

# **Breaking the Bias: Referrals offset class differences in social networks**

**1 hour internal presentation**

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# Motivation

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- 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

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- 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

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- 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

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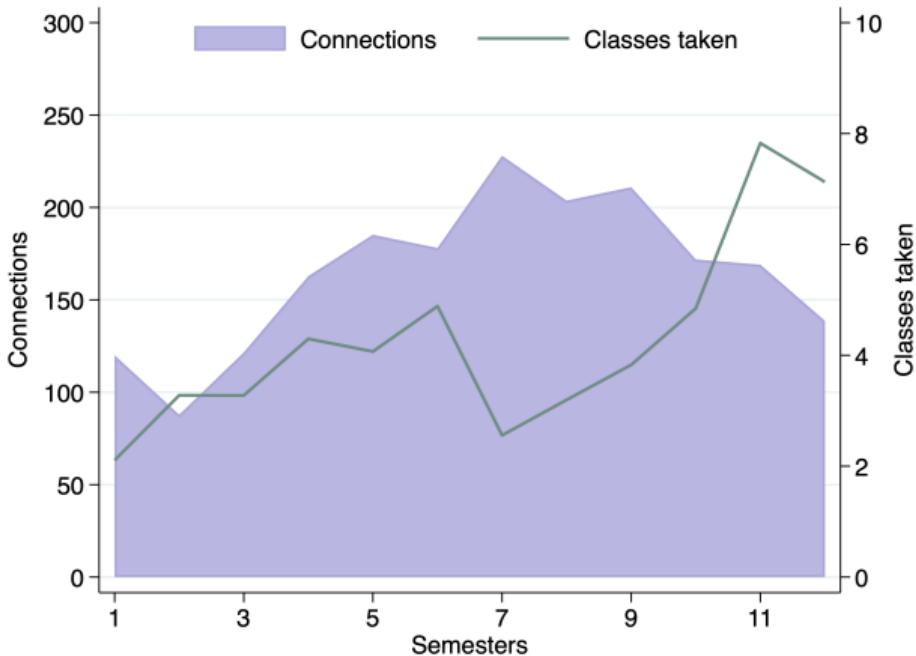
- Successful randomization

	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

# Referrer network size and tie strength

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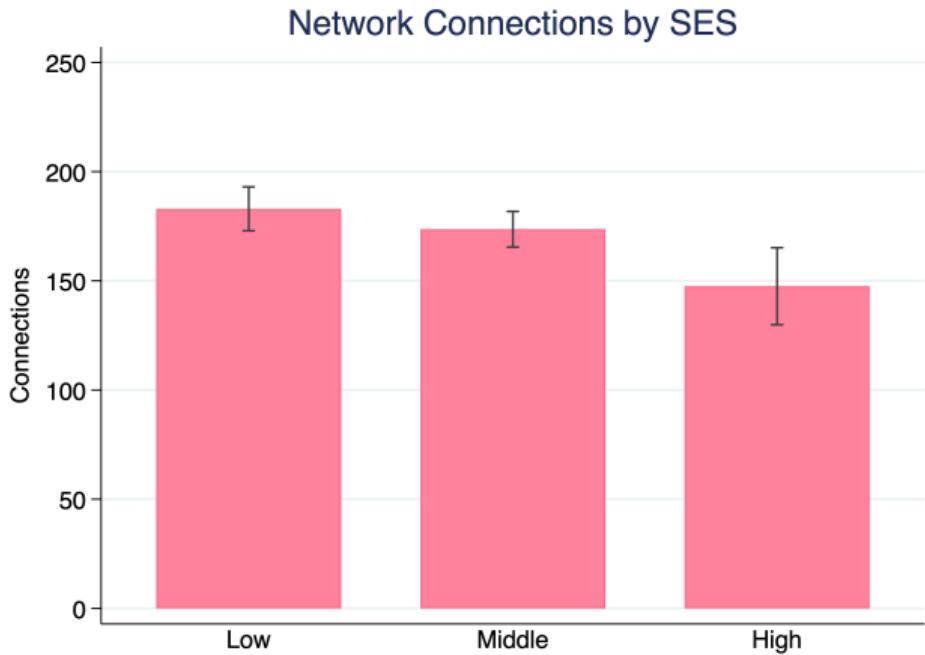
- Classes taken with peers increase over time
- Connections peak around 7 semesters and decline as students change majors or graduate



