Breaking the Bias: Referrals offset class differences in social networks

1 hour internal presentation

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Motivation

- Understand persistent class differences in labor market outcomes, like the underrepresentation of Low-SES researchers in academia [Stansbury and Rodriguez, 2024]
- Focus on social class biases in referrals
  - Numbers 1
  - Numbers 2

Procedures

- Recruited participants by emailing 4500 students (>1st year)
- Online experiment in Qualtrics
- Average time spent 30 minutes
- Randomly select 1 of every 10 for pay
- Average payment of 80 USD (includes show-up fee)
- 840 complete responses
- Final sample 734 participants who referred someone they took a class with

Selection into the experiment

- Higher performing students overrepresented
- Low-SES overrepresented
- High-SES underrepresented

	Admin Data	**Sample**	**p**
Reading score	62.651	65.183	< 0.001
Math score	63.973	67.477	< 0.001
GPA	3.958	4.012	< 0.001
Low-SES	0.343	0.410	< 0.001
Med-SES	0.505	0.499	0.763
High-SES	0.153	0.091	< 0.001
Observations	4,417	734	

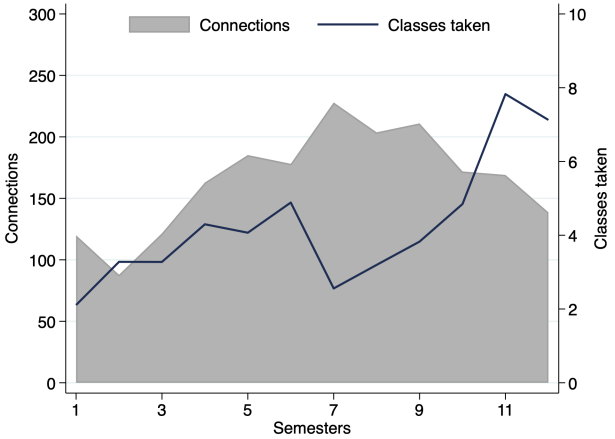
Balance between treatments

- Successful randomization

	Baseline	Bonus	p
Reading score	64.712	65.693	0.134
Math score	67.366	67.597	0.780
GPA	4.003	4.021	0.445
# connections	173.40	176.88	0.574
Tie strength	3.939	3.719	0.443
Low-SES	0.419	0.401	0.615
Med-SES	0.492	0.506	0.714
High-SES	0.089	0.094	0.824
Observations	382	352	734

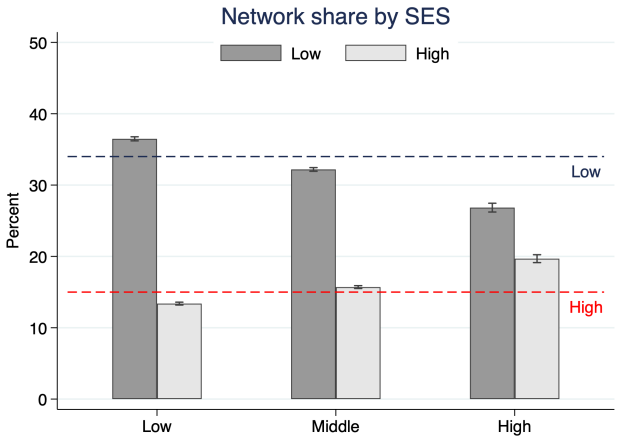
Network size and tie strength

- Classes taken with peers increase over time
- Connections peak around 7 semesters and decline as students change majors or graduate



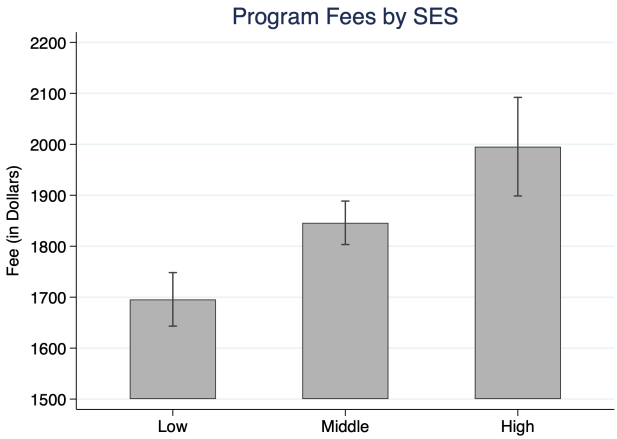
Network-level SES shares

- 35 % of UNAB is Low-SES, and 15 % High-SES
- Network shares are very different from the population
- Why?



