

Breaking the Bias: Referrals offset class differences in social networks

1 hour internal presentation

Reha Tuncer - University of Luxembourg

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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 (>1 st 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	

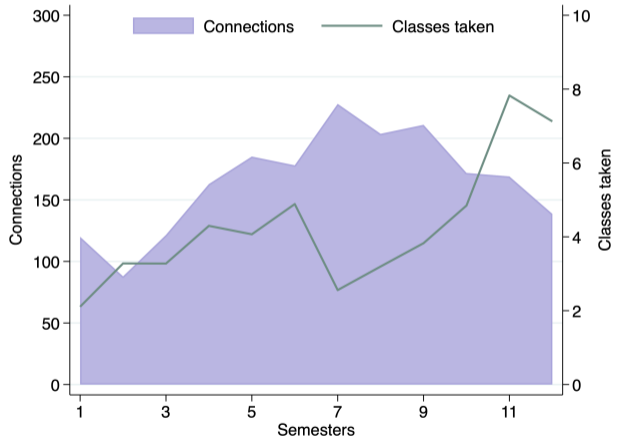
Balance between treatments

- 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

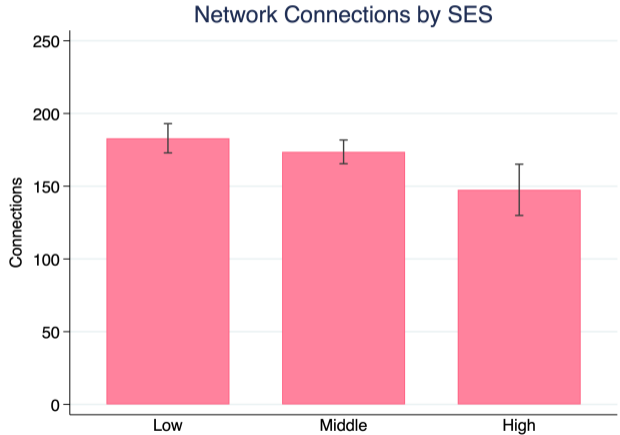
Referrer network size and tie strength

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



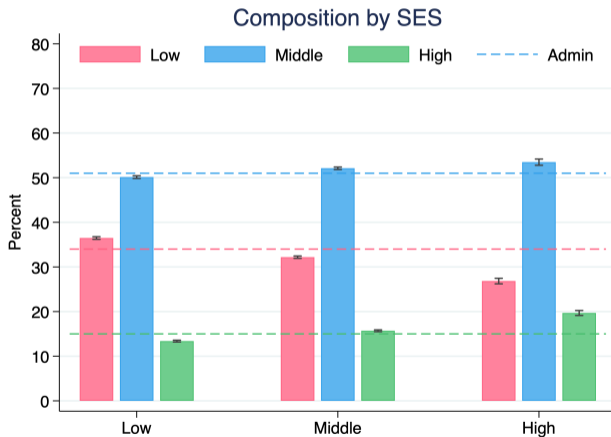
Referrer network connections

- Connections decrease as SES increases



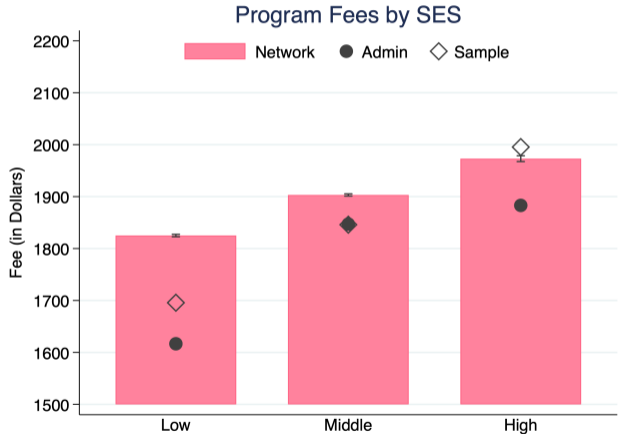
Referrer network SES composition

