Gender, Grade Sensitivity, and Major Choice

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  - Labor market outcomes of highly skilled women
    - STEM and Business jobs pay higher wages than other fields

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  - Labor market outcomes of highly skilled women
    - STEM and Business jobs pay higher wages than other fields
  - Policymakers interest in closing the gender gap in these areas

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  - Negative relationship between first-year GPA and gender gap in probability of staying in STEM and business majors.

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  - Women in STEM and business value an extra GPA point about $3760 more than men
  - Women believe they are more likely to face gender discrimination in the labor market
    - Particularly in STEM and business
  - Those beliefs decrease the gap in grade valuation by 48%

Outline

Value of Grades

Anticipated Discrimination

Conclusion

Value of Grades

Hypothetical Scenarios

Example:

	GPA	**Study Hours**	**Earnings after Grad. (full-time job)**
SSH	3.47	8.0	$24,000
BEC	2.23	7.0	$49,000
STEM	2.00	22.0	$46,000

Hypothetical Scenarios

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- A major is characterized by:
  - Average GPA at graduation
  - Average weekly study time
  - Average earnings in full-time job after graduation

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- A major is characterized by:
  - Average GPA at graduation
  - Average weekly study time
  - Average earnings in full-time job after graduation
- Scenarios are not fully specified
- Participants reported the probability (0-100) of choosing each major
- Participants faced 10 individual-specific scenarios

Hypothetical Scenarios

- Idea: estimate the role of GPA, study time, earnings when choosing a major
- Hypothetical scenarios provide a panel of probability choices per individual
  - Allows me to estimate preferences at individual level
  - No restriction on population distribution of preferences

A Model of Major Choice

- Let U_{ijs} be individual i's utility from major j in scenario s:

$$U_{ijs} = X'_{ijs}\beta_i + \kappa_{ij} + \epsilon_{ijs} \tag{1}$$

  - X_{ijs} matrix of major attributes
  - κ_{ij} major-specific constant (tastes for major)
  - ϵ_{ijs} all other attributes

    Assumptions:
    - Unknown at the time of elicitation
    - Orthogonal to X_{ijs} conditional on major
    - $\{\epsilon_{ijs}\}_J$ i.i.d Type 1 extreme value

A Model of Major Choice

- Then the choice probability of choosing each major is

$$p_{ijs} = \frac{exp(X'_{ijs}\beta_i + \kappa_{ij})}{\sum_{j'=1}^{J} exp(X'_{ij's}\beta_i + \kappa_{ij'})} \tag{2}$$

- Applying the log-odds transformation

$$ln\left(\frac{p_{ijs}}{p_{ij's}}\right) = (X_{ijs} - X_{ij's})'\beta_i + (\kappa_{ij} - \kappa_{ij'}) \tag{3}$$

- Use the least absolute deviations (LAD) estimator
  - Less sensitive to extreme values

Willingness to Pay (WTP)

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- Increase attribute X_k from $X_k = x_k$ to $X_k = x_k + \Delta$ with $\Delta > 0$
- Indifference condition:

$$x_k \beta_{ik} + \beta_{i1} ln(Y) = \beta_{ik}(x_k + \Delta) + \beta_{i1} ln(Y + WTP_{ik}(\Delta)) \tag{4}$$

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- Then,

$$WTP_{ik}(\Delta) = \left[exp\left(\frac{-\beta_{ik}}{\beta_{i1}} \Delta \right) - 1 \right] \times Y \tag{5}$$

Y: average level of earnings ($53,318).

WTP for GPA/Study Time

Summary Statistics

	WTP ($)
	Overall
	(1)
GPA	8,309
	[6,608]
Study time	-1,479
	[-638]
N	1,192

Note: Table reports mean [median] WTP.

- WTP for GPA: amount of average annual earnings that a student is willing to pay for a 1-point increase in the average GPA at graduation.

WTP for GPA/Study Time

Summary Statistics

	WTP ($)		
	Overall	Female	Male
	(1)	(2)	(3)
GPA	8,309	9,089	6,799
	[6,608]	[7,790]	[4,882]
Study time	-1,479	-1,428	-1,579
	[-638]	[-608]	[-714]
N	1,192	786	406

Note: Table reports mean [median] WTP.