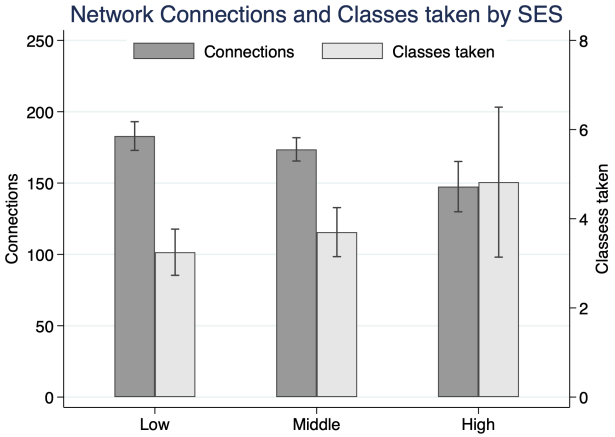
Selection into programs

- Low-SES study in more affordable programs
- Large difference as net average monthly salary around $350



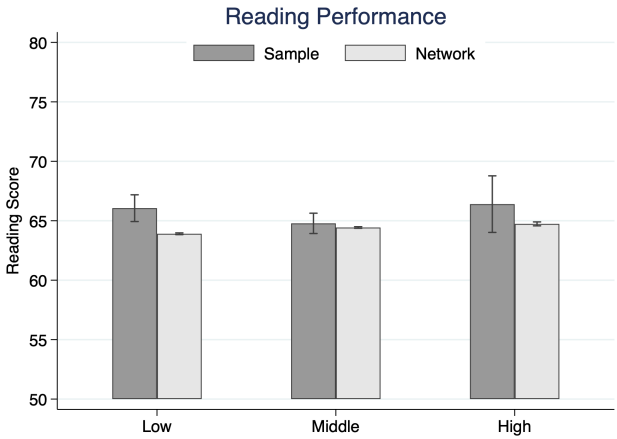
Selection into programs

- Program selection affects the network dynamics
- Connections decrease with SES
- Classes taken with peers increases with SES
- How about entry exam performance?



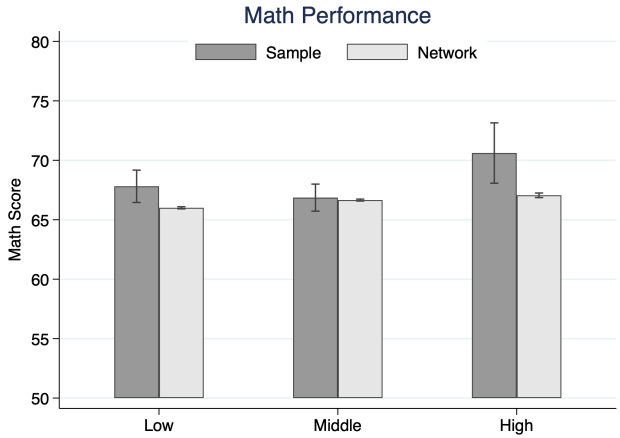
Reading performance

- Similar performance across SES
- Network averages are close to the referrer sample



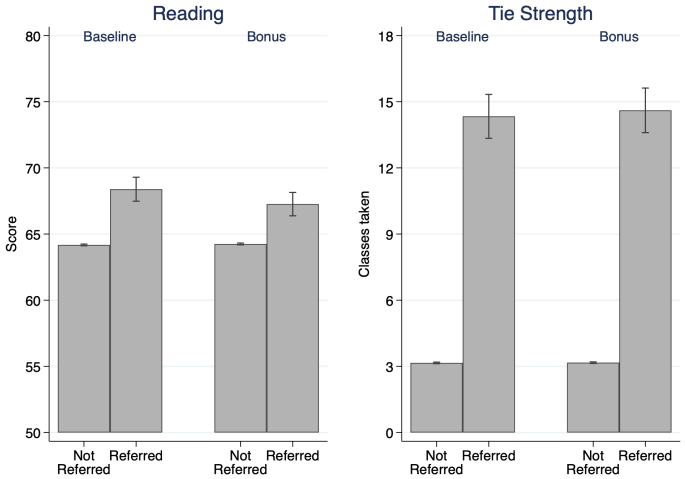
Math performance

- Similar performance for Reading and Math
- Who gets a referral?