# Referrer network connections

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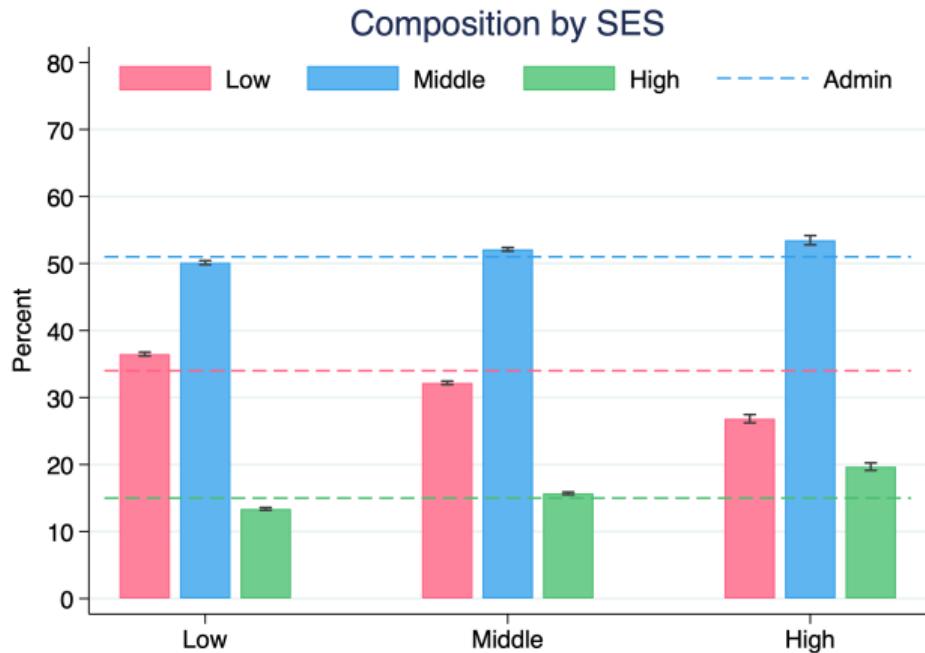
- Connections decrease as SES increases



# Referrer network SES composition

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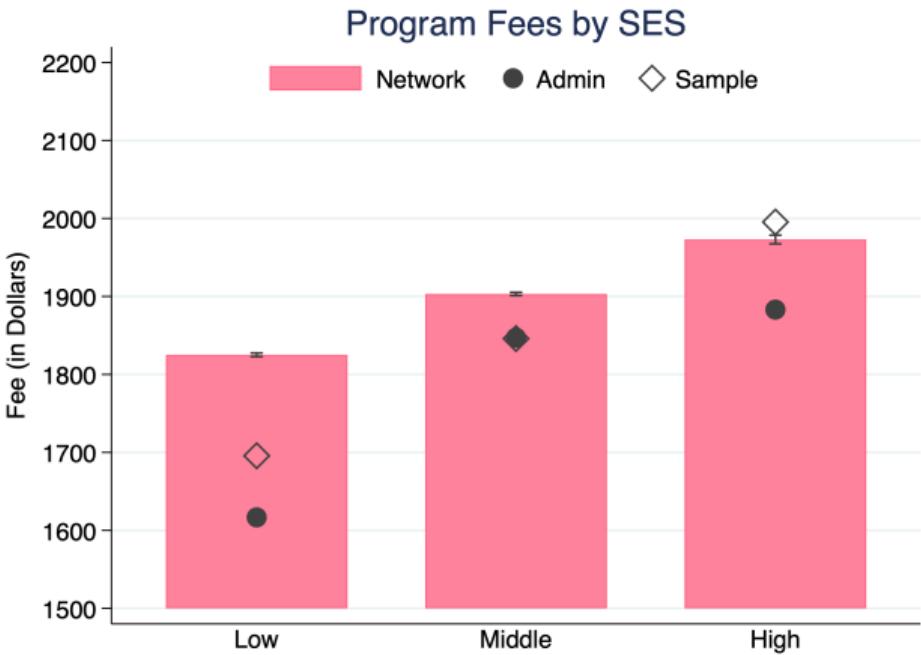
- Monotonic increase in Middle and High SES shares as SES increases