- Women value an extra GPA point more than men
  - Smaller differences in WTP for study time

WTP for GPA

Gender Gaps

$$WTP_{GPAi} = \alpha_0 + \alpha_1 Female_i + \mathbf{C}_i + \xi_i$$

	Overall
	(1)
Female	3,057**
	(1,438)
Mean	8,309
N	1,192

Notes: All columns control for household income, parents education, SAT/ACT, school year, honors, minority. Column (1) controls for major. Standard errors reported in parentheses. *Significant at 10%, **5%, ***1%.

- Women are willing to pay $3,057 more than men for an extra GPA point.

WTP for GPA

Gender Gaps

$$WTP_{GPAi} = \alpha_0 + \alpha_1 Female_i + \mathbf{C}_i + \xi_i$$

	Overall	STEM/BEC	SSH
	(1)	(2)	(3)
Female	3,057**	3,760**	1,760
	(1,438)	(1,702)	(2,783)
Mean	8,309	9,414	6,307
N	1,192	768	424

Notes: All columns control for household income, parents education, SAT/ACT, school year, honors, minority. Column (1) controls for major. Standard errors reported in parentheses. *Significant at 10%, **5%, ***1%.

- Women are willing to pay $3,057 more than men for an extra GPA point.
  - In STEM/BEC: women are willing to pay $3,760 more than men

Why do these differences arise?

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  - Women believe they will be held to more rigorous standards (STEM/BEC)

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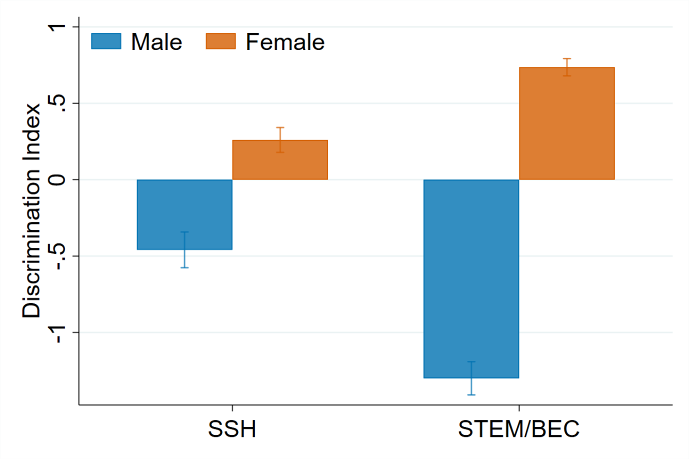
- Intuition:
  - Women believe they will be held to more rigorous standards (STEM/BEC)
  - Higher GPA than men to be competitive
  - Low grades at the beginning makes them leave

Beliefs about Gender Discrimination

- Gender discrimination module
  - It would be harder to find a job because of your gender
  - Boss would treat you differently because of your gender
  - Peers would treat you differently because of your gender
- 5-point scales (Extremely unlikely - Extremely likely)
- Combined these questions to create a composite index

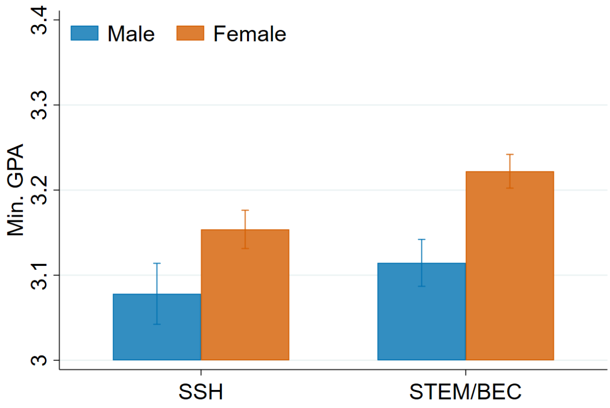
Women believe they are more likely to experience discrimination