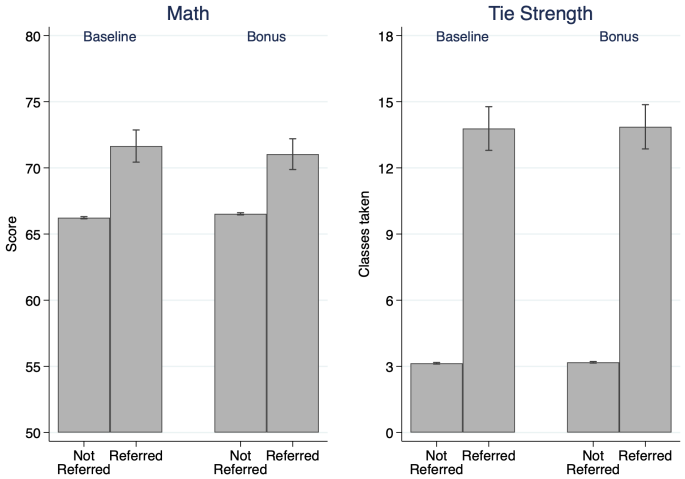
Referrals for Reading

- Referrals have higher reading scores and much higher tie strength
- No treatment effect on the referred (both $p > 0.08$)



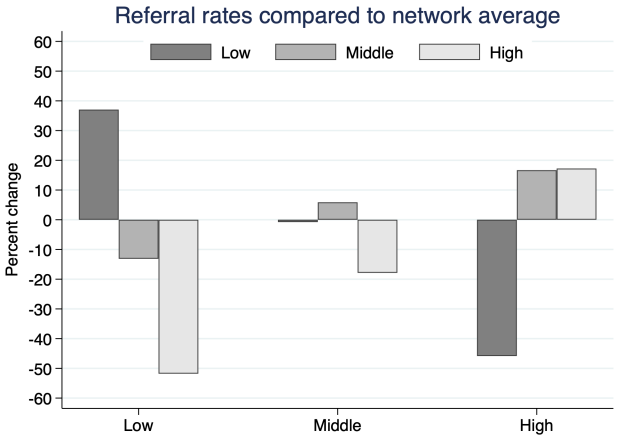
Referrals for Math

- Referrals have higher math scores and much higher tie strength
- No treatment effect on the referred (both $p > 0.1$)



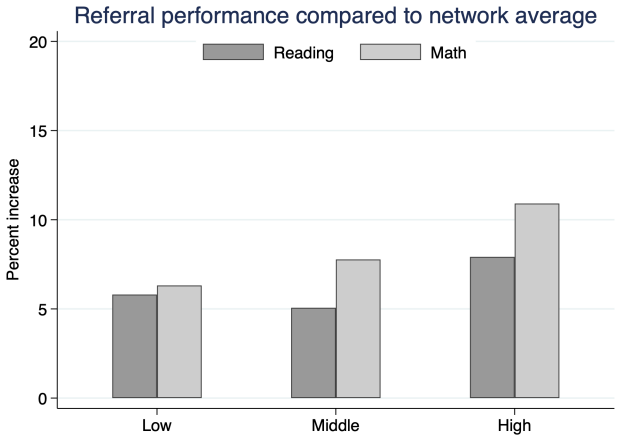
Referral SES composition

- Stark differences in referral rates considering network compositions were imbalanced to begin with
- Do differences impact scores and tie strength?



