ability, and the remainder from either the bottom 20% or median ability. Therefore, each respondent was shown two profiles, one male and one female, that were identical apart from their gender, including in terms of ability, and a third profile of another ability level that could be either male or female. Appendix Figure C.1 provides an example vignette where the respondent is presented with profiles of a female and male student with low ability (bottom 20%), and a profile of a female student with high ability (top 20%). The design thus allows for within-subject analyses, using answers regarding the two profiles identical apart from their gender, as well as between-subject analyses using answers regarding the third profile. We focus on within-subject analyses, but as shown in the Appendix, our results are similar when using either source of variation, suggesting that experimenter demand effects are unlikely to be driving our results.

We first ask respondents which major category would be the best choice for each hypothetical student they were shown. We compare beliefs for the same respondent regarding whether STEM/BE or non-STEM/BE would be a better choice for a student profile, separating profiles in whether they have a male or female name. As shown in panel (a) of Figure 3, there exists a sizable difference in respondent beliefs based on a profile's gender. Respondents are more likely to report that STEM/BE would be a better choice for male than female profiles, with a statistically significant difference of approximately 6 percentage points: around 19% of respondents reported that STEM/BE would be a better choice for a male than a female profile, 13% reported the opposite, and the remainder reported that both major categories would be an equally good choice for each gender. In comparison, the raw gender gap in propensity to major in STEM/BE versus non-STEM/BE is approximately 24% at the university. This suggests that a 6 percentage point difference represents approximately 25% of the gap, which is expected to be unexplained by factors like ability, interest, and intentions to work full-time, and may instead be explained by residual factors, including discrimination.

We then ask respondents in which major category they expect that it would be harder for each student profile to have a successful career in, again comparing answers by whether the profile name was male or female (holding the other characteristics constant). Panel (b) of Figure 3 documents a statistically significant gender difference of 5 percentage points, with respondents expecting that it would be relatively harder for female than male profiles to have a successful career in STEM/BE.

In the context of the model, it is respondents' beliefs specifically regarding discrimination against their gender which are most relevant. As shown in Figure B.3, differences shown in Figure 3 are present when restricting to either female or male respondents, although they are larger when restricting to female respondents. They are also similar when we instead use between-respondent comparisons (Figure B.4).

Whenever a respondent made different recommendations as to the best major choice for a male and female profile of the same ability, they were asked to write a brief explanation, without being provided with further information. Notably, over 60% (65% of women and 53% of men) mentioned some notion of discrimination or differential treatment against women, often explicitly relating to STEM/BE. See Table 3 for example responses. Although these provide only anecdotal evidence, they capture some key elements documented more systematically through the rest of the survey. Combined with Figure 3, they make clear that concerns of gender discrimination across majors were present among at least some respondents *before* mentioning discrimination in the survey. This alleviates concerns that our primary findings result from priming or experimenter-demand effects. Moreover, if they did result from such effects, then arguably they should not explain respondent behavior as we document in Section 7.

5.2 Anticipated discrimination by profile gender, major, and ability

The survey next introduced the notion of discrimination to test Assumptions 1 and 2 of the model by providing explicit evidence on anticipated discrimination across gender, major, and ability. Discrimination was introduced as follows: *"In the media and public discourse, it is sometimes discussed that some students may face additional barriers or disadvantages in certain career paths, for example because of how they are perceived or treated given stereotypes associated with their gender [...] Name 1, Name 2, and Name 3 are concerned about potential discrimination they may face depending on the major they select."*

Respondents were first asked about the importance they attached to concerns of discrimination when making their earlier recommendations regarding which major would be the best choice for a given student profile. Consistent with the open-ended answers discussed above, discrimination concerns were substantially more important for recommendations made for female profiles about whether to major in STEM/BE, especially recommendations made by female respondents (Figure B.5).[21]

[21] Respondents were asked *"How much did concerns of discrimination or differential treatment factor into your previous answer about whether majoring in STEM/BE or non-STEM/BE would be the best choice for the student?"* Responses were elicited on a 1-5 scale, with a higher number signifying higher concerns of discrimination. The average response to this question for respondents who reported that STEM/BE would

We proceed by explicitly documenting beliefs about anticipated discrimination across three survey questions. When summarizing these results, we use respondents' answers regarding all three profiles they were presented with, given that profiles of different gender are equally represented across ability levels due to random assignment of vignettes. Results are once again similar when relying instead on between-respondent variation (Figure B.6).

The first question asked: "Do you think there is at least one category of majors in which [Name 1, Name 2, or Name 3] are likely to face additional barriers or disadvantages because of their gender?". Panel (a) of Figure 4 shows that female profiles were far more likely to be expected to face labor market discrimination (86% vs. 31% for male profiles). These differences are once again larger when restricting to female respondents, though they are present for both female and male respondents (Figure B.7). They vary little with profile ability, suggesting that, at the extensive margin, ability is not expected to prevent facing discrimination *entirely* (Figure B.8). These results support the first component of Assumption 1: labor market discrimination is expected to be stronger against women.

Among respondents who reported that a profile is likely to face labor market discrimination, we then asked in which major category the profile would be more likely to face discrimination. As shown in panel (b) of Figure 4, the vast majority of these respondents indicated that it would be in STEM/BE for female profiles (89%). The opposite is true for male profiles (71% in non-STEM/BE), although male profiles are expected to be much less likely to face discrimination in the first place, as shown in panel (a). These patterns vary little by respondent gender or profile ability (Figures B.7 and B.8). These results support the second component of Assumption 1: labor market discrimination against women is expected to be stronger in some majors, namely STEM/BE.

We then asked respondents whether they expect that a student profile could overcome discrimination: "Now consider STEM/BE and non-STEM/BE majors together. How likely do you think it is that [Name] could overcome these additional barriers or disadvantages by working hard and excelling?". Panel (c) shows that, at the intensive margin, discrimination is expected to be partly overcome through hard work and excelling. This is expected to be particularly likely for male profiles, even though they are expected to be less likely to face discrimination in the first place. There is also some evidence of a modest ability gradient,

be a better choice for a male than a female profile of the same ability was 2.7 for female profiles, versus 2.0 for male profiles.

especially for female profiles. These results support the notion that effort and good performance are relevant to overcoming discrimination and that high-ability students are expected to face less discrimination. Combined with evidence from Figure B.5 that respondents were less concerned about high-ability profiles facing discrimination in the first place, these results suggest the existence of an expected ability gradient to discrimination, as posited in Assumption 2.

5.3 Anticipated discrimination by respondent gender, major, and ability

Patterns of anticipated discrimination documented in the vignette experiment are similar when instead considering beliefs from the counterfactual choice experiment, eliciting respondents' expectations about whether they *themselves* will face discrimination depending on their major choice.

We first ask the following question: "Please answer to what extent you agree with the following statements: [While pursuing your degree/In the workplace], you will face additional barriers or disadvantages [in university] because of your gender". Answers were elicited on a -3 (strongly disagree) to +3 (strongly agree) scale. Figure 5 shows a stark gender differential. Looking at responses regarding gender-specific disadvantages while in university, female respondents agree that would be the case when studying STEM/BE (average response of 1.38), but on average, neither agree nor disagree when studying non-STEM/BE. Turning to barriers in the workplace, women agree with the notion that they would face barriers in both major categories, but greater barriers in STEM/BE (average response of 1.67 versus 0.50). Male respondents do not expect disadvantages due to their gender, either while studying or in the workplace, regardless of major.

Anticipated discrimination as elicited through the question above statistically significantly decreases with ability, specifically for women in STEM/BE, with little observed gradient for men or in non-STEM/BE. We also find a statistically significant ability gradient in expecting to be able to overcome discrimination for women in STEM/BE.[22] See figure B.9 for these results.

[22] The corresponding survey question is: "Please answer to what extent you agree with the following statements: If you face additional barriers or disadvantages in school or the workplace, you will be able to overcome them if you work hard enough and excel".

Overall, consistent with our theoretical framework, beliefs documented in the vignette and counterfactual choice experiments indicate that anticipated discrimination by women is higher, particularly in STEM/BE, and lower for high-ability women.

6 What type of discrimination or differential treatment is anticipated?

So far, we have documented the existence of anticipated discrimination, but not the form(s) students expect it to take. We now turn to this question, focusing first on discrimination in terms of classical economic outcomes and then in terms of differential workplace treatment. While our theoretical framework focuses on expected productivity, which presumably affects both wages and employment, anticipated discrimination may also affect non-wage amenities that workers value, like work climate.

6.1 Economic outcomes

We begin by providing evidence regarding the two most studied outcomes in the literature: wages and employment. Figure 6 shows responses to questions about whether students expect a differential likelihood of receiving a job offer or differential pay for the same work, compared to a similarly-qualified candidate of another gender. Panel (a) shows that 60% of women believe they would be less likely to receive a job offer when competing for a position with a similarly-qualified man if they graduated in STEM/BE fields, while fewer than 10% of women expect the opposite. For non-STEM/BE jobs, a plurality of women anticipate similar chances of receiving an offer. Most men expect similar chances across both major categories. Respondents who anticipated being more or less likely to get an offer were then asked to quantify the expected difference in percentage terms, enabling us to estimate expected offer differentials in panel (b) of Figure 6.[23] Women expect that they would be 11% (3%) less likely to receive an offer for STEM/BE (non-STEM/BE) jobs, while men anticipate negligible differences. These estimates suggest that, in spite of various industry claims regarding efforts to increase female representation in STEM, women expect to be disadvantaged for these positions.

[23]Respondents who expected no difference in panel (a) were assigned a value of 0 for this calculation.

Panels (c) and (d) provide similar evidence on pay. Over 70% of women expect that they would be paid less than similarly-qualified men for the same STEM/BE work, compared to over 75% of men anticipating equal pay. In non-STEM/BE, 51% of women expect equal pay and a slightly lower fraction expect lower pay, while most men again expect parity. Women would expect a 10% (6%) wage gap in STEM/BE (other fields), as shown in panel (d). Directionally, men also expect to be paid more, but expect much smaller pay gaps of 3% (1%).

Comparing these estimates to those of realized labor market discrimination from the literature is challenging. While these anticipated outcome differentials may appear larger than observed gaps in the labor market (for example, from correspondence studies or adjusted wage gap regressions),[24] our design differs importantly from those commonly employed in analyses of labor market discrimination. Most importantly, the estimates we present are based on counterfactual outcomes averaged across all respondents, while estimates from the literature are based on equilibrium market outcomes in which workers select into fields. Presumably, students who sort into STEM/BE, on average, perform better in the field than those who sort elsewhere would. In fact, weighting estimates from panels (b) and (d) by respondents' self-reported probabilities of majoring in STEM/BE versus non-STEM/BE approximately halves the expected gaps by women in STEM/BE, although estimates of anticipated discrimination remain substantial and statistically significant (Figure B.10). Additional caution is warranted when attempting to interpret these estimates as too small or too large, because correspondence studies typically measure callback rather than hiring differentials, and it is challenging to approximate the notion of two workers with the same qualifications doing the same work through adjusted wage gap regressions.

Still, men and women in our survey disagree on the extent of labor market discrimination, indicating that at least some have inaccurate beliefs.[25] We stress that our focus is not on identifying whose beliefs are correct, but on being the first to document these beliefs. It is these beliefs – whether correct or incorrect – that matter for understanding major choices.