- Particularly in STEM/BEC fields

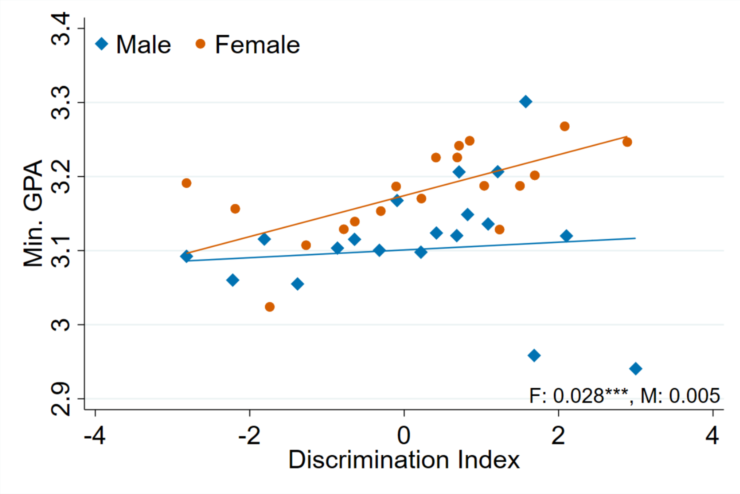
Women believe they will need a higher GPA to secure a job

Labor Market Standards: What is the min. GPA you need to secure a FT job?



- Especially in STEM/BEC fields.

Positive relationship between discrimination and LM standards for women



Role of Anticipated Discrimination

Outcome: WTP for extra GPA point

	(1)
Female	3,057**
	(1,438)
Min. GPA STEM/BEC	
Min. GPA SSH	
Gen. Discrimination STEM/BEC	
Gen. Discrimination SSH	
Mean	8,309
R2	0.018
N	1,192

Notes: Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

Role of Anticipated Discrimination

Outcome: WTP for extra GPA point

	(1)	(2)
Female	3,057**	2,671*
	(1,438)	(1,427)
Min. GPA STEM/BEC		5,548**
		(2,426)
Min. GPA SSH		-499
		(2,057)
Gen. Discrimination STEM/BEC		
Gen. Discrimination SSH		
Mean	8,309	8,309
R2	0.018	0.024
N	1,192	1,192

Notes: Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

Role of Anticipated Discrimination

Outcome: WTP for extra GPA point

	(1)	(2)	(3)
Female	3,057**	2,671*	1,965
	(1,438)	(1,427)	(2,047)
Min. GPA STEM/BEC		5,548**	
		(2,426)	
Min. GPA SSH		-499	
		(2,057)	
Gen. Discrimination STEM/BEC			620
			(728)
Gen. Discrimination SSH			-261
			(536)
Mean	8,309	8,309	8,309
R2	0.018	0.024	0.019
N	1,192	1,192	1,192

Notes: Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

Role of Anticipated Discrimination

Outcome: WTP for extra GPA point

	(1)	(2)	(3)	(4)
Female	3,057**	2,671*	1,965	$\boxed{1{,}600}$
	(1,438)	(1,427)	(2,047)	$\boxed{(2{,}036)}$
Min. GPA STEM/BEC		5,548**		5,533**
		(2,426)		(2,423)
Min. GPA SSH		-499		-487
		(2,057)		(2,064)
Gen. Discrimination STEM/BEC			620	613
			(728)	(730)
Gen. Discrimination SSH			-261	-270
			(536)	(532)
Mean	8,309	8,309	8,309	8,309
R2	0.018	0.024	0.019	0.025
N	1,192	1,192	1,192	1,192

Notes: Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

- The gender gap in WTP for GPA decreases by 48%

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  - Women believe they are more likely to experience gender discrimination
  - Evidence that anticipated discrimination plays a role in this context