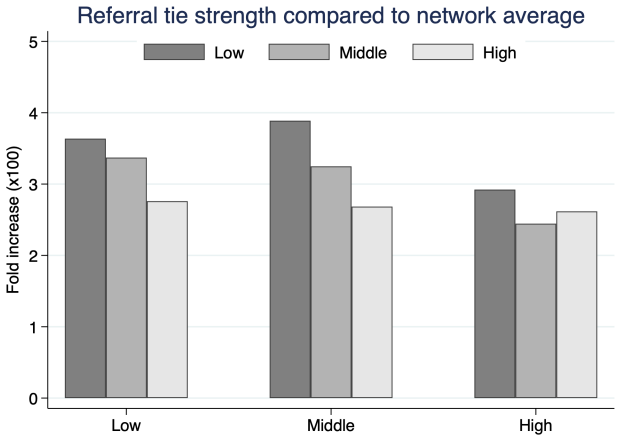
Referral performance

- Consistent performance increase in referrals
- High-SES seem to refer slightly better



Referral tie strength

- Very large but consistent increase in referral tie strength



Is there a SES bias in referrals?

Conditional Logit Model:

$$\Pr(\text{Refer}_{ij} = 1) = \Lambda\left(\beta_1 \text{SES}_j + \beta_2 \text{Score}_j + \beta_3 \text{Tie}_{ij} + \beta_4 \text{Score}_j \times \text{Tie}_{ij} + \alpha_i\right)$$

- Refer_{ij}: Binary outcome indicating whether individual i refers individual j
- SES_j: Referral j is Low, Middle, or High SES
- Score_j: Standardized Math or Reading score of referral j
- Tie_{ij}: Standardized number of classes taken together for i and j
- α_i: Individual fixed effect for referrer i

Features:

- FE controls for referrer network structure and other unobservables

Bias against High-SES in aggregate

- Bias against High-SES
- Score and tie strength are strong predictors of referrals
- Small interaction between score and tie strength
- How about by referrer SES?

	(1)	(2)	(3)
Low	0.152**	-0.013	-0.013
	(0.070)	(0.080)	(0.080)
High	-0.300***	-0.306***	-0.315***
	(0.108)	(0.115)	(0.116)
Nominee score		0.618***	0.527***
		(0.034)	(0.035)
Tie		0.916***	0.894***
		(0.026)	(0.026)
Score x Tie			0.059***
			(0.015)
Observations	256997	256997	256997
Ind.	734	734	734
Chi-test	17.44	1602.42	1640.06

SES extremes reveal origin of the bias

- Low-SES referrers are biased against High-SES and vice-versa
- Mid-SES show smallest bias to either extreme
- Does the bias impact referral performance?

	Low-SES (1)	Middle-SES (2)	High-SES (3)
Low	0.237*	-0.155	-0.583*
	(0.124)	(0.114)	(0.331)
High	-0.451**	-0.281*	-0.382
	(0.223)	(0.157)	(0.293)
Nominee score	0.540***	0.503***	0.650***
	(0.056)	(0.049)	(0.116)
Tie	0.842***	0.930***	0.959***
	(0.037)	(0.039)	(0.104)
Score x Tie	0.043*	0.057***	0.148**
	(0.022)	(0.021)	(0.066)
Observations	110142	127088	19767
Ind.	301	366	67
Chi-test	804.58	766.33	144.77

Who makes better referrals?

OLS Model:

$$\text{Premium}_{ij} = \beta_0 + \beta_1 \text{SES}_i + \beta_2 \text{Score}_i + \beta_3 \Delta\text{OBlf}_i + \beta_4 \Delta\text{NBlf}_i + \text{X}_i'\gamma + \epsilon_i$$

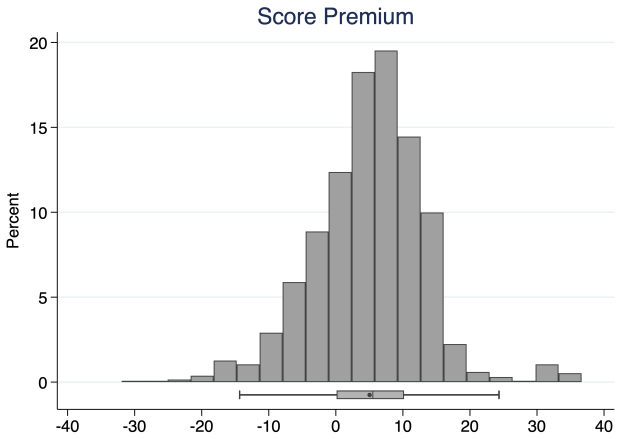
- Premium_i: Nominee j's test z-score minus mean score of i's network
- SES_i: Referrer i's socioeconomic status (Low, Middle, High)
- ΔOBlf_i, ΔNBlf_i: i's beliefs on own and nominee test scores minus actual scores (standardized)
- Score_i: Referrer i's own test z-score