[24] See Bertrand and Duflo (2023) for an overview of correspondence studies. For wage gap regressions, looking at college-educated workers aged 22-30 in the ACS from 2019-2023, the unconditional gender wage gap is 15% in STEM/BE and 9% in non-STEM/BE. But, after controlling for industry and occupation, to approximate the notion of "for the same work" from our survey question, it falls to 2.8 and 2.2%, respectively.

[25] Previous work has shown evidence of inaccurate beliefs about the extent of discrimination in the labor market (Haaland and Roth, 2023; Angeli, Matavelli and Secco, 2023).

In fact, in Section 7, we show that they are systematically related to intended major choice and course-taking behavior of students. Although not the focus of this paper, systematic biases in beliefs could indicate a role for information interventions (Patnaik, Wiswall and Zafar, 2020). Such interventions may be particularly difficult to implement in this context, given the lack of objective information on the extent of discrimination across occupations.

6.2 Workplace treatment

Beyond economic outcomes, workers also value workplace conditions, such as environments free of harassment and hostility (Folke and Rickne, 2022, 2023; Collis and Van Effenterre, 2024). Worse workplace conditions could result from treatment that does not necessarily result in economic disparities in terms of wages and employment, or could represent some underlying causes of these economic disparities. In either case, if men and women anticipate that they would face different workplace conditions based on their gender in different majors, then these could also influence major choice.

Panel (e) of Figure 6 shows the frequency with which students expect their workplace competence to be underestimated due to their gender, to face workplace hostility or worse treatment due to their gender, and to face sexual harassment at work. Men expect such instances to be very rare across both major categories. In stark contrast, women anticipate that their competence would be underestimated frequently in STEM/BE fields and occasionally in non-STEM/BE fields. They also expect that they would face hostility slightly more than occasionally in STEM/BE and somewhat less than occasionally in non-STEM/BE, and that they would experience sexual harassment occasionally in STEM/BE and slightly less than occasionally in non-STEM/BE. For women, differences in anticipated workplace conditions across major categories are statistically significant for all three outcomes and substantial for the first two. However, the striking takeaway is the high frequency with which women expect negative workplace conditions in either major category. It suggests that such conditions are expected to be a routine feature of working life for women and that, to a large extent, they are not anticipated to be avoidable by choosing between STEM/BE and other fields.

7 Anticipated discrimination and student behavior

Finally, we test whether subjective beliefs of anticipated discrimination discussed in the previous sections explain students' educational decisions, namely intended major choice and course taking.

We construct standardized indices of anticipated discrimination, separately by gender and major category, by combining answers regarding economic outcomes, workplace conditions, or both, along with the overall extent to which a respondent anticipates labor market discrimination because of their gender, presented in Figures 5 and 6.[26]

Table 4 reports values of the index, across major categories. Higher values reflect stronger anticipated discrimination. Consistent with the evidence presented above, women, particularly in STEM/BE, anticipate discrimination. Men anticipate positive discrimination in both fields. Splitting students by above/below-median interest, we see lower anticipated discrimination for women with high interest, though it remains substantial across both groups. Next, we separate the index by the gender composition of the specific majors (e.g. biology, psychology, nursing, etc.) that respondents reported they would likely choose if they majored in STEM/BE and non-STEM/BE. Female respondents anticipate more discrimination in majors with a higher share of men, within both STEM/BE and non-STEM/BE (although the difference is not statistically significant). Similarly, male respondents expect more positive discrimination in majors with a higher share of men. Last, we separate the index by the school (engineering, business, etc.) the student is enrolled in within the university, which can vary in their rules regarding major declaration (Table B.1). Female students enrolled in all schools (both STEM/BE- and non-STEM/BE-centric) anticipate that they would face discrimination in STEM/BE, and quantitatively much more than in non-STEM/BE.

Overall, anticipated discrimination is not confined to a narrow subset of women with lim-

[26] The "economic outcomes" index combines standardized measures of anticipated gender gaps in job offers and pay for respondents who expect to be less or equally likely to receive a job offer or to be paid less or equally than a worker of the other gender. The "workplace conditions" index includes standardized measures of the anticipated frequency of having one's competence underestimated and of facing worse treatment in the workplace. The "overall" index combines these four measures with a standardized measure of agreement about facing additional workplace barriers or disadvantages in the workplace due to gender (presented in Figure 5). All standardizations are conducted across major categories, pooling responses from STEM/BE and non-STEM/BE fields. It is then standardized again to have a mean of 0 and a standard deviation of 1. Anticipations relating to sexual harassment are evaluated separately since they relate less closely to classical notions of discrimination in economics.

ited interest or ability in STEM/BE or to a narrow subset of intended majors. This alleviates concerns that women who report anticipating discrimination in STEM/BE could mostly be women who would be unlikely to select it regardless of discrimination and hold those beliefs due to lack of information or in an effort to rationalize their decision to not pursue STEM/BE. Moreover, the converse is not true. Women who do intend to major in STEM/BE do not report higher anticipated discrimination in non-STEM/BE than STEM/BE, indicating that there is a specific association between STEM/BE and anticipated discrimination.

We use the index to test whether anticipated discrimination is systematically related to (stated or revealed) behavior. Panel (a) of Table 5 reports estimates from an OLS regression of respondents' stated likelihood of majoring in STEM/BE – elicited near the beginning of the survey (see Figure 1) – onto gender and survey measures of anticipated discrimination. Columns 1 and 2 show that anticipated discrimination in STEM/BE predicts a lower likelihood of women intending to major in those fields, with minimal effect on men. Interaction terms between a respondent being female and the index are statistically significant and substantial, indicating a 7.8-8.7 differential percentage point decrease in women's intentions to major in STEM/BE for a one standard deviation increase in the index. Adding controls for respondent ability, interest in course content, study hours, and non-monetary job benefits has relatively little effect on these results.[27] Separating the index into its sub-components in the next two columns indicates that the impact appears mostly driven by expected differences in economic outcomes. One explanation for this pattern is that, as shown in Figure 6, the STEM/BE versus non-STEM/BE difference in anticipated discrimination is larger for economic outcomes than for differential workplace treatment.

Since anticipated discrimination could be endogenous to experiences and choices, we perform the same analysis separately for freshmen and sophomores (Table B.2). We find that the effects are mainly driven by freshmen, suggestive of our results being driven by anticipated discrimination influencing eventual major choice, rather than anticipated discrimination being endogenously shaped by major choice.

What are the implications of these estimates for the gender gap in STEM/BE? To answer this, we estimate a regression of the probability of a student intending to major in STEM/BE

[27]Controlling for self-reported ability rather than SAT scores or adding controls for the importance of having same-gender peers in the workplace or expected monetary benefits has minimal impact, as shown in Table B.3. These controls are excluded from the main analysis as they may themselves be influenced by anticipated discrimination.

as a function of gender and progressively control for gender differences in various characteristics, including anticipated discrimination, to investigate how closing these gender differences would close the gender gap in intentions to major in STEM/BE. Depending on the order in which we include the controls, accounting for the stark gender difference in anticipated discrimination closes between 30 and 45% of the gender gap in STEM/BE - a substantially larger share than accounting for gender differences in expected salary (on average 5% of the gap), interest (on average 25% of the gap), or ability (on average 21% of the gap), which are all substantially smaller than differences in anticipated discrimination.[28]

Lastly, we investigate the impact of anticipated discrimination on first-term course taking, which likely contributes to eventual differences in major choice, by linking survey responses to transcript records. Panel (b) of Table 5 shows that women who anticipate higher discrimination in STEM/BE take a statistically significantly lower share of STEM/BE courses, with little evidence of responses by men. Expectations of discrimination gathered in the survey thus relate to earlier education decisions of students from outside the survey.

8 Conclusion

This paper shows that anticipated gender discrimination (primarily, in the labor market) distorts college students' major choice. Namely, it dissuades women from studying in STEM, business, and economics, contributing to their well-known, long-standing under-representation in those fields. Using administrative transcript records, we identify novel empirical patterns of major choice and achievement. In particular, women are less likely to major in STEM/BE, but the gender gap is substantially smaller near the top of the ability distribution. Moreover, women who do decide to major in STEM/BE obtain higher grades than men of the same ability. A theoretical framework rationalizes these patterns as resulting from female students' anticipation of labor market discrimination in STEM/BE.

Survey data confirms the notion that female students anticipate discrimination, particularly in STEM/BE and particularly lower in the ability distribution, while men anticipate little discrimination. Women anticipate discrimination in terms of lower pay, fewer job opportunities, and negative workplace conditions. These expectations are consistent with

[28]See Table B.4 for regressions showing the specifications which yield the smallest (30%) and largest (45%) effects of closing the gender difference in anticipated discrimination on the gender gap in STEM/BE.

dissuading women from majoring in STEM/BE, with little effect on men's choices.

Our findings point to several avenues for future research. For example, how women perceive the relationship between achievement, success, and discrimination remains relatively unexplored. Although high-ability women expect less discrimination in our survey, even they anticipate significant barriers. Understanding what determines whether some women persevere in the face of discrimination while others withdraw could provide insights into research on confidence, bargaining, and competitiveness (Niederle and Vesterlund, 2007; Biasi and Sarsons, 2022; Roussille, 2024).

In addition, in this paper, we focus on documenting beliefs about future discrimination held at the time of choosing a major. It is these ex-ante beliefs – regardless of whether they are correct or not in some ex-post sense – that are fundamental to understanding behavior. However, in future work, it would be valuable to investigate how these beliefs correspond to discrimination eventually experienced when these individuals enter the labor market. Understanding potential discrepancies between anticipated and realized discrimination would be important to design effective policies to enable individuals to make informed educational decisions.

Another key question is how beliefs about discrimination are formed and evolve. Addressing gender inequality could require interventions targeting both perceptions and actual discrimination. Interventions might also be needed at different stages: before college, during university, and in the workplace. More than half of women in our survey report having had negative experiences in STEM/BE courses and activities as well as having been exposed to discouraging information about STEM/BE for women (Figure B.2). Anticipated discrimination in STEM/BE also increases over time during university for women, including those who declare a major in STEM/BE (Figure B.1). These patterns suggest that anticipated labor market discrimination may be shaped by earlier exposure of women to negative treatment in those fields, consistent with life experiences shaping individuals' views of discrimination (Benson and Lepage, 2024). Understanding these processes is critical for designing effective policies.