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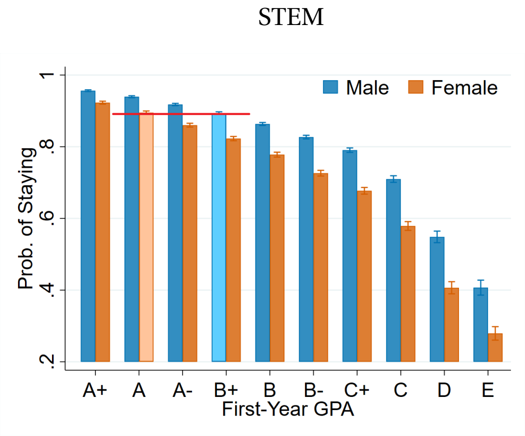
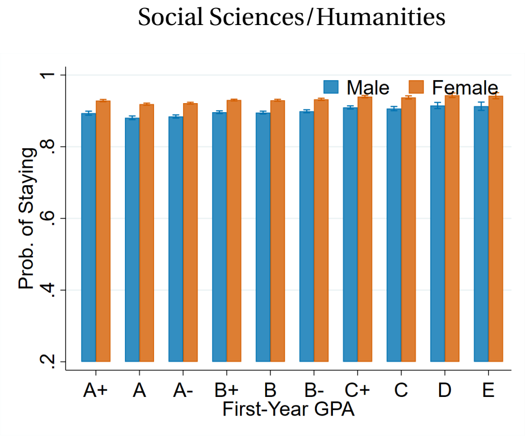
- Using survey data, I find
  - Women are WTP more for a one-point increase in GPA
  - Women believe they are more likely to experience gender discrimination
  - Evidence that anticipated discrimination plays a role in this context
- Future research should determine the accuracy of these beliefs

Extra Slides

Motivation: Patterns in ASU

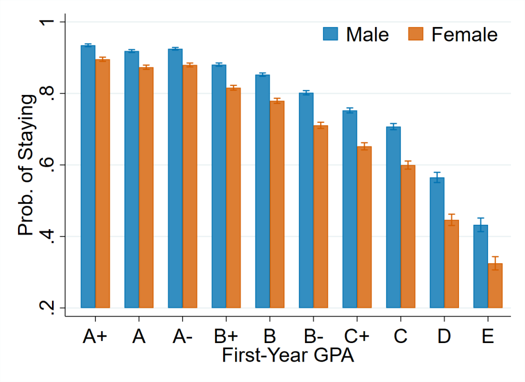




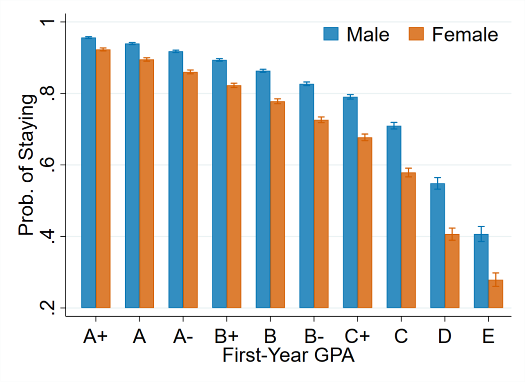
Notes: Conditional on ACT/SAT, high school GPA, indicators for honors and exploratory students, minority, income, in-state student, first-generation status and cohort FE.

Motivation: Patterns in ASU

Business/Economics



STEM



Notes: Conditional on ACT/SAT, high school GPA, indicators for honors and exploratory students, minority, income, in-state student, first-generation status and cohort FE.

Survey

- Online survey at ASU during Spring 2021
  - Recruitment via email and advertisement on MyASU
  - All undergraduate students were invited
- Compensation: lottery of 350 $20 Amazon eGift Cards
- 2036 students completed the survey
  - 62% women, 35% men
- No differential selection on socio-demographic characteristics across genders

Comparison with ASU student body

	Survey			ASU			P-value
	Female	Male	Diff.	Female	Male	Diff.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black	0.05	0.03	0.02	0.04	0.03	0.01	0.134
White	0.66	0.70	-0.04	0.46	0.48	-0.02	0.498
Hispanic	0.23	0.18	0.05	0.29	0.23	0.07	0.284
First Generation	0.29	0.23	0.06	0.31	0.23	0.08	0.263
Family Income	102	109	-7.1	126	151	-26	0.181
Freshman	0.22	0.20	0.02	0.26	0.25	0.01	0.776
Sophomore	0.24	0.23	0.00	0.26	0.25	0.01	0.853
Junior	0.30	0.30	0.01	0.22	0.22	0.00	0.806
Senior	0.24	0.27	-0.03	0.26	0.28	-0.02	0.742
ACT	27.71	28.56	-0.85	23.98	25.62	-1.64	0.003
Sample Size	1,236	700		22,755	21,637		0.000