# Network-level program sorting

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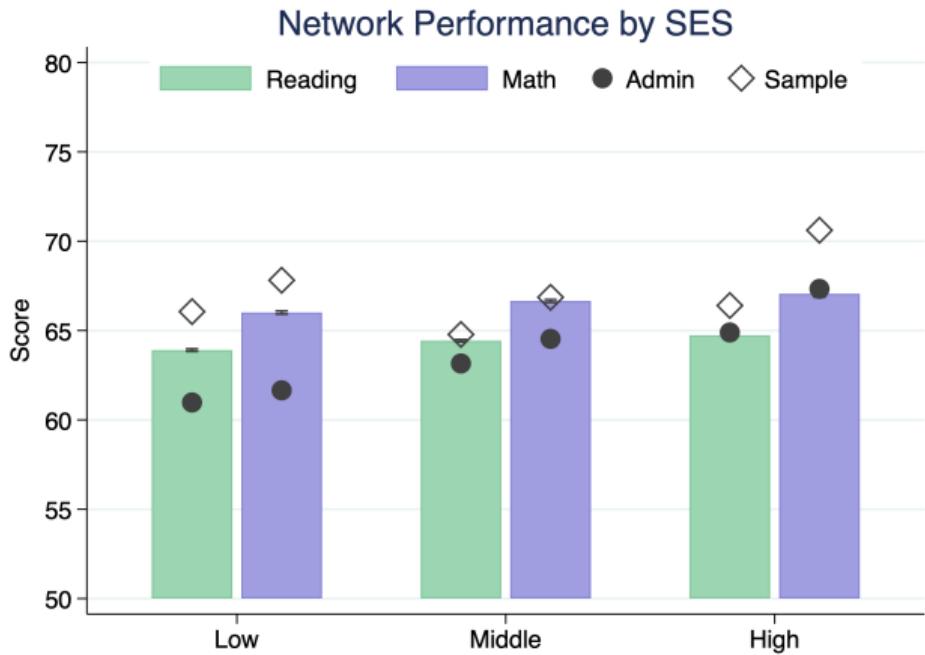
- Net average monthly salary  
\$350 in Colombia
- Networks of Low-SES sort  
into more affordable  
programs



# Referrer network performance

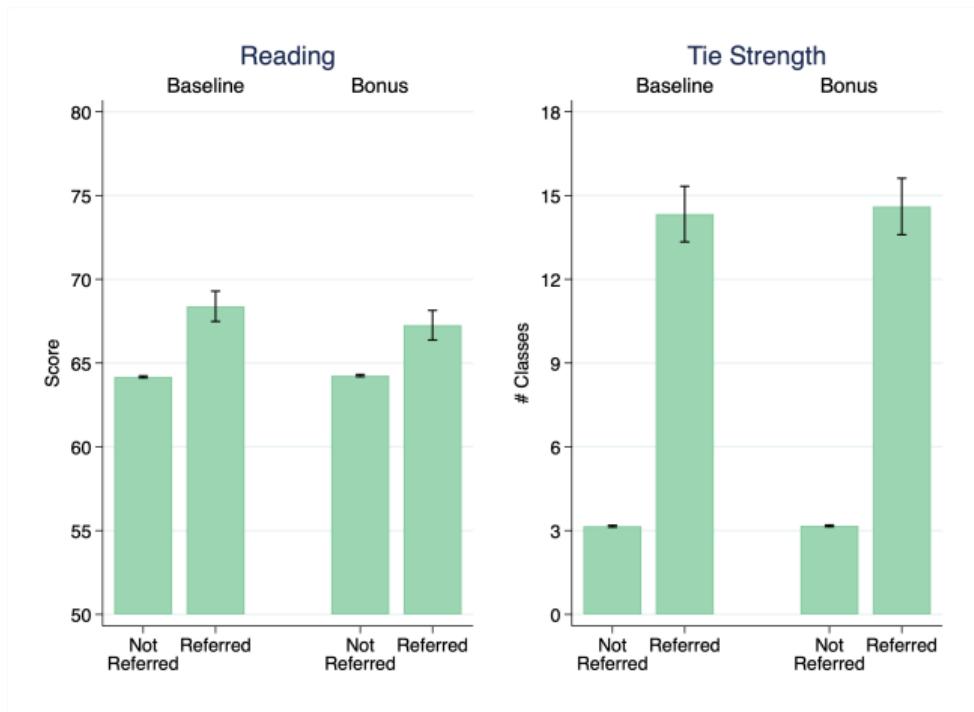
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- Strongest selection w.r.t. performance for the Low-SES
- Network performance represents selection
- Comparable performance across SES