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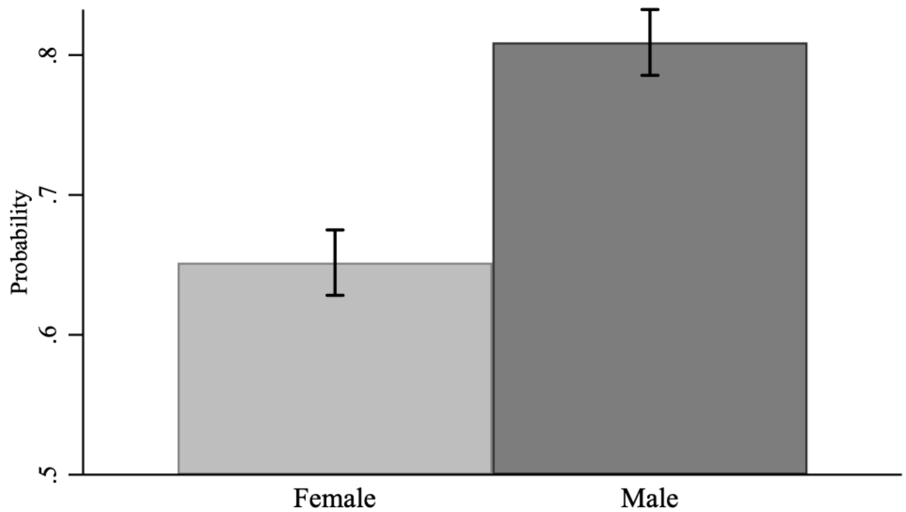
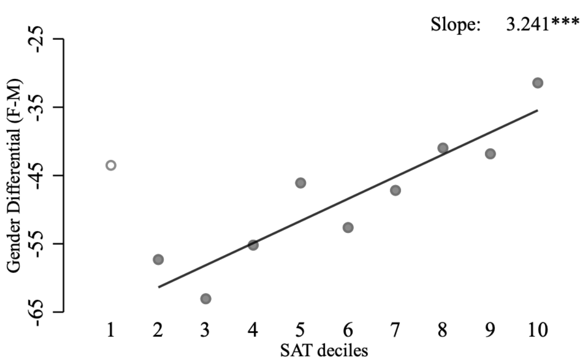
Figure 1: Intended probability of majoring in STEM/BE in the survey, by respondent gender



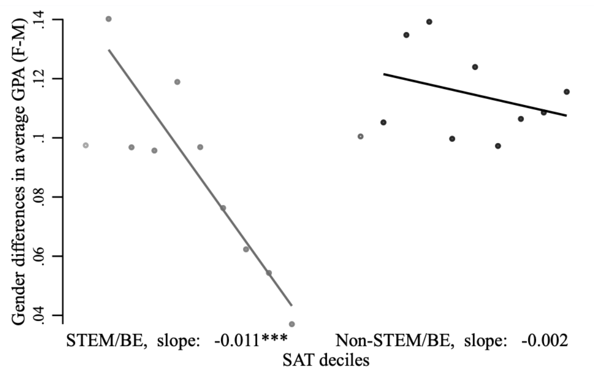
Notes: This figure reports the intended probability of survey respondents to select a major in STEM/BE, by gender. The corresponding survey question is: "What do you think is the percent chance (or chances out of 100) that you will graduate with a major in STEM/BE?".

Figure 2: Gender differences in major choice and grades from transcript records

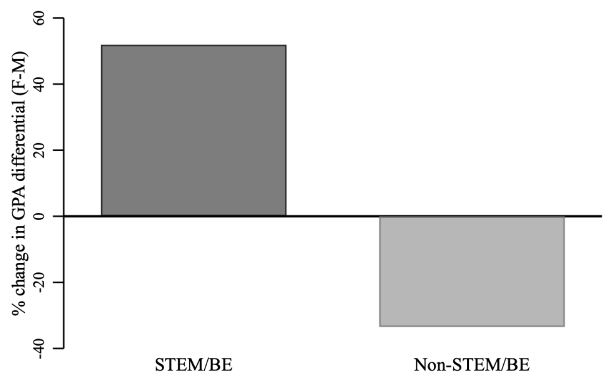
(a) Relative propensity to major in STEM/BE



(b) Relative grades across major and ability

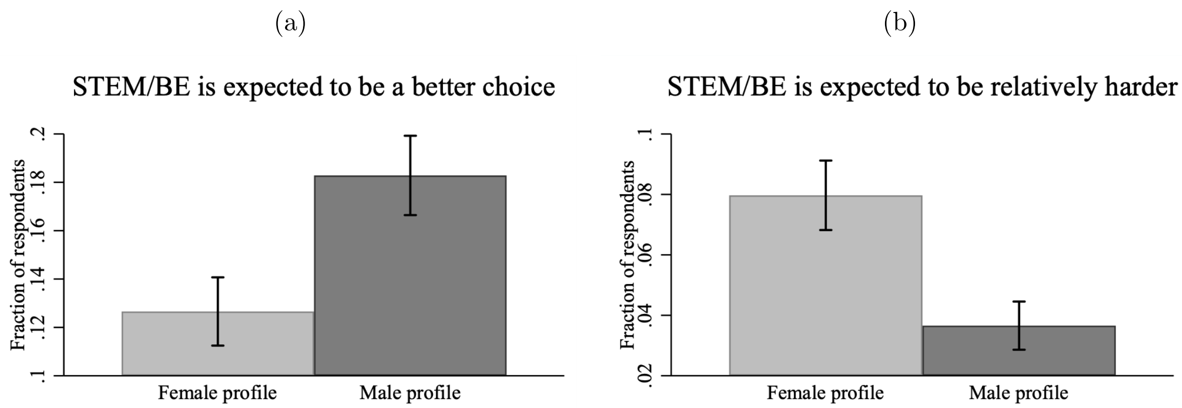


(c) Change in gender grade differential after declaring a major



Notes: Panel (a) plots the gender difference in the probability of majoring in STEM/BE versus other majors across SAT deciles. The gender difference is calculated as the fraction of women who graduate in STEM/BE minus the fraction of women who graduate in non-STEM/BE, minus the corresponding difference for men. Panel (b) plots the gender differences in graduating cumulative GPA, across SAT deciles and separately for STEM/BE and non-STEM/BE. Panel (c) plots the change in the gender difference in GPAs (Female GPA - Male GPA) from the term before students declared a major to the term after they declared a major, separately for students who declared a major in STEM/BE and those who declared a major in non-STEM/BE. We use the final major declared by a student for this analysis. This figure is based on the records of 39,650 undergraduate students first enrolled between fall 2013 and fall 2020.

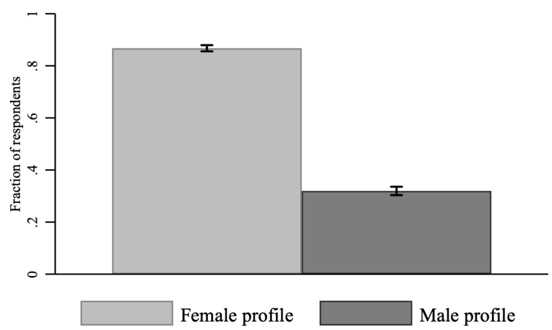
Figure 3: Major fit and career difficulty by profile gender in the vignette experiment



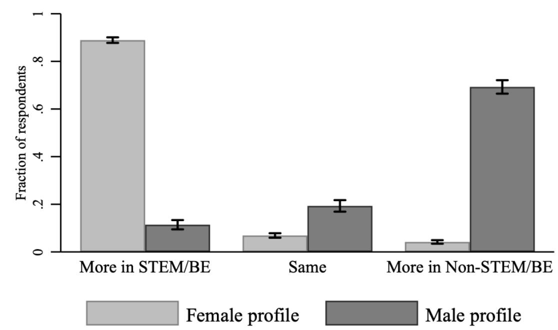
Notes: In the left panel (a), the two bars show the fraction of respondents who assign a higher probability to STEM/BE being the best major choice for a hypothetical female (male) than male (female) profile. In the right panel (b), the two bars show the fraction of respondents who reported that it would be harder for a hypothetical female (male) profile to have a successful career in STEM/BE than non-STEM/BE, compared to a male (female) profile. The figure is computed from within-respondent comparisons for two hypothetical students of different genders, but the same ability level. Corresponding survey questions are: "To what extent do you think that majoring in STEM/BE (as opposed to non-STEM/BE) would be the best choice for each student? [Answer ranges from 0 to 100.]" and "In which major category would it be more difficult for [name] to have a successful career? [Answer ranges from -3 (non-STEM/BE) to 3 (STEM/BE).]".

Figure 4: Anticipated discrimination in the vignette experiment

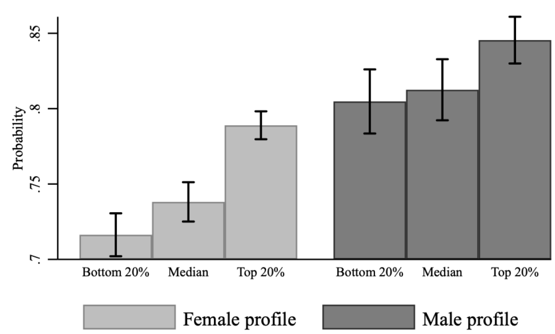
(a) Student is likely to face discrimination (yes = 1)



(b) Major in which student will face more disc.

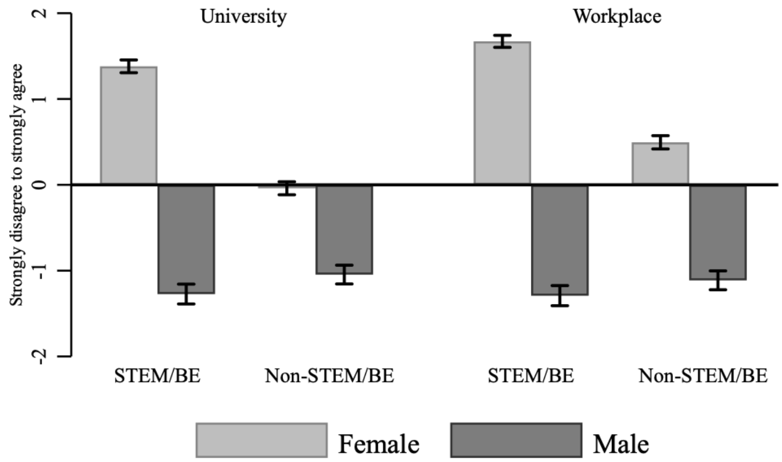


(c) Likelihood that the student can overcome disc.



Notes: Panel (a) displays the fraction of respondents who answered "Yes" (1) rather than "No" (0) to the following question: "Do you think there is at least one category of majors in which [names] are likely to face additional barriers or disadvantages because of their gender?", separately for female and male profiles. Panel (b) displays the fraction of respondents who indicated that discrimination faced by a student profile would be more, equally, or less likely in STEM/BE than non-STEM/BE, separately for female and male profiles. The question was only asked to respondents who answered "Yes" to the question from Panel (a) and was asked as follows: "In which major category would [names] be more likely to face additional barriers or disadvantages?". Panel (c) shows the reported likelihood across respondents that a student profile could overcome discrimination, separately by profile gender and ability, based on the following question: "How likely do you think it is that [names] could overcome these additional barriers or disadvantages by working hard and excelling?" [1-100]. The figure is computed using respondents' answers for each of the three student profiles presented to them.

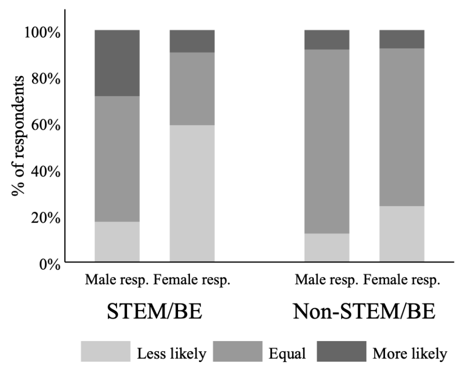
Figure 5: Anticipated discrimination in university and the workplace



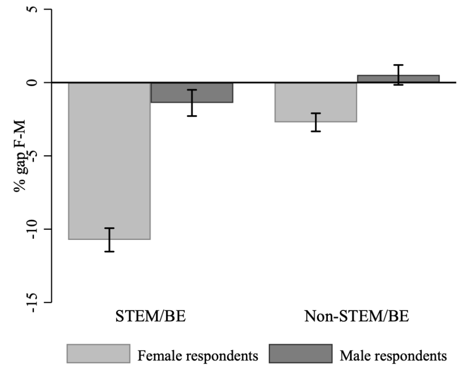
Notes: This figure plots anticipated discrimination in university and the workplace by respondent gender and their hypothetical major choice. The corresponding question was: "While pursuing your degree, you will face additional barriers or disadvantages in university because of your gender" and "In the workplace, you will face barriers or disadvantages because of your gender." The answer scale ranges from strongly disagree (-3) to strongly agree (3).