Comparison with ASU student body

	Survey			ASU			P-value
	Female	Male	Diff.	Female	Male	Diff.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
STEM	0.38	0.58	-0.20	0.25	0.46	-0.20	0.689
BEC	0.18	0.21	-0.03	0.18	0.27	-0.10	0.000
SSH	0.44	0.22	0.22	0.57	0.27	0.30	0.001
N	1,236	700		22,755	21,637		

Scenarios Wording

Imagine a situation in which you have not chosen a major yet and each major category is characterized as in the table below.

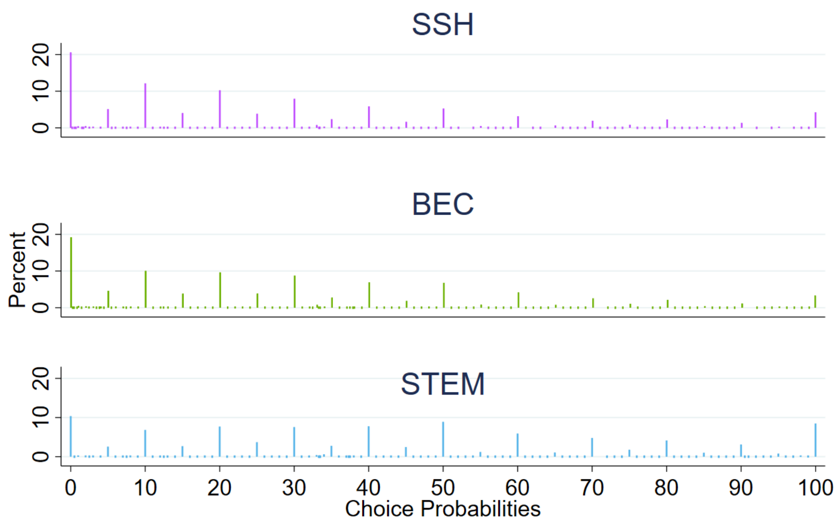
	Average GPA (a)	Average Weekly Study Hours (b)	Average Earnings After Graduation (full-time job) (c)
Social Sciences/Humanities/Other	3.47	8.0	$24,000
Business/Economics	2.23	7.0	$49,000
Science/Technology/Engineering/Math	2.00	22.0	$46,000

For example, in this scenario students from Social Sciences/Humanities/Other (a) graduate with a cumulative GPA of 3.47 on average; (b) study 8.0 hours per-week on average, and (c) on average have annual earnings of $24,000 in a full-time job.

What is the percent chance (or chances out of 100) that you would choose to graduate from each category given these characteristics?

<u>Note: The chance of each major category should be a number between 0 and 100 and the chances assigned to the three categories should add up to 100.</u>

Choice Probabilities by Major



Choice Model

- Let U_{ijs} be individual i's utility from major j in scenario s:

$$U_{ijs} = X'_{ijs}\beta_i + \kappa_{ij} + \epsilon_{ijs} \tag{6}$$

- Then, individual i's reported probability of choosing j in scenario s is:

$$p_{ijs} = \int \mathbb{1}\left\{U_{ijs} > U_{ij's} \quad \forall j' \neq j\right\} dH_i(\epsilon_{is}) \tag{7}$$

where $H_i(\epsilon_{is})$ is i's belief about the distribution of $\left\{\epsilon_{i1s}, \ldots, \epsilon_{iJs}\right\}$

Dealing with Rounding Bias

Assumptions:

- Reported $\tilde{p}_{ijs}$ measures "true" p_{ijs} with error
- Measurement error takes linear-in-logs form such that:

$$ln\left(\frac{\tilde{p}_{ijs}}{\tilde{p}_{ij's}}\right) = (X_{ijs} - X_{ij's})'\beta_i + (\kappa_{ij} - \kappa_{ij'}) + \underbrace{\omega_{ijs}}_{m.e} \tag{8}$$

- $\omega i1s, ..., \omega_{iJs}$ have median 0 conditional on $X_{1s}, ..., X_{Js}s$

Then,

$$M\left[\ln\left(\frac{\tilde{p}_{ijs}}{\tilde{p}_{ij's}}\right)|X_{js}, X_{j's}\right] = (X_{ijs} - X_{ij's})'\beta_i + (\kappa_{ij} - \kappa_{ij'}) \tag{9}$$

Average Estimates

	Overall	Female	Male
	(1)	(2)	(3)
GPA	0.683***	0.696***	0.656***
	(0.064)	(0.079)	(0.118)
Study time (h/week)	-0.067***	-0.057***	-0.084***
	(0.007)	(0.009)	(0.014)
Log earnings	4.287***	3.798***	5.245***
	(0.154)	(0.182)	(0.291)
N	1,266	838	428

- On average, coefficients have the expected signs

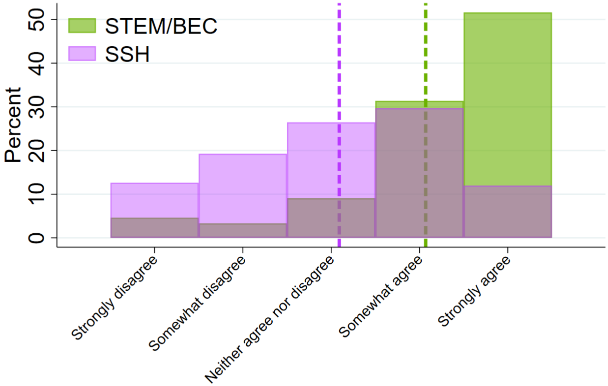
WTP for GPA/Study Time

Summary Statistics

	WTP (% of av. earnings)		
	Overall	Female	Male
	(1)	(2)	(3)
GPA	15.58	17.05	12.75
	[12.39]	[14.61]	[9.16]
Study time	-2.77	-2.68	-2.96
	[-1.20]	[-1.14]	[-1.34]

Note: Table reports mean [median] WTP.

"Women need a higher GPA to compete against similar man"



- ~ 83% of females somewhat agree or strongly agree in the case of STEM/BEC

Labor Market

- Posterior belief

$$p(\theta; \pi_g^k) = \frac{\pi_g^k f_h(\theta)}{\pi_g^k f_h(\theta) + (1 - \pi_g^k) f_l(\theta)}$$

Labor Market

- Using $p(\theta;\pi_g^k)$ in the condition before, a firm hires a student if and only if:

$$\frac{f_h(\theta)}{f_l(\theta)} \geq \frac{1-\pi^k}{\pi^k}\frac{x_l^k}{x_h^k} \tag{10}$$

- MLRP implies $\exists! \quad \tilde{\theta}(\pi^k) \in (0,1)$ such that (10) holds with equality.
- I.e. employer follows a cutoff hiring rule.