Controls:

- Referrer i's treatment (Baseline vs. Bonus)
- Test area indicator (Math vs. Reading)
- Number of classes taken together for i and nominee j

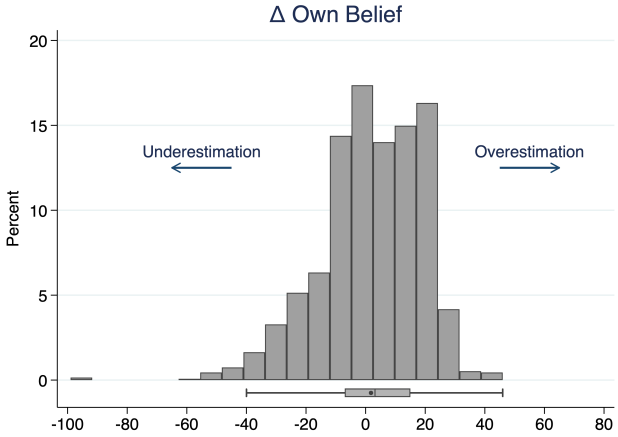
Referals are better than network average

- Defined as nominee *j*'s score minus network average for each referrer *i* across Math and Reading
- No difference between SES groups See



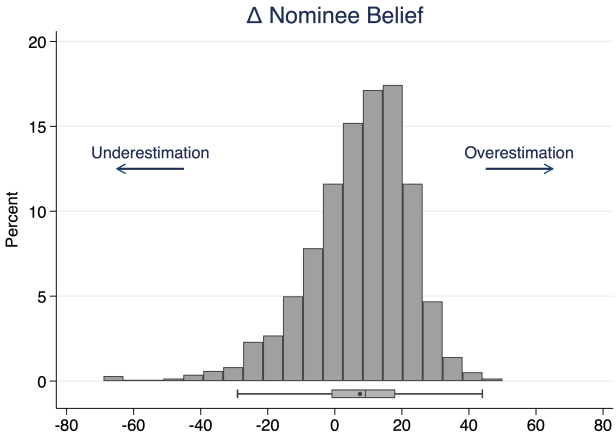
Beliefs about own scores are accurate

- Defined as referrer *i*'s own beliefs minus their score across Math and Reading
- No difference between SES groups See



Beliefs about nominees reveal a positive bias

- Defined as referrer *i*'s beliefs about nominee *j* minus *j*'s score across Math and Reading
- No difference between SES groups See



Referrer score and beliefs predict better referrals

- Referrer *i*'s score predicts premium
- Overestimating own scores increases premium
- "Accurate" nominee beliefs increases premium See
- No effect of SES?

	(1)	(2)
Low	0.031	0.026
	(0.061)	(0.061)
High	0.158	0.155
	(0.100)	(0.100)
Referrer score	0.269***	0.264***
	(0.031)	(0.032)
Δ own belief	0.237***	0.241***
	(0.038)	(0.038)
Δ nominee belief	-0.383***	-0.378***
	(0.045)	(0.044)
Controls	No	Yes
Observations	1,342	1,342
Ind.	734	734

Interactions?