Figure 6: Anticipated discrimination in job offers, pay, and negative workplace conditions

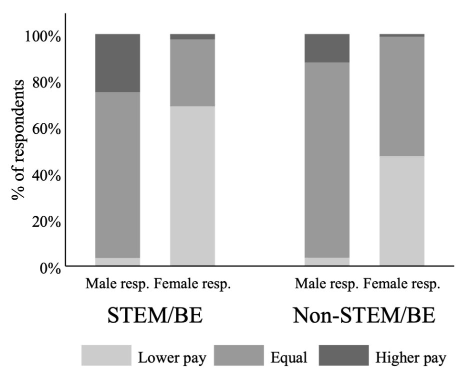
(a) Relative likelihood of getting an offer



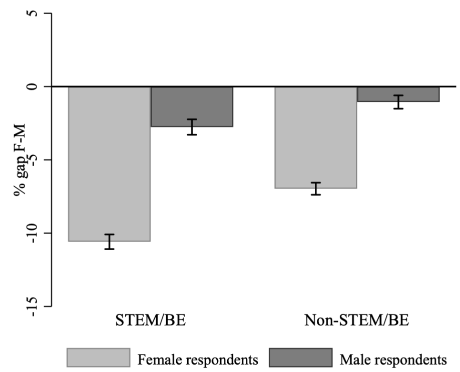
(b) Expected gender gap in job offers



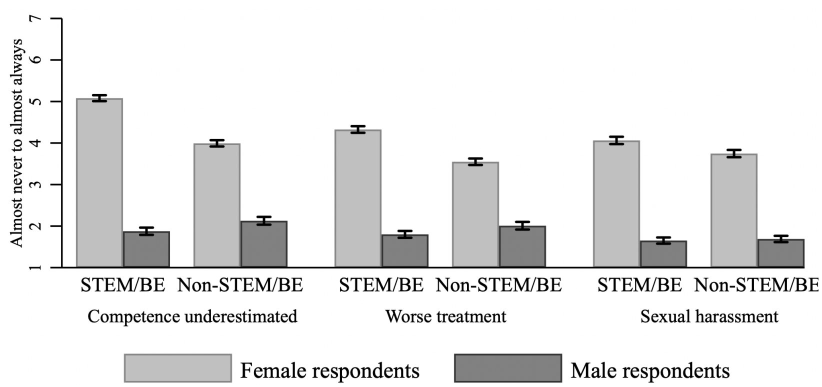
(c) Relative pay



(d) Expected gender pay gap



(e) Frequency of negative workplace conditions



Notes: Panel (a) displays the fraction of respondents who expect to be less/equally/more likely to receive a job offer than a similarly-qualified applicant of another gender, by respondent gender and their hypothetical major choice. Panel (c) displays the fraction of respondents who expect to be paid less/equally/more for the same work than a similarly-qualified applicant of another gender, by respondent gender and their hypothetical major choice. The corresponding survey questions are: "Do you expect to be [more or less likely to receive an offer for a job you apply to/paid more or less for doing the same work] than a similarly-qualified graduate of the opposite gender?". Panels (b) and (d) display the expected gender gaps in job offers and pay. When respondents expected equal outcomes in terms of job offers or pay, we assigned an expected gender gap of 0. When they expected different outcomes, the gap was calculated based on the following survey questions: "You said that you think you are [more/less likely to receive an offer/ expect to be paid more/less] in [STEM/BE or non-STEM/BE] than a similarly-qualified graduate of the opposite gender. Please indicate the percent difference you expect." Panel (e) reports responses to the following questions by respondent gender and their hypothetical major choice: "How frequently do you expect that the following situations will arise at your workplace: [Your competence will be underestimated or questioned because of your gender/You will face hostility or worse treatment because of your gender/You will face sexual harassment]? Please answer on a scale of 1-7, where 1 means almost never and 7 means almost always.".

Table 1: Summary statistics and comparison between transcript and survey samples

	Transcript		Survey population		Survey sample	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(5)	(6)
Age	22.22	(0.68)	18.87	(1.20)	18.75	(1.08)
Female	0.51	(0.50)	0.56	(0.50)	0.62	(0.49)
White	0.72	(0.45)	0.63	(0.48)	0.63	(0.48)
URM	0.09	(0.29)	0.24	(0.43)	0.20	(0.40)
International	0.04	(0.20)	0.06	(0.23)	0.06	(0.23)
GPA	3.49	(0.41)	3.55	(0.51)	3.63	(0.40)
SAT	1,425	(96)	1,402	(134)	1,415	(127)
Household income less than $99,000	0.22	(0.41)	0.26	(0.44)	0.30	(0.46)
Household income more than $100,000	0.54	(0.50)	0.51	(0.50)	0.48	(0.50)
Observations	39,650		13,705		2,133	

Notes: Columns 1 and 2 correspond to our transcript analysis sample, including all students who initially enrolled between fall 2013 and fall 2020 and subsequently earned a degree. Columns 3 and 4 correspond to the survey population of all current freshmen and sophomores, while columns 5 and 6 correspond to the survey sample. "URM" represents U.S. citizens or U.S. permanent residents who have self-identified as belonging to specific race/ethnicity categories, including Hispanic, Native American, Black or African American, Native Hawaiian, or Other Pacific Islander. The "International" indicator denotes whether the student is an international student. GPA refers to the cumulative GPA at graduation for the transcript population and the cumulative GPA at the start of Winter 2024 for columns 3-6.

Table 2: Expectations about studying and having a career in STEM/BE versus non-STEM/BE

	STEM/BE			Non-STEM/BE			Difference (P-value) STEM/BE vs Non-STEM/BE	
	Female (1)	Male (2)	P-value (3)	Female (4)	Male (5)	P-value (6)	Female (7)	Male (8)
Find a good job within 6 months of graduation (%)	73.43	74.95	0.07	54.96	53.42	0.10	0.00	0.00
	(18.27)	(18.82)		(20.05)	(21.51)			
Full-time work annual salary at age 30 ($1,000s)	108.80	126.86	0.00	70.53	75.98	0.01	0.00	0.00
	(73.92)	(97.54)		(50.60)	(41.90)			
The career provides good non-monetary benefits (%)	63.54	66.79	0.00	67.28	66.02	0.12	0.00	0.41
	(21.15)	(20.51)		(17.81)	(17.95)			
Weekly studying hours in order to do well	26.46	24.83	0.01	17.41	16.41	0.03	0.00	0.00
	(13.81)	(12.87)		(10.26)	(10.52)			
Rank in terms of ability (1=best, 100=worst)	44.08	33.63	0.00	37.40	34.58	0.01	0.00	0.34
	(25.38)	(25.03)		(23.21)	24.54)			
Interested in subject content (%)	67.78	75.34	0.00	73.38	64.26	0.00	0.00	0.00
	(24.98)	(21.53)		(20.76)	(23.63)			

Notes: This table summarizes expectations regarding studying and having a career in STEM/BE and non-STEM/BE, split by respondent gender. The corresponding survey questions are: "If you were to graduate in each of these major categories [STEM/BE or non-STEM/BE], what do you think is the percent chance that you could find a good job within 6 months of graduating?", "If you were to graduate in each of these major categories [STEM/BE or non-STEM/BE], what do you think would be your annual salary if you worked full-time at age 30?", "How likely are the following to happen if you major in each category [STEM/BE or non-STEM/BE]: (1) the career will provide good non-monetary benefits (working conditions, schedule flexibility, etc.) and allow for a good work-life balance; (2) the subject content related to courses and careers will be interesting.", "If you were to major in each of these categories [STEM/BE or non-STEM/BE], what is the average number of hours that you think you would have to spend studying per week in order to do well in the major?", and "If you were to graduate in each of these major categories [STEM/BE or non-STEM/BE], where do you think you would rank in terms of ability among graduates of that major category (1=best, 100=lowest)?"

Table 3: Example quotes justifying different major recommendations for male and female profiles in the vignette experiment

1. *"Women are underrepresented in STEM and face discrimination in the field."*

2. *"Unfortunately misogyny is a very real problem in STEM fields and less so in non-STEM fields."*

3. *"It is more important for Jennifer to do well in STEM/BSE than non-STEM/BSE because she is a woman. This means she has to prove herself more than Mark, regardless of if they have the same bottom 20% placement. He is more likely to be accepted into jobs and earn more because of that identity."*

4. *"I assumed Mark was a man, and Jennifer making 82 cents to his dollar would impact recommendations."*

5. *"Gender bias in STEM/BE industries."*

6. *"Because Jennifer would be entering a male-dominated field where she would need to show she excels in order to see success."*

Notes: This table presents quotes from an open-ended question in the survey. Whenever a respondent was more or less likely to report that STEM/BE was a better choice for a female than a male profile of the same ability level, corresponding to the evidence shown in panel (a) of Figure 3, they were asked to explain why. The corresponding survey question was "Please briefly explain why you made different recommendations for [Student] compared to [Other student]." See Figure 3 for additional details.

Table 4: Anticipated discrimination index by respondent subgroup

	STEM/BE		Non-STEM/BE	
	Female	Male	Female	Male
	(1)	(2)	(3)	(4)
Overall	0.823	-0.852	0.070	-0.842
By subject interest				
High	0.755	-0.915	0.077	-0.898
Low	0.876	-0.769	0.063	-0.811
High vs low: p-value	0.016	0.007	0.758	0.071
By gender composition of intended major within the major category				
Male dominated	0.862	-0.892	0.091	-0.889
Female dominated	0.794	-0.744	0.060	-0.749
Male vs female dom.: p-value	0.178	0.015	0.497	0.004

Notes: This table summarizes the anticipated discrimination index by gender and major category. "By subject interest" further separates respondents into whether they report interest in STEM/BE or non-STEM/BE content at a value above (below) the median level. "By gender composition of intended major within the major category" further separates respondents into whether the major they would most likely choose within STEM/BE and non-STEM/BE has a female ratio below (above) the median female ratio across all majors. See footnote 26 for details on the anticipated discrimination index and Table 2 as well as Figures 5 and 6 for corresponding survey questions.