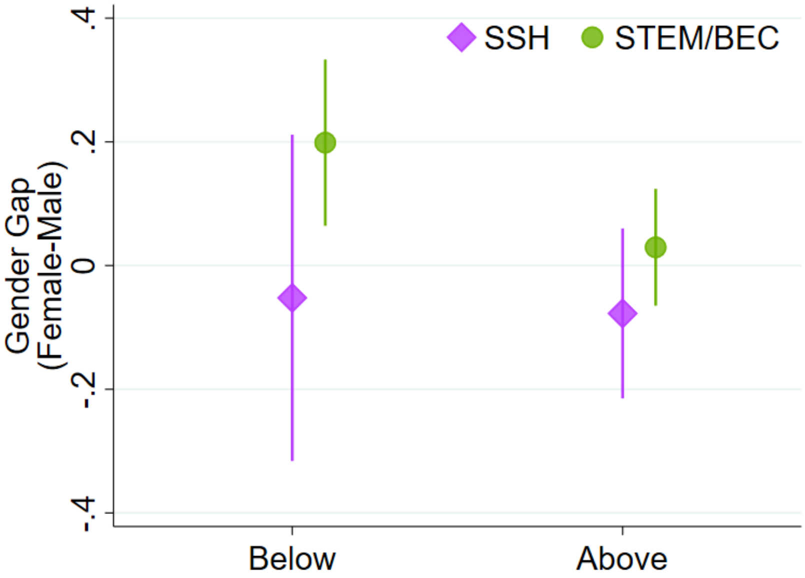
$$\begin{cases} \text{Hire,} & \text{if } \theta > \tilde{\theta}(\pi_g^k) \\ \text{Not hire,} & \text{otherwise} \end{cases}$$

Students Updated Beliefs

- Posterior belief

$$P'(\theta_i) = \frac{Pf_h(\theta_i)}{Pf_h(\theta_i) + (1-P)f_l(\theta_i)}$$

Gender Gap in Prob. of Changing Fields



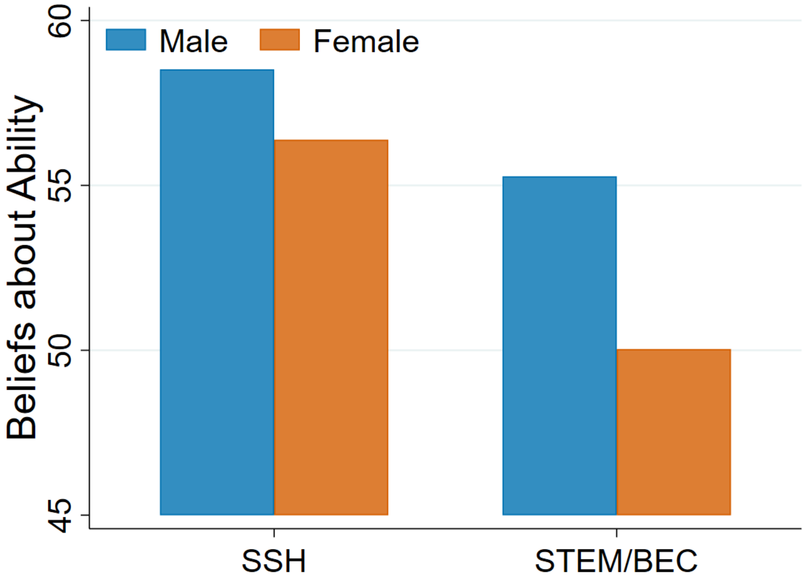
Other Potential Mechanisms

- Self-confidence
  - Men rank themselves better than women in all majors.
- Beliefs about grades at graduation
  - More women overestimate the average GPA at graduation

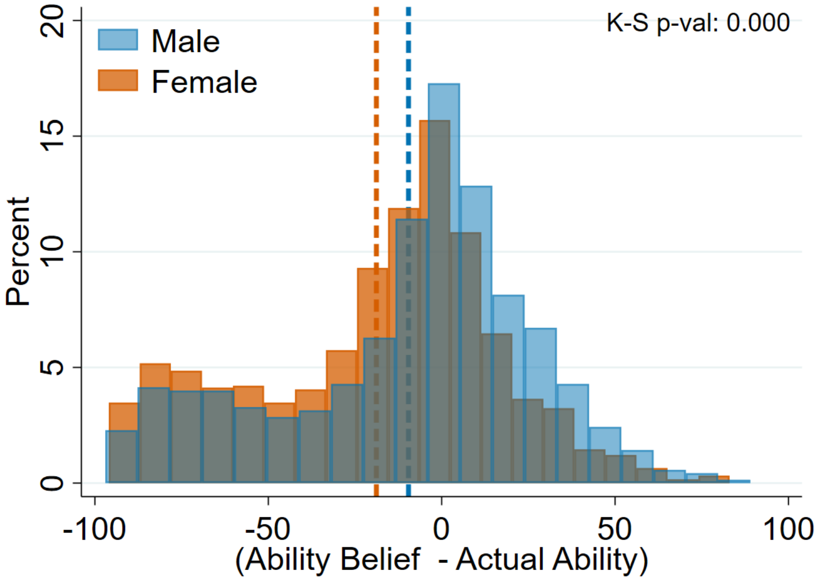
They contribute less than anticipated discrimination and labor market standards to reducing the gender gap in WTP for GPA!