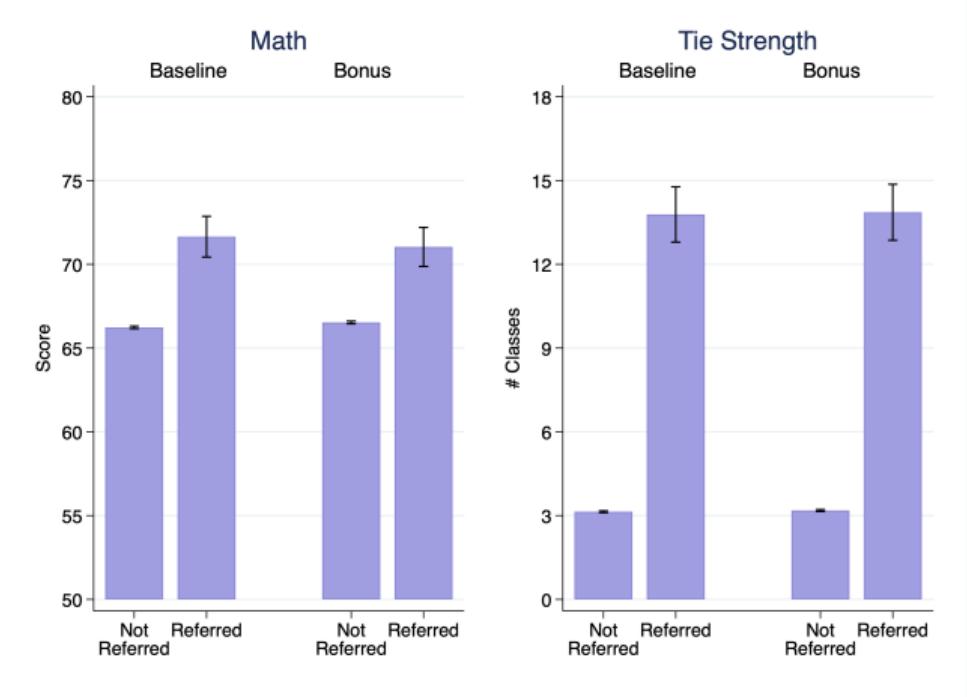
# Referrals for Reading

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



# Referrals for Math

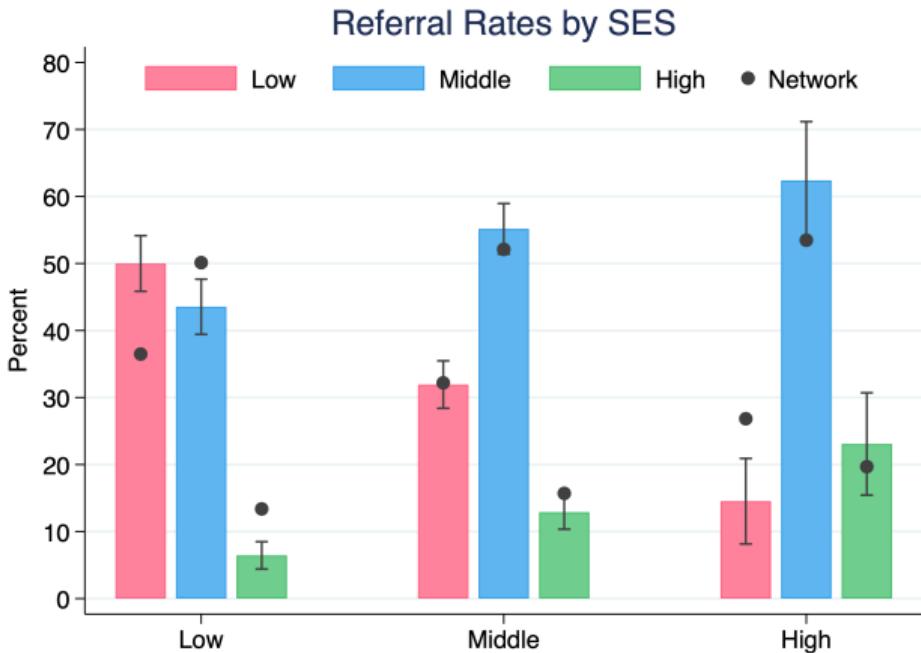
- Referrals have higher math scores and much higher tie strength