Table 5: Anticipated discrimination and intended major choice

Panel (a): Intended probability of majoring in STEM/BE	(1)	(2)	(3)	(4)
Female	-15.777***	-9.699***	-15.089***	-9.240***
	(3.478)	(3.311)	(3.682)	(3.395)
AD index	2.208	3.847		
	(2.947)	(2.748)		
Female × AD index	-8.660***	-7.761**		
	(3.266)	(3.116)		
Economic outcomes index			3.010	3.684
			(2.539)	(2.533)
Female × Economic outcomes index			-8.476***	-7.990***
			(2.809)	(2.850)
Workplace conditions index			0.036	2.098
			(3.694)	(3.503)
Female × Workplace conditions index			0.366	-2.241
			(4.267)	(4.126)
Sexual harassment			-1.564	-2.091
			(4.019)	(3.822)
Female × Sexual harassment			-0.216	3.278
			(4.353)	(4.175)
Controls		Yes		Yes
Observations	2,054	1,262	2,054	1,262
Control mean	80.902	85.118	80.902	85.118

Panel (b): Fraction of first term STEM/BE courses	(1)	(2)	(3)	(4)
Female	-0.209***	-0.193***	-0.194***	-0.199***
	(0.026)	(0.032)	(0.025)	(0.030)
Overall index	0.015	0.033		
	(0.023)	(0.027)		
Female × Overall index	-0.053**	-0.051*		
	(0.025)	(0.031)		
Economic outcomes index			0.011	0.038**
			(0.014)	(0.018)
Female × Economic outcomes index			-0.031*	-0.049**
			(0.016)	(0.020)
Workplace conditions index			0.008	0.036**
			(0.014)	(0.018)
Female × Workplace conditions index			-0.027*	-0.045**
			(0.016)	(0.021)
Sexual harrassment			-0.015	-0.017
			(0.020)	(0.024)
Female × Sexual harrassment			0.006	0.014
			(0.023)	(0.028)
Controls		Yes		Yes
Observations	1,981	1,218	1,981	1,218
Control mean	0.632	0.669	0.632	0.669

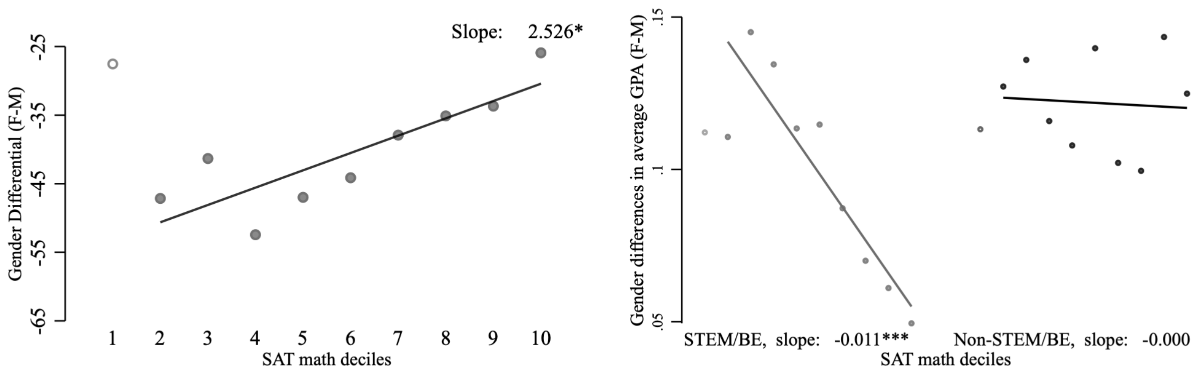
Notes: This table presents estimates from an OLS regression of the intended probability of majoring in STEM/BE in panel (a), and an OLS regression of the fraction of STEM/BE courses taken by survey respondents in their first term at the university on anticipated discrimination in panel (b). The variable "Female" is a binary indicator with a value of one (zero) when the student self-identifies as female (male) in the survey. The Economic outcomes index includes standardized measures of the expected gender gap in job offers and pay for students who expect to be less or equally likely to receive a job offer or to be paid less or equally. The workplace conditions index includes standardized measures of the frequency of being underestimated or facing worse treatment. The Overall index includes those four standardized measures, along with a standardized measure of how strongly the respondent agrees that they will face additional barriers or disadvantages in the workplace because of their gender. The overall index is further standardized to have a mean of 0 and a standard deviation of 1. When indicated, controls include respondents' stated likelihood of the career providing good non-monetary benefits, weekly studying hours in order to do well, SAT score, and interest in the subject content. The sample size decreases when adding controls because the university adopted a test-optional policy in 2021, leading to some students having missing entry test scores. Results are similar when instead controlling for self-assessed ability, which is available for all respondents (Table B.3). The fraction of STEM/BE courses is calculated from a student's transcript data and linked to their survey responses regarding anticipated discrimination. See footnote 26 for details on the anticipated discrimination index and notes from Table 2, Figure 5, and Figure 6 for corresponding survey questions. Standard errors are reported in parentheses, and ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

A Additional transcript evidence

A.1 Figures

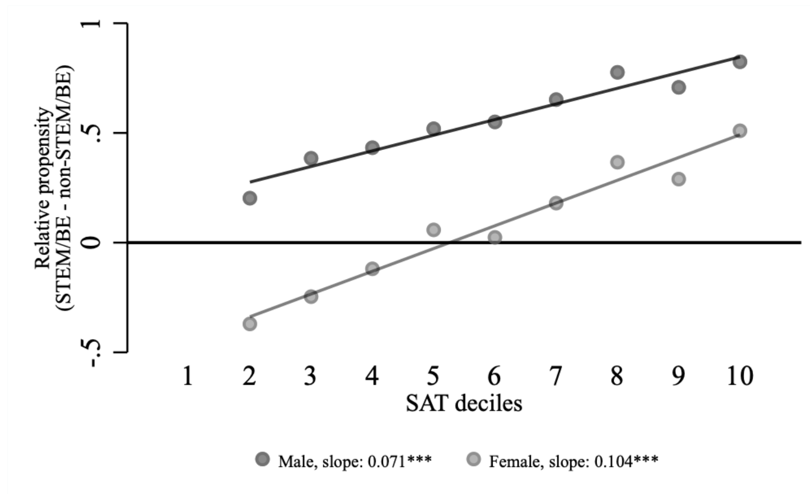
Figure A.1: Transcript evidence using SAT Math scores

(a) Relative propensity to major in STEM/BE (b) Relative grades across major and ability



Notes: See Figure 2 for details.

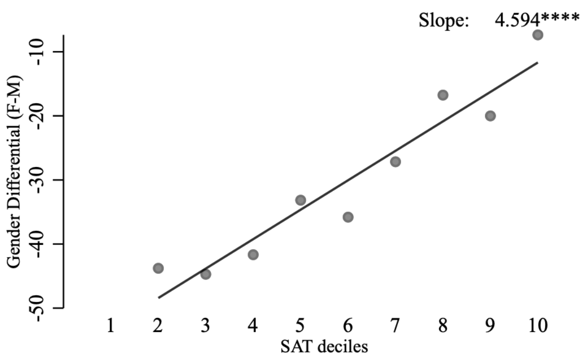
Figure A.2: Propensity to major in STEM/BE, separately by gender



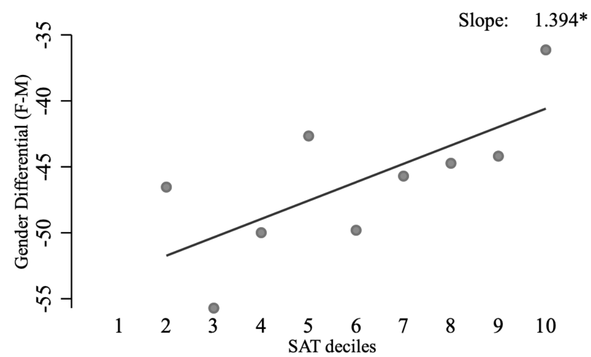
Notes: This figure plots the fraction of students majoring in STEM/BE minus the fraction of students majoring in non-STEM/BE, across SAT deciles and by gender. See Figure 2 for additional details.

Figure A.3: Transcript evidence excluding specific majors

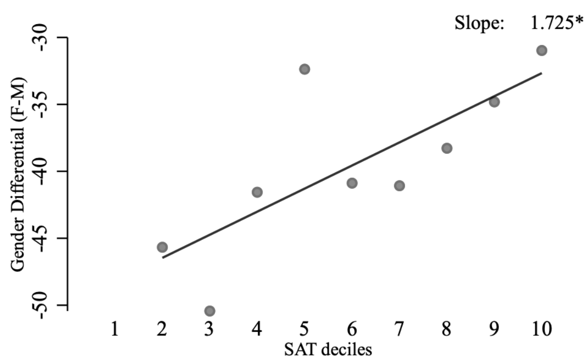
(a) Relative propensity to major in STEM/BE, excluding engineering



(b) Relative propensity to major in STEM/BE, excluding female-dominated STEM/BE majors



(c) Relative propensity to major in STEM, excluding BE



Notes: The figure plots the gender difference in the probability of majoring in STEM/BE versus other majors, across SAT deciles and for three samples. Panel (a) excludes engineering majors, which require applying to a different school within the university. Panel (b) excludes majors within STEM/BE that have a majority of female students, namely biology. Panel (c) restricts to STEM majors, excluding business and economics. See Figure 2 for additional details.

A.2 Tables

Table A.1: Change in gender grade differential after declaring a major, additional controls and dependent variable

	Dep: GPA		Dep: Major specific GPA	
	STEM/BE	Non-STEM/BE	STEM/BE	Non-STEM/BE
	(1)	(2)	(3)	(4)
Female	0.016**	0.111***	0.019	0.085***
	(0.008)	(0.011)	(0.014)	(0.019)
After declaration	0.086***	0.236***	0.208***	0.355***
	(0.006)	(0.011)	(0.009)	(0.016)
Female × After declaration	0.027***	-0.059***	0.085***	-0.031
	(0.008)	(0.012)	(0.014)	(0.020)
Major FE	Yes	Yes	Yes	Yes
Declaration term FE	Yes	Yes	Yes	Yes
Observations	44,635	27,348	30,064	14,173
Outcome mean	3.389	3.472	2.361	2.867

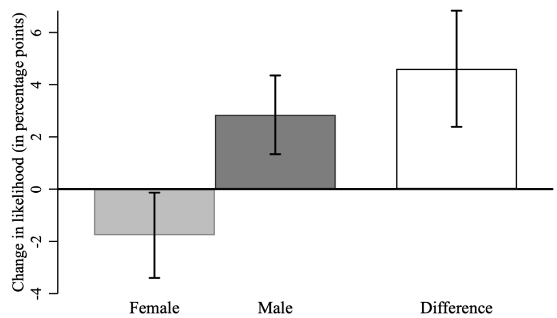
Notes: This table presents estimates from an OLS regression of students' GPA on their gender and whether they have declared their major for the final time, separately for whether they declared a major in STEM/BE or non-STEM/BE. The variable "Female" is a binary indicator with a value of one (zero) when the student self-identifies as female (male) in the survey. The variable "After declaration" is a binary indicator with a value of one (zero) in the term before (during) which students declare a major. Major FEs are fixed effects for narrower major categories, encompassing fields such as Engineering, Humanities, Natural Science, and Social Science. Declaration term FEs are fixed effects for the term in which a student declared their graduating major. GPA refers to term GPA, while major-specific GPA is calculated based on grades in major-specific core courses. Clustered standard errors at the individual level are reported in parentheses, and ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

B Additional survey evidence

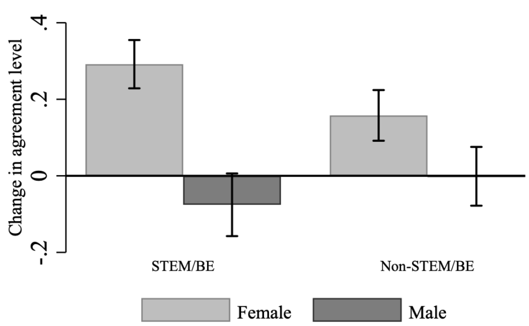
B.1 Figures

Figure B.1: Changes in responses between enrollment and the time of the survey

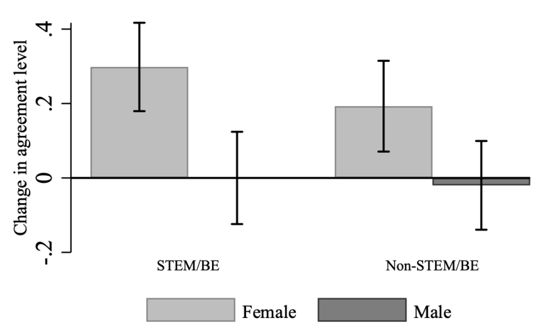
(a) Change in intended probability of majoring in STEM/BE