- SES w/ own other beleifs and score interact

	(1)	(2)
Low	0.031	0.026
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High	0.158	0.155
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Δ nominee belief	-0.383***	-0.378***
	(0.045)	(0.044)
Controls	No	Yes
Observations	1,342	1,342
Ind.	734	734

Conclusion

- Referrers pick better nominees as their own scores get higher
- Accurate beliefs about nominee scores maximizes premium
- Bonus for nominee reduces premium
- No effect of SES on beliefs or premium

Reading

- Reading score and tie strength are strong predictors of referrals
- No interaction between reading score and tie strength
- No evidence for a Low-SES bias Alt. Specification

	(1)	(2)	(3)
Low-SES	0.143*	-0.007	-0.007
	(0.086)	(0.101)	(0.102)
High-SES	-0.293**	-0.271*	-0.275**
	(0.128)	(0.139)	(0.139)
Nominee score		0.566***	0.513***
		(0.044)	(0.048)
Tie		0.949***	0.939***
		(0.031)	(0.032)
Score x Tie			0.030
			(0.018)
Observations	128847	128847	128847
Ind.	673	673	673
Chi-test	10.81	1117.46	1145.58

Math

- Math score and tie strength are strong predictors of referrals
- Significant but small interaction between math score and tie strength
- No evidence for a Low-SES bias Alt. Specification

	(1)	(2)	(3)
Low-SES	0.161*	-0.013	-0.015
	(0.086)	(0.099)	(0.100)
High-SES	-0.309**	-0.343**	-0.361**
	(0.131)	(0.142)	(0.144)
Nominee score		0.662***	0.546***
		(0.040)	(0.042)
Tie		0.885***	0.851***
		(0.029)	(0.029)
Score x Tie			0.089***
			(0.019)
Observations	128150	128150	128150
Ind.	669	669	669
Chi-test	12.38	1122.75	1154.40

Reading (Low-SES vs others)

- Alternative specification with binary Low-SES
- No evidence for a Low-SES bias
- Consistent with main model

Return

	(1)	(2)	(3)
Low-SES	0.199**	0.041	0.042
	(0.083)	(0.100)	(0.100)
Nominee Score		0.561***	0.509***
		(0.044)	(0.048)
Tie		0.951***	0.941***
		(0.031)	(0.032)
Score x Tie			0.029
			(0.018)
Observations	128,847	128,847	128,847
Ind.	673	673	673
Chi-test	5.73	1100.40	1127.92

Math (Low-SES vs others)

- Alternative specification with binary Low-SES
- No evidence for a Low-SES bias
- Consistent with main model

Return

	(1)	(2)	(3)
Low-SES	0.220***	0.049	0.050
	(0.083)	(0.097)	(0.098)
Nominee Score		0.653***	0.538***
		(0.040)	(0.041)
Tie		0.887***	0.854***
		(0.029)	(0.030)
Score x Tie			0.088***
			(0.019)
Observations	128,150	128,150	128,150
Ind.	669	669	669
Chi-test	7.02	1124.24	1156.08

Reading across SES

- Restrict sample by referrer SES
- Low-SES bias against other SES
- No evidence for a bias against Low-SES Alt. Specification

	Low-SES (1)	Middle-SES (2)	High-SES (3)
Low-SES	0.266*	-0.202	-0.275
	(0.155)	(0.149)	(0.369)
High-SES	-0.307	-0.254	-0.511
	(0.268)	(0.186)	(0.377)
Nominee score	0.548***	0.483***	0.553***
	(0.076)	(0.067)	(0.179)
Tie	0.873***	0.991***	0.986***
	(0.046)	(0.046)	(0.128)
Score x Tie	0.019	0.021	0.145**
	(0.027)	(0.027)	(0.072)
Observations	54611	64596	9640
Ind.	275	340	58
Chi-test	531.49	553.06	97.57

Reading across SES (Low-SES vs others)

- Alternative specification with binary Low-SES
- Low-SES bias against other SES
- No evidence for a bias against Low-SES
- Consistent with main model

Return

	Low-SES (1)	Other-SES (2)
Low-SES	0.312**	-0.160
	(0.153)	(0.137)
Nominee score	0.545***	0.486***
	(0.076)	(0.062)
Tie	0.876***	0.996***
	(0.046)	(0.044)
Score x Tie	0.019	0.036
	(0.027)	(0.025)
Observations	54611	74236
Ind.	275	398
Chi-test	517.41	627.40

Math across SES

- Restrict sample by referrer SES
- Low-SES bias against High-SES
- High-SES bias against Low-SES Alt. Specification