Self-Confidence

Men report higher beliefs about their ability than women



Women are more under-confident than men



Self-Confidence does not explain much of the WTP gender gap

	(1)	(2)
Female	3,057**	2,905**
	(1,438)	(1,443)
Error in Beliefs about Ability		-18
		(20)
Mean	8,309	8,309
N	1,192	1,192

Notes: Outcome variable is WTP for GPA. Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

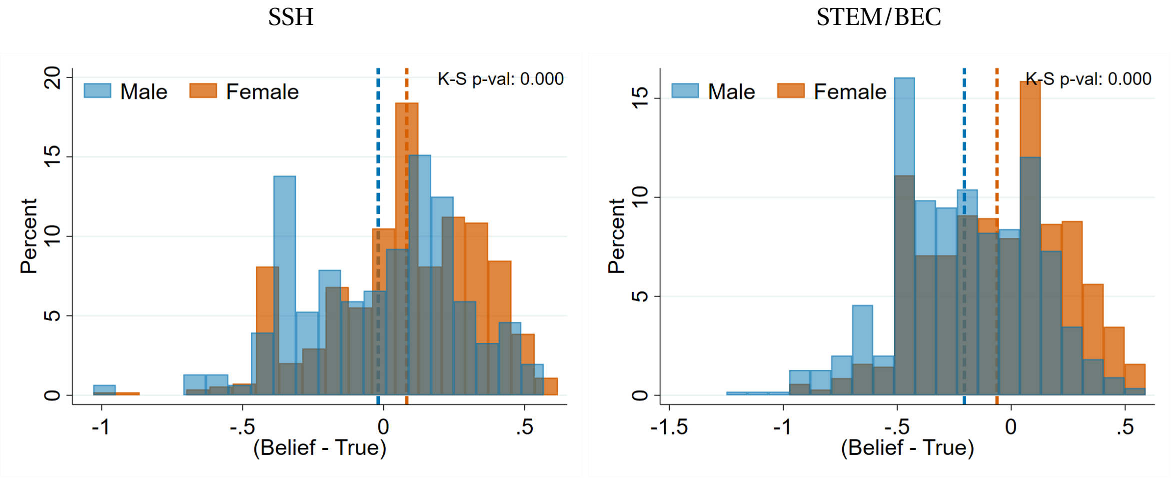
Beliefs about Grades at Graduation

Beliefs about average GPA at graduation

	Female	Male	P-value
	(1)	(2)	(3)
SSH	3.46	3.36	0.000
STEM/BEC	3.37	3.23	0.000

- Women believe that the average GPA at graduation is higher
- All participants believe that the average GPA at graduation is lower in STEM/BEC

Participants underestimate the GPA at graduation in STEM/BEC



Notes: Vertical dashed lines represent the mean of the distribution.

Beliefs about grades do not explain much of the WTP gender gap

	(1)	(2)
Female	3,057**	2,796*
	(1,438)	(1,448)
Error in Beliefs about GPA at Graduation		1,871
		(2,397)
Mean	8,309	8,309
N	1,192	1,192

Notes: Outcome variable is WTP for GPA. Controls: household income, parents education, SAT/ACT, school year, honors, minority, and major. *Significant at 10%, **5%, ***1%.

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- Men and women with same grade revise major choices differently because of different beliefs about labor market standards

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- Firm will hire a student with grade θ iff

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- Low study cost students choose S

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- $\dfrac{\partial \theta_i^*}{\partial \tilde{\theta}_g^S} > 0$

Gender Discrimination in S

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- If they get a grade θ such that

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  The man stays in S but the woman leaves S!