(b) Change in anticipated labor market discrimination

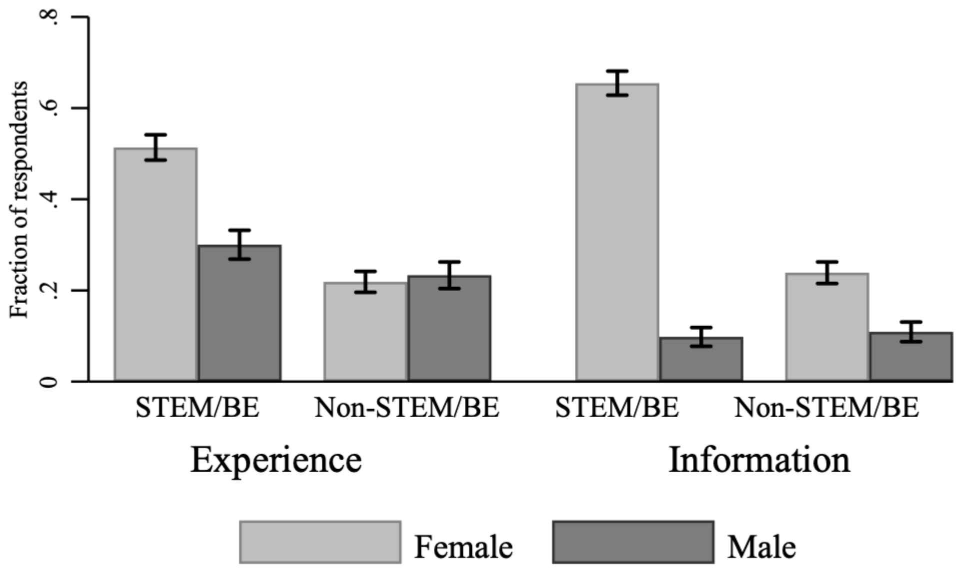


(c) Change in anticipated labor market discrimination, STEM/BE majors



Notes: Panel (a) of this figure illustrates changes in the reported probability that survey respondents will select a major in STEM/BE since their enrollment, separately by gender. The rightmost bar labeled "Difference" corresponds to the gender gap (Male - Female) in the change in probability of majoring in STEM/BE. The survey asked respondents how they would have answered the following question just before starting university: "What do you think is the percent chance (or chances out of 100) that you will graduate with a major in [STEM/BE]?" and subtracts from it their answer to the question shown in Figure 1. Panel (b) of this figure plots the extent to which anticipated discrimination in the workplace changed since enrollment, separated by major category and respondent gender. Panel (c) further restricts the sample to students who had already declared a STEM/BE major. Participants were asked to indicate their agreement level with the following statements both at the time of the survey and how they would have answered just before starting university: "In the workplace, you will face barriers or disadvantages because of your gender." The answer scale ranged from strongly disagree (-3) to strongly agree (3).

Figure B.2: Had a negative experience or was exposed to negative information

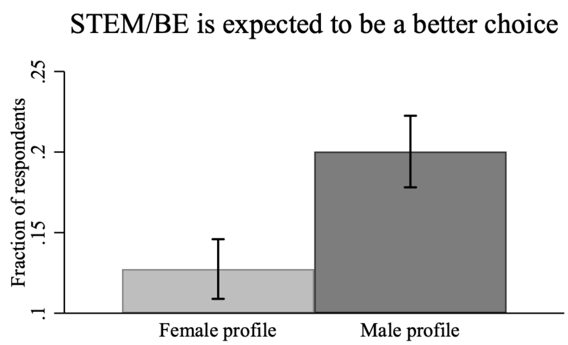


Notes: This figure plots the fraction of respondents who reported having had negative experiences or having been exposed to negative information, separately for each major category and by respondent gender. Participants were asked to indicate yes or no to the following statements: “Have you ever had any unpleasant and/or negative experiences in courses or activities which discouraged you from studying that major category? Have you been exposed to information suggesting that studying in the major category or working in related fields would be less suitable or more difficult because of your gender?”

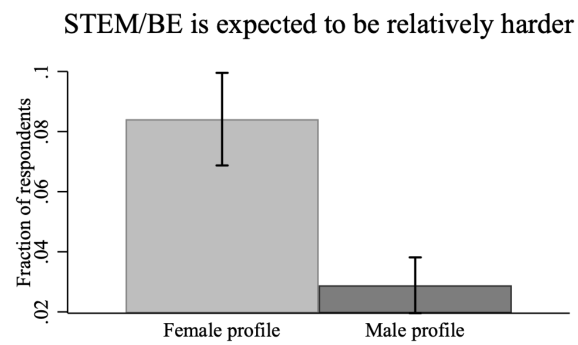
B.1.1 Evidence from the vignette experiment

Figure B.3: Major fit and career difficulty across profile gender in the vignette experiment, by respondent gender

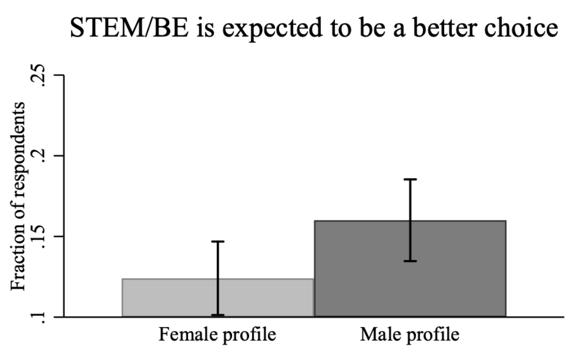
(a) Female respondents



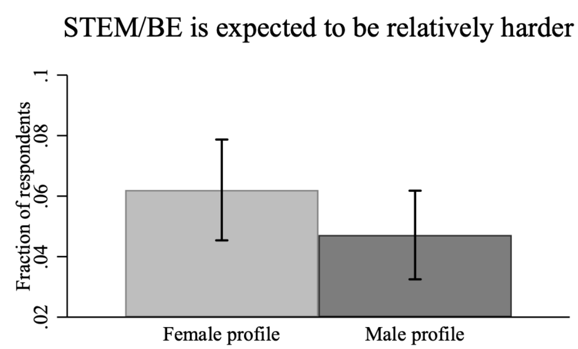
(b) Female respondents



(c) Male respondents

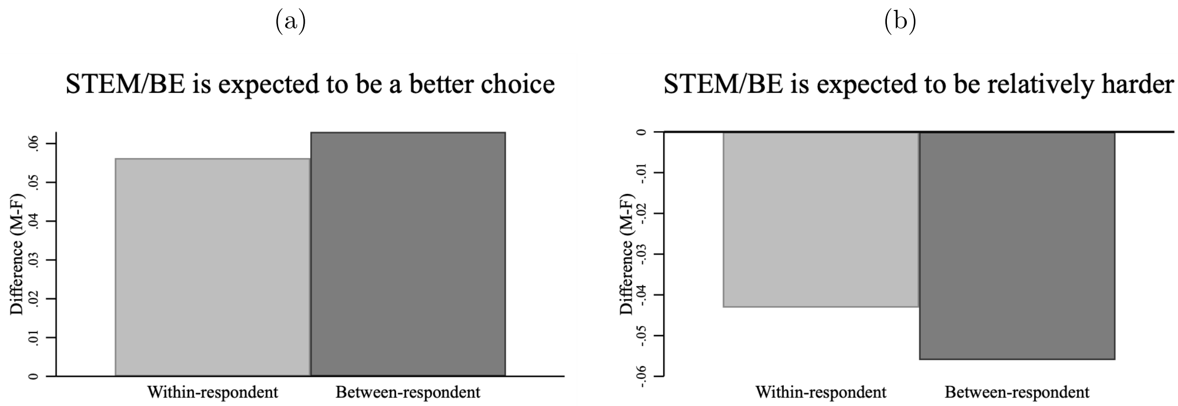


(d) Male respondents



Notes: The figure is computed from within-respondent comparisons for two hypothetical students of different genders, but the same ability level. See Figure 3 for additional details.

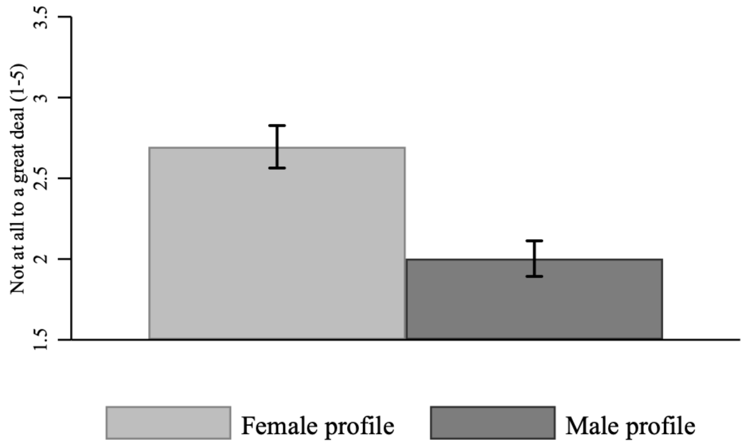
Figure B.4: Major fit and career difficulty across profile gender in the vignette experiment, between-respondent variation



Notes: In panel (a), the two bars show the within and between differences in the fraction of respondents who assign a higher probability to STEM/BE being the best major choice for a hypothetical male than female profile, and vice versa. In panel (b), the two bars show the within and between differences in the fraction of respondents who reported that it would be harder for male profiles to have a successful career in STEM/BE than non-STEM/BE, compared to female profiles, and vice versa. For between differences, we compared answers across profile gender between 100 randomly-matched pairs of respondents who were shown profiles of the same two ability levels and repeated the process 100 times. See Figure 3 for additional details.

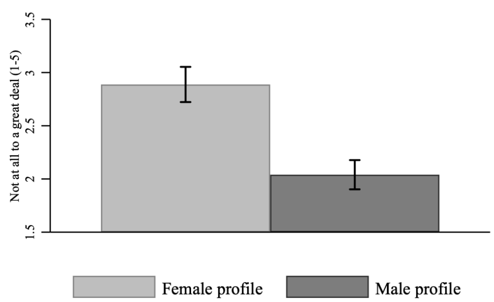
Figure B.5: How important were concerns of discrimination when recommending a major for a given student profile, by profile gender and ability