- No treatment effect on the referred (both  $p > 0.1$ )



# Referral SES composition

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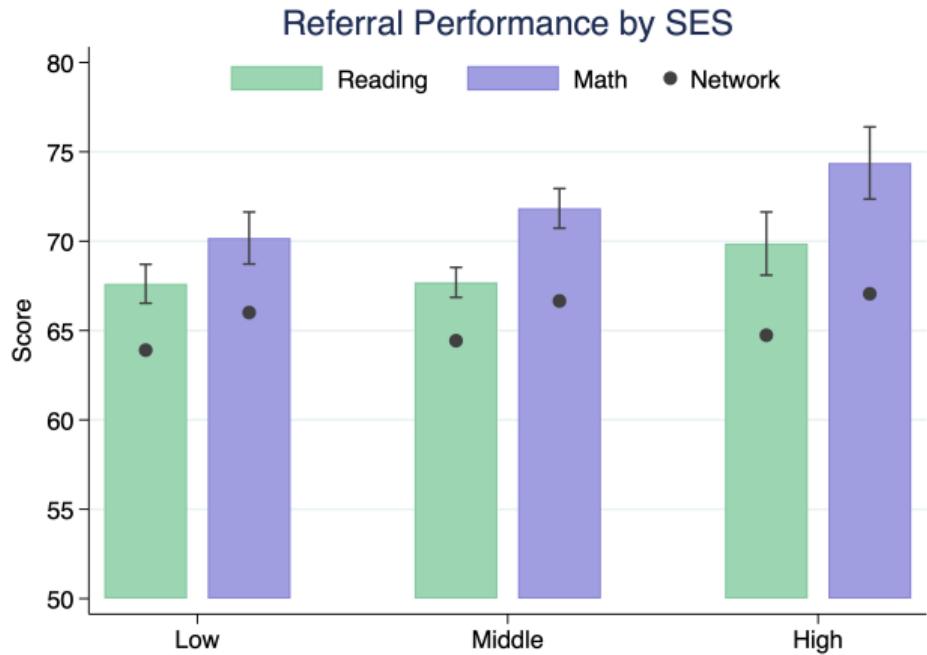
- Large monotonic differences in referral shares as SES increases (all  $p < 0.1$ )