	Low-SES (1)	Middle-SES (2)	High-SES (3)
Low-SES	0.208	-0.101	-0.986**
	(0.150)	(0.145)	(0.469)
High-SES	-0.619**	-0.313	-0.269
	(0.283)	(0.195)	(0.381)
Nominee score	0.540***	0.526***	0.730***
	(0.064)	(0.060)	(0.128)
Tie	0.814***	0.870***	0.929***
	(0.041)	(0.043)	(0.128)
Score x Tie	0.067**	0.096***	0.160
	(0.028)	(0.029)	(0.097)
Observations	55531	62492	10127
Ind.	283	327	59
Chi-test	525.71	561.64	110.76

Math across SES (Low-SES vs others)

- Alternative specification with binary Low-SES
- Low-SES bias against other SES
- No evidence for a bias against Low-SES
- Consistent with main model

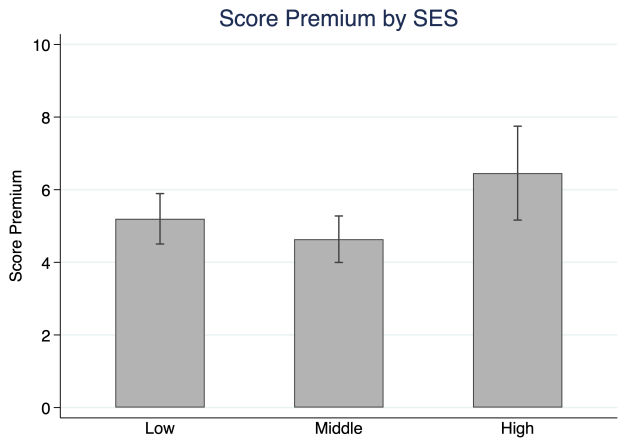
Return

	Low-SES (1)	Other-SES (2)
Low-SES	0.296**	-0.138
	(0.147)	(0.136)
Nominee score	0.533***	0.541***
	(0.063)	(0.055)
Tie	0.820***	0.882***
	(0.042)	(0.042)
Score x Tie	0.064**	0.106***
	(0.028)	(0.027)
Observations	55531	72619
Ind.	283	386
Chi-test	523.84	647.99

No differences for Score Premium by SES

- Differences are negligeable

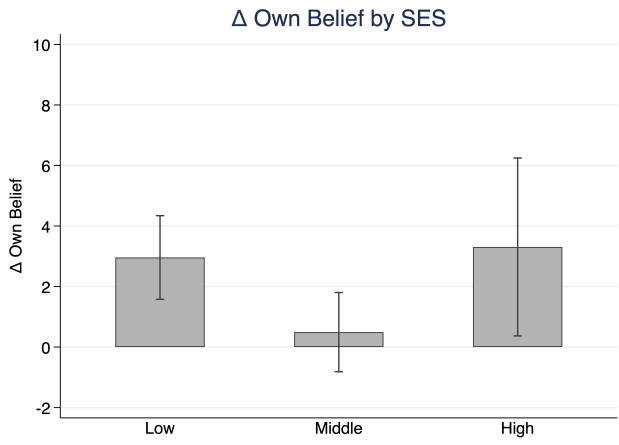
Return



No differences for own score beliefs by SES

- Differences are negligeable

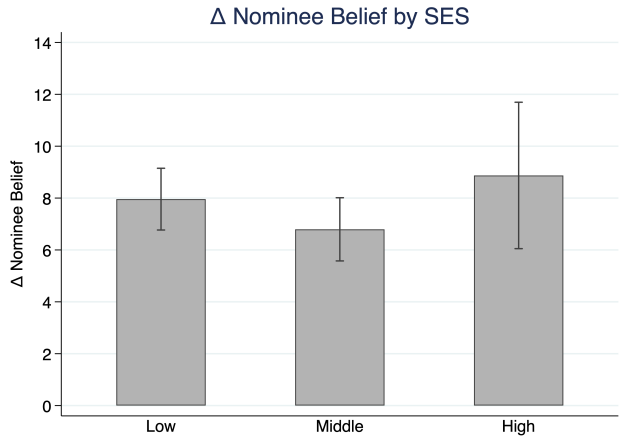
Return



No Differences for nominee score beliefs by SES

- Differences are negligeable

Return



Nominee Beliefs are rewarded for accuracy

- Negative coeffient is explained by quadratic shape

Return