(a) All respondents

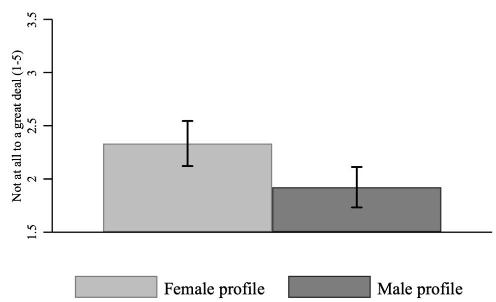


(b) By respondent gender

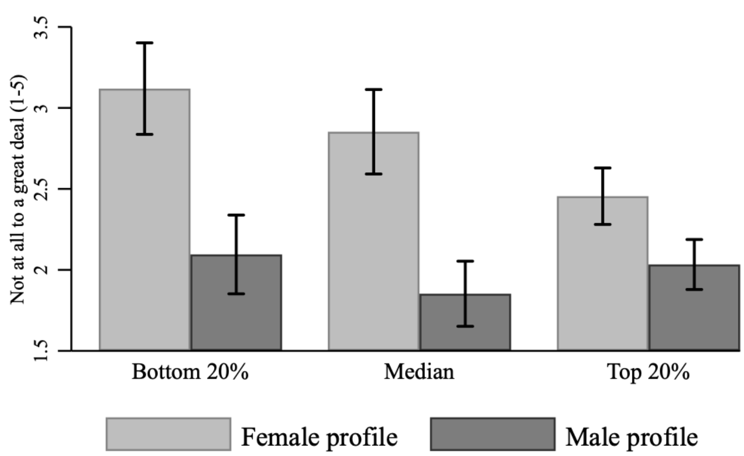
(b1) Female respondents



(b2) Male respondents



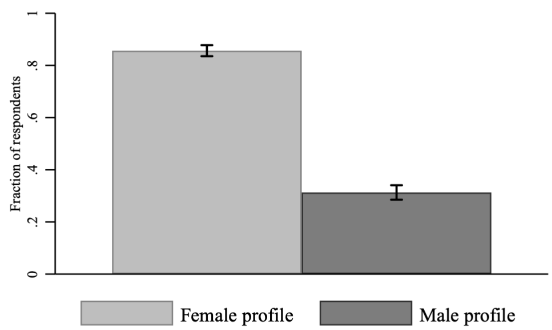
(c) All respondents



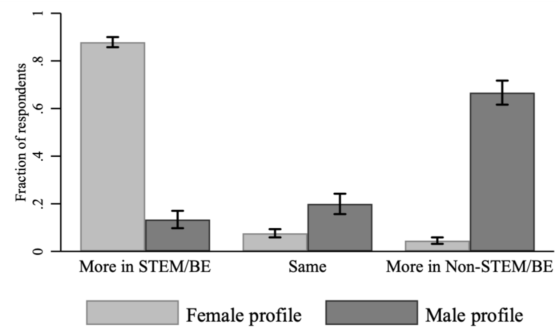
Notes: This figure shows the importance of respondents' concerns about discrimination when making the major recommendations for hypothetical student profiles shown in Figure 3, based on the following survey question: "How much did concerns of discrimination or differential treatment factor into your previous answer about whether majoring in STEM/BE or non-STEM/BE would be the best choice for the student?" [1-5]. Answers are restricted to the subset of respondents who reported that STEM/BE would be a better choice for male than female profiles, based on within-respondent comparisons for two hypothetical students of different genders, but the same ability level. Panels (a) and (b) pool across all profile ability levels, while panel (c) conditions on the ability level shown in the profile. See Figure 3 for additional details.

Figure B.6: Anticipated discrimination in the vignette experiment, between-respondent variation

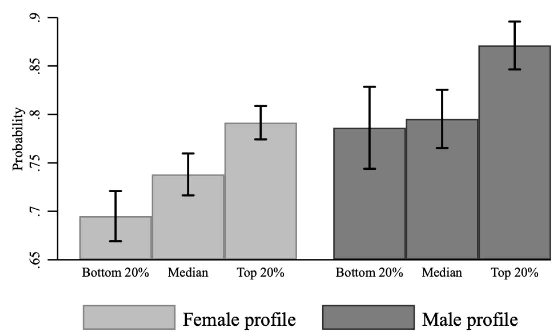
(a) Student is likely to face discrimination (yes = 1)



(b) Major in which student will face more disc.



(c) Likelihood that the student can overcome disc.

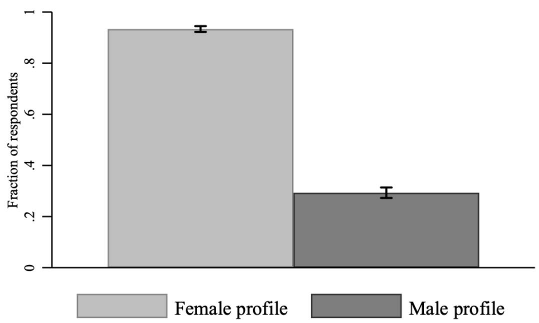


Notes: The figure is computed from between-respondent profile comparisons. Specifically, for each respondent, we use only answers referring to one of the three student profiles they were shown: the profile that did not have a counterpart profile of the other gender but same ability level. See Figure 4 for additional details.

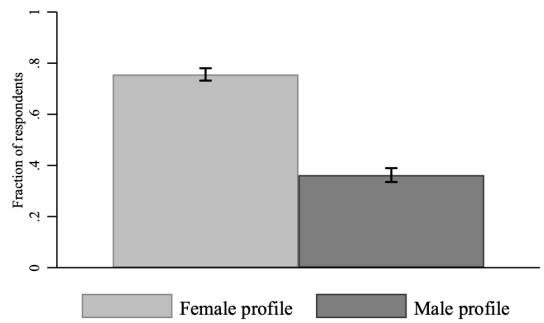
Figure B.7: Anticipated discrimination in the vignette experiment, by respondent gender

(a) Student is likely to face discrimination (yes = 1)

(a.1) Female respondents

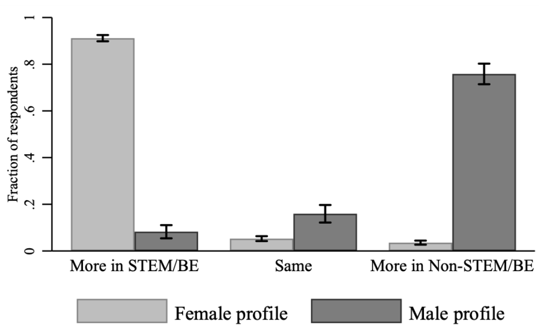


(a.2) Male respondents

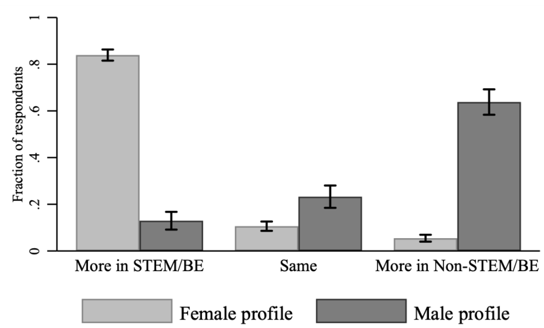


(b) Major in which student will face more discrimination

(b.1) Female respondents

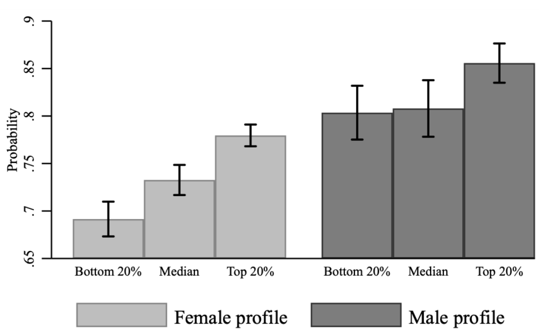


(b.2) Male respondents

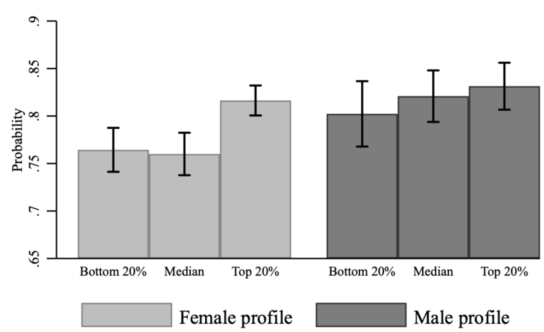


(c) Likelihood that the student can overcome discrimination

(c.1) Female respondents



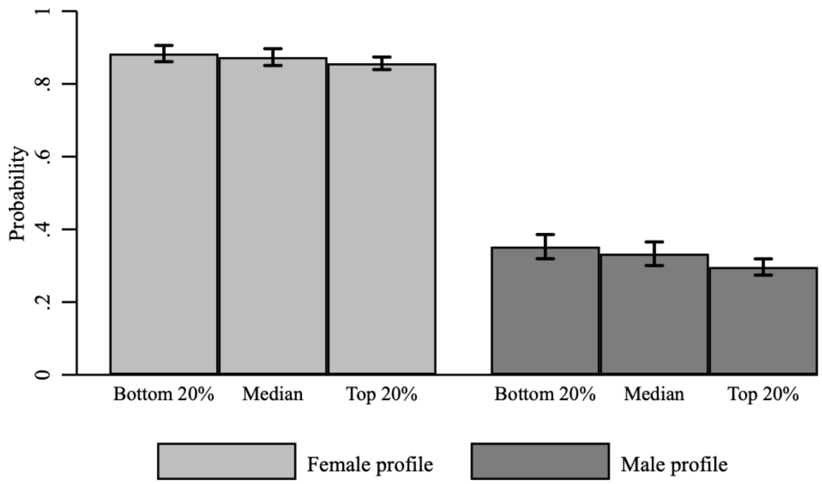
(c.2) Male respondents



Notes: The figure is computed using respondents' answers for each of the three student profiles presented to them. See Figure 4 for additional details.

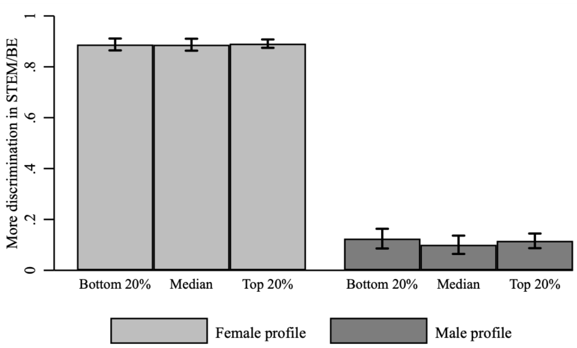
Figure B.8: Anticipated discrimination in the vignette experiment, by profile ability

(a) Student is likely to face discrimination (yes = 1)

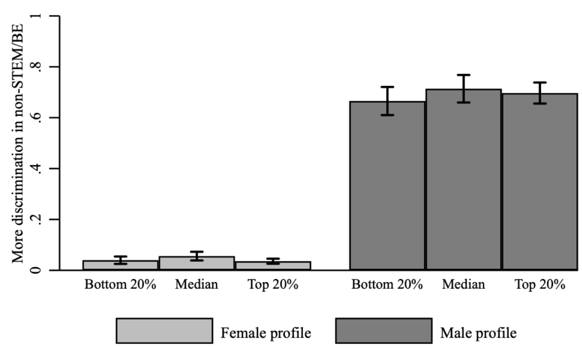


(b) Major in which student will face more disc.

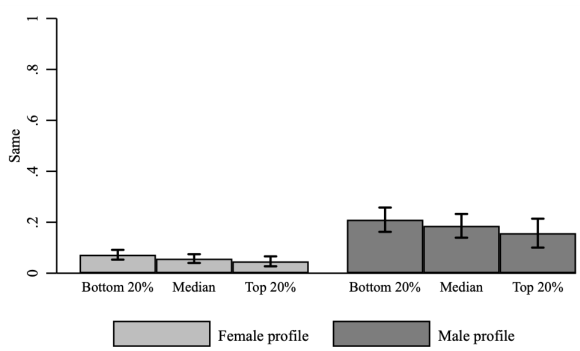
(b.1) STEM/BE



(b.2) Non-STEM/BE



(b.3) Same



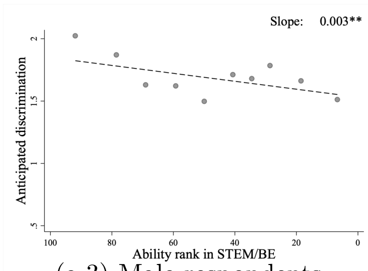
Notes: The figure is computed using respondents' answers for each of the three student profiles presented to them. See Figure 4 for additional details.