# Referral performance

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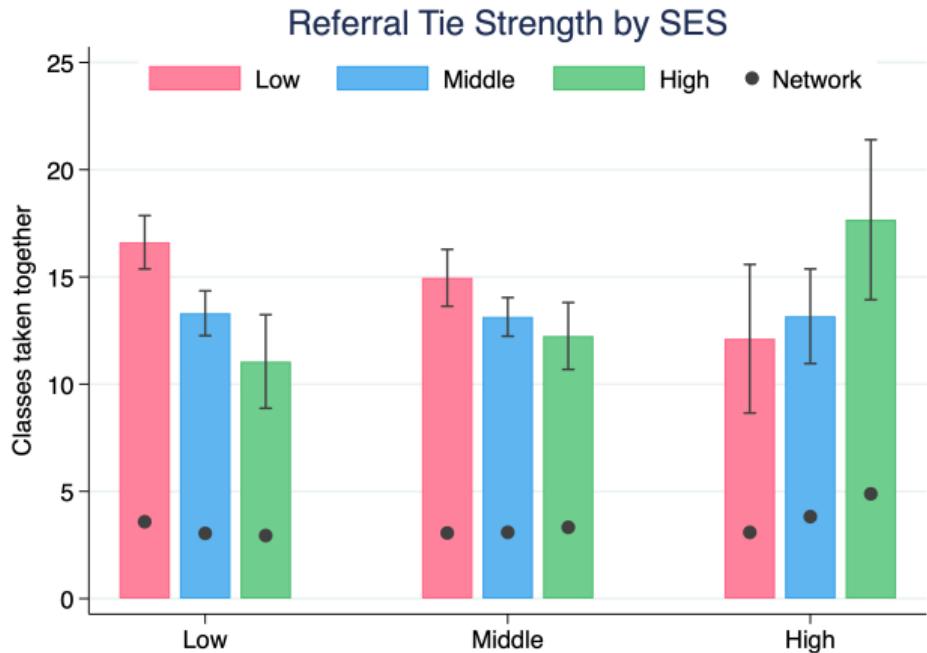
- Small differences in referral performance across SES (all  $p > 0.08$ )



# Referral tie strength

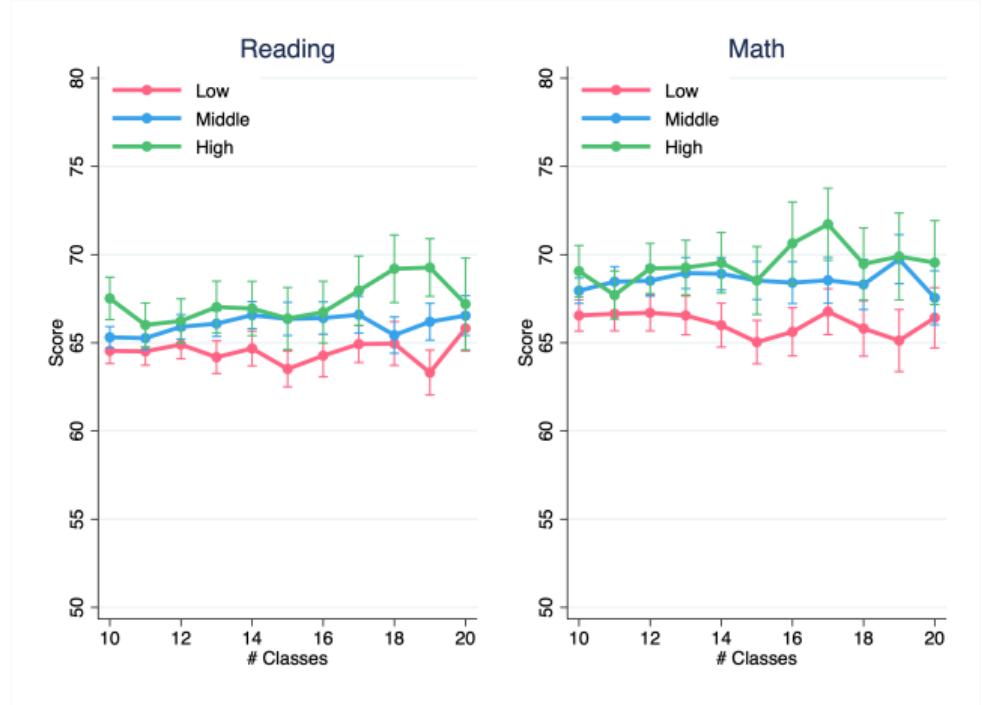
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- Low and High SES take more classes with their own SES
- Low and High SES refer from those with whom they take more classes