B.1.2 Evidence from the counterfactual choice experiment

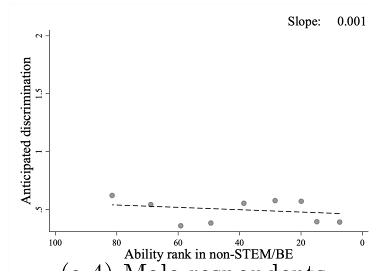
Figure B.9: Anticipated discrimination and ability

(a) Level of agreement about facing discrimination

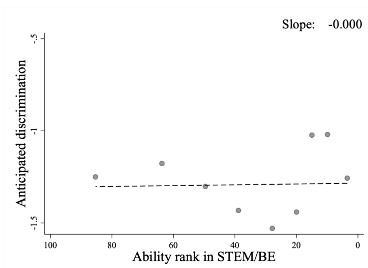
(a.1) Female respondents



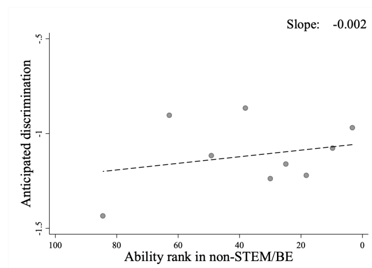
(a.2) Female respondents



(a.3) Male respondents

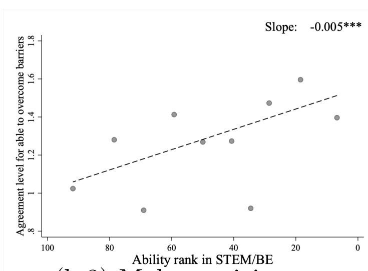


(a.4) Male respondents

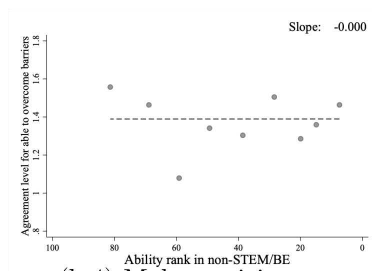


(b) Overcoming discrimination and ability

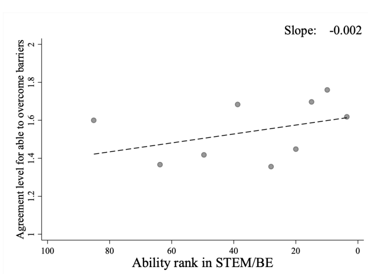
(b.1) Female participants



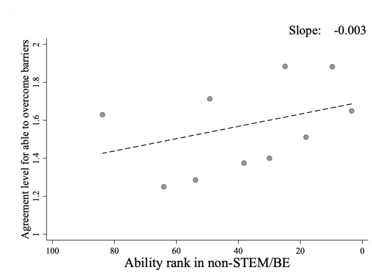
(b.2) Female participants



(b.3) Male participants



(b.4) Male participants

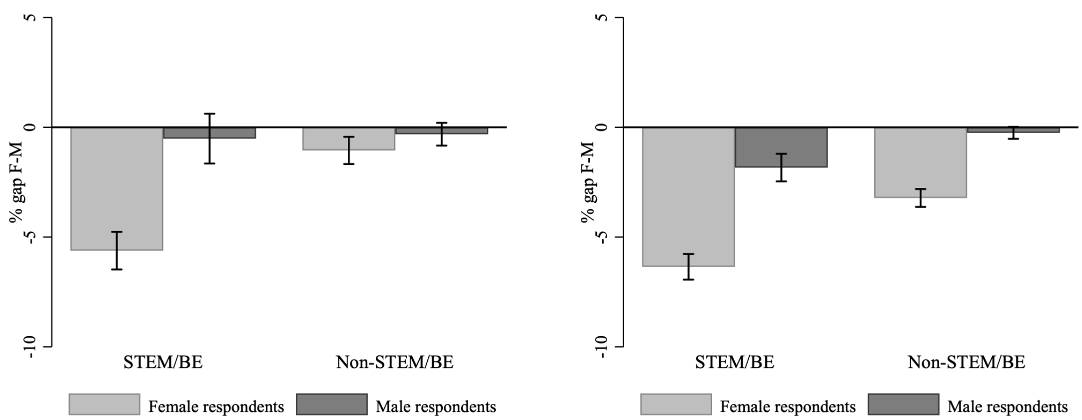


Notes: Panel (a) of this figure plots anticipated discrimination by respondents in STEM/BE and non-STEM/BE against their self-assessed ability in each major category, where 1 is the top ability and 100 is the bottom, by respondent gender. Panel (b) of this figure plots the extent to which respondents expect being able to overcome discrimination, separately for STEM/BE and non-STEM/BE, against their self-assessed ability in each major category, where 1 is the top ability and 100 is the bottom, by respondent gender. The corresponding survey question for overcoming discrimination is: "If you face additional barriers or disadvantages in school or the workplace, you will be able to overcome them if you work hard enough and excel [-3 (Strongly disagree) to 3 (Strongly agree)]." See Table 2 for the survey question on ability.

Figure B.10: Anticipated discrimination in job offers and pay, weighted by likelihood of majoring in each category

(a) Expected gender gap in job offers

(b) Expected gender pay gap



Notes: This figure shows the gap in job offers and pay shown in Figure 6 multiplied by the probabilities that each respondent assigns to majoring in STEM/BE and non-STEM/BE. See Figure 6 for additional details.

B.2 Tables

Table B.1: Anticipated discrimination index by school of enrollment

	(1) CALS	(2) Engineering	(3) Business	(4) Nursing	(5) Music/Arts	(6) F-test P-value
STEM/BE, Female	0.861	0.734	0.619	0.852	0.758	0.072
STEM/BE, Male	-0.836	-0.908	-0.602	-0.666	-0.905	0.154
Non-STEM/BE, Female	0.127	-0.070	-0.059	-0.097	0.036	0.002
Non-STEM/BE, Male	-0.829	-0.877	-0.745	-0.566	-0.883	0.426

Notes: This table summarizes the anticipated discrimination index by the student's school of enrollment within the university, where CALS stands for the College of Arts, Literature, and Science. The F-test p-value indicates the result of a joint test for equality of the index across schools. See footnote 26 for details on the anticipated discrimination index, and refer to Table 2 as well as Figures 5 and 6 for the corresponding survey questions.

Table B.2: Anticipated discrimination and intended major choice, by program year

	Freshmen		**Sophomores**	
	(1)	(2)	(3)	(4)
Female	-21.088***	-14.470***	-9.680*	-4.210
	(4.430)	(4.058)	(5.493)	(5.471)
AD index	5.984	8.359**	-2.398	-1.719
	(3.722)	(3.373)	(4.695)	(4.529)
Female × AD index	-10.384**	-10.833***	-5.636	-4.123
	(4.204)	(3.875)	(5.121)	(5.084)
Controls		Yes		Yes
Observations	1,113	716	941	546
Control mean	83.409	86.584	77.619	82.948

Notes: This table presents estimates from an OLS regression of the intended probability of majoring in STEM/BE by program year. The variable "Female" is a binary indicator with a value of one (zero) when the student self-identifies as female (male) in the survey. When indicated, controls include respondents' stated likelihood of the career providing good non-monetary benefits, weekly studying hours in order to do well, SAT score, and interest in the subject content. The sample size decreases when adding controls because the university adopted a test-optional policy in 2021, leading to some students having missing entry test scores. Results are similar when instead controlling for self-assessed ability, which is available for all respondents. See Table 5 for additional details. Standard errors are reported in parentheses, and ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.3: Anticipated discrimination and intended major choice, additional controls

	Perceived ability	**Preference for peers' gender**	**Expected salary at 30**
	STEM/BE	STEM/BE	STEM/BE
	(1)	(2)	(3)
Female	-15.724***	-12.636***	-12.057***
	(3.387)	(3.866)	(3.831)
AD index	5.894**	4.220	4.413
	(2.662)	(2.982)	(2.983)
Female × AD index	-8.464***	-8.629**	-8.697**
	(2.945)	(3.378)	(3.379)
Controls	Yes	Yes	Yes
Observations	2,054	1,262	1,262
Outcome mean	71.337	77.662	77.662

Notes: Control variables differ from those in Table 5: column 1 controls for self-assessed ability instead of SAT scores. See Table 2 for the survey question on ability. Column 3 controls for peer preferences elicited from the following survey question: "Please answer to what extent you agree with the following statement: It is important to have others of your gender in your classes and in the workplace in order to have people to relate to, develop a sense of belonging, or create a better culture". The answer scale ranged from strongly disagree (0) to strongly agree (100). Column 5 controls for salary expectations. See Table 2 for the survey question on salary expectations. See Table 5 for additional details. Standard errors are reported in parentheses, and ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.4: Impact of controlling for anticipated discrimination on the gender gap in intentions to major in STEM/BE, most and least conservative specifications

	Largest impact of controlling for AD		**Smallest impact of controlling for AD**	
	(1)	(2)	(3)	(4)
Female	-14.199***	-7.685***	-7.401***	-5.154**
	(1.755)	(2.362)	(1.510)	(2.005)
Expected salary at 30	2.552***	2.482***	1.500**	1.486**
	(0.842)	(0.839)	(0.712)	(0.712)
AD index		-4.924***		-1.995**
		(1.136)		(0.967)
Subject interest			21.003***	20.883***
			(0.796)	(0.798)
Perceived rank			-3.502***	-3.409***
			(0.762)	(0.763)
Controls	Yes	Yes	Yes	Yes
Observations	2,054	2,054	2,054	2,054
Control mean	80.902	80.902	80.902	80.902
% of the gender gap explained	46		30	

Notes: This table presents estimates from an OLS regression of the probability of a student majoring in STEM/BE. In column (1), we include only basic controls described below and expected salary at age 30. Adding the AD index to this specification in column (2) reduces the gender gap from 14.2% to 7.7%, or by 45.9%. In column (3), we include basic controls described below as well as expected salary at 30, subject interest, and perceived rank. Augmenting this specification with the AD index in column (4) reduces the gap from 7.4% to 5.2%, or by approximately 30%. The variable "Female" is a binary indicator, taking the value of one if the student self-identifies as female and zero if male. Basic controls include respondents' stated likelihood of the career providing good non-monetary benefits, and weekly studying hours in order to do well. See footnote 26 for details on the anticipated discrimination index and Table 2 as well as Figures 5 and 6 for corresponding survey questions. Expected salary at 30 is a standardized measure of respondents' expected salary at age 30, with a mean of 0 and a standard deviation of 1. Subject interest and perceived rank are also standardized to have a mean of 0 and a standard deviation of 1. Standard errors are reported in parentheses, and ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

C Vignette Screenshot

Figure C.1: Sample vignette

You will next be presented with a hypothetical scenario and asked some questions about it.

Jennifer, Mark, and Emma are in their first year and considering whether to pursue a major in a STEM/BE or non-STEM/BE field. They are all equally interested in pursuing a career in either category of majors and plan to work full-time after graduating.

Jennifer and Mark have both been told that they would rank in the **bottom 20%** of students for either category of majors, based on their performance in high school and college entrance exams. They also both feel that their preparation so far has been equally suitable for studying in STEM/BE or non-STEM/BE.

In contrast, **Emma** has been told that she would rank in the **top 20%** of students for either category of majors, again based on her performance in high school and college entrance exams. She also feels that her preparation so far has been equally suitable for studying in STEM/BE or non-STEM/BE.