# Referral performance and tie strength

- High-SES referrers access slightly higher performing nominees



# Is there a bias against Low-SES in referrals?

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## Conditional Logit Model:

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

- $\text{Refer}_{ij}$ : Binary outcome indicating whether individual  $i$  refers individual  $j$
- $\text{SES}_j$ : Referral  $j$  is Low, Middle, or High SES
- $\text{Score}_j$ : Standardized Math or Reading score of referral  $j$
- $\text{Tie}_{ij}$ : Standardized number of classes taken together for  $i$  and  $j$
- $\alpha_i$ : Individual fixed effect for referrer  $i$

## Features:

- Control for referrer networks other unobservables with FE
- Estimate separately for Math and Reading scores

# Reading

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- 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)
Reading 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

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

# Math

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- 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* (0.086)	-0.013 (0.099)	-0.015 (0.100)
High-SES	-0.309** (0.131)	-0.343** (0.142)	-0.361** (0.144)
Math score		0.662*** (0.040)	0.546*** (0.042)
Tie		0.885*** (0.029)	0.851*** (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

# Math across SES

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

# Result 1: No bias against Low-SES

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- Referrers pick nominees based on performance and tie strength
- No support for a bias against Low-SES
- add graph/visuals to illustrate?

# Who makes good referrals?

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## OLS Model:

$$\text{Premium}_{ij} = \beta_0 + \beta_1 \text{Score}_i + \beta_2 \text{OwnBelief}_i + \beta_3 \text{OtherBelief}_i + \beta_4 \text{Treat}_i + \mathbf{X}'_i \boldsymbol{\gamma} + \epsilon_i$$

- $\text{Premium}_{ij}$ : Nominee  $j$ 's test score minus mean score of  $i$ 's network Distribution
- $\text{OwnBelief}_i$ ,  $\text{OtherBelief}_i$ :  $i$ 's beliefs on own and nominee test scores
- $\text{Score}_i$ : Referrer  $i$ 's own test score
- $\text{Treat}_i$ : Referrer  $i$ 's treatment indicator (Baseline vs. Bonus)

## Controls:

- Referrer  $i$ 's socioeconomic status (Low, Middle, High)
- Subject test area indicator (Math vs. Reading)
- Number of classes taken together for  $i$  and nominee  $j$
- Standard deviation of test scores in  $i$ 's network

# Grades and beliefs bring in better referrals

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- Referrer  $i$ 's score predicts premium
- Beliefs about own score negatively related to premium
- Stronger belief in nominee  $j$ 's score yields higher premium
- Bonus for the nominee  $j$  marginally reduces premium

	(1)	(2)	(3)
Score	0.197*** (0.025)	0.197*** (0.025)	0.192*** (0.025)
Belief own score	-0.097*** (0.015)	-0.097*** (0.015)	-0.095*** (0.015)
Belief nominee score	0.211*** (0.016)	0.210*** (0.016)	0.211*** (0.016)
Bonus		-0.763* (0.415)	-0.719* (0.415)
Mean of dep. var.	-17.661*** (1.557)	-17.337*** (1.566)	-20.346*** (2.696)
Controls	No	No	Yes
Observations	1,342	1,342	1,342

# Conclusion

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- Referrers pick nominees based on performance and tie strength
- No support for a bias against Low-SES

# Reading (Alt.)

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- 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** (0.083)	0.041 (0.100)	0.042 (0.100)
Reading Score		0.561*** (0.044)	0.509*** (0.048)
Tie		0.951*** (0.031)	0.941*** (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

# Reading across SES (Alt.)

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

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

[Return](#)

# Math (Alt.)

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- 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*** (0.083)	0.049 (0.097)	0.050 (0.098)
Math Score		0.653*** (0.040)	0.538*** (0.041)
Tie		0.887*** (0.029)	0.854*** (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

# Math across SES (Alt.)

---

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

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

[Return](#)

# Score Premium distribution

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- Defined as nominee  $j$ 's score minus network average for each referrer  $i$  across Math and Reading
- Referrals are better than network average [Return](#)