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



Network-level program sorting

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



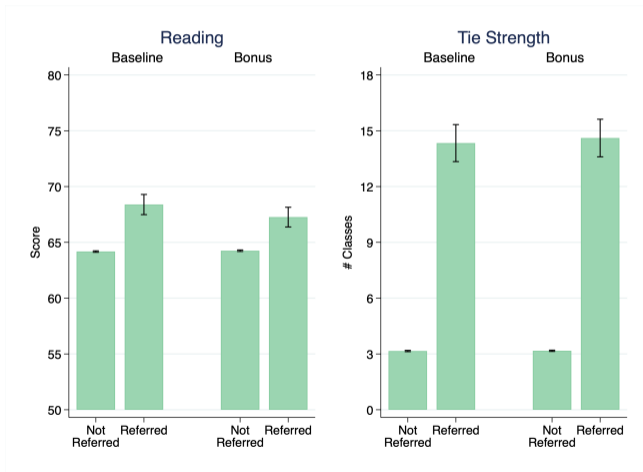
Referrer network performance

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



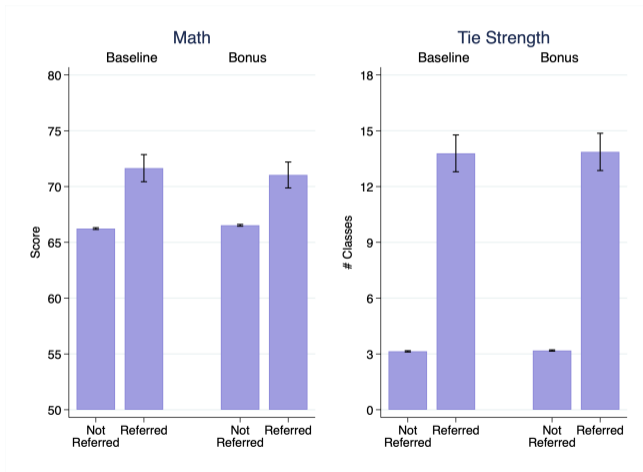
Referrals for Reading

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



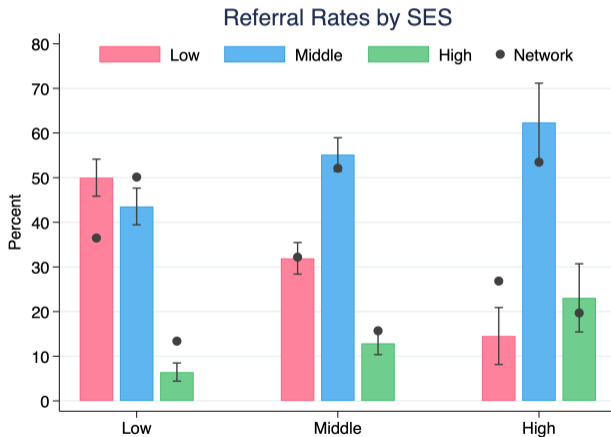
Referrals for Math

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



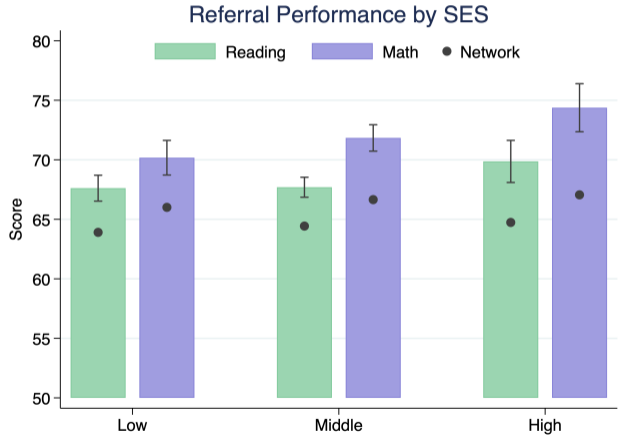
Referral SES composition

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



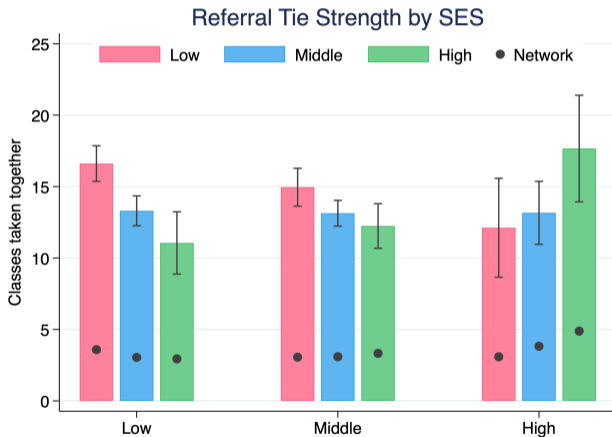
Referral performance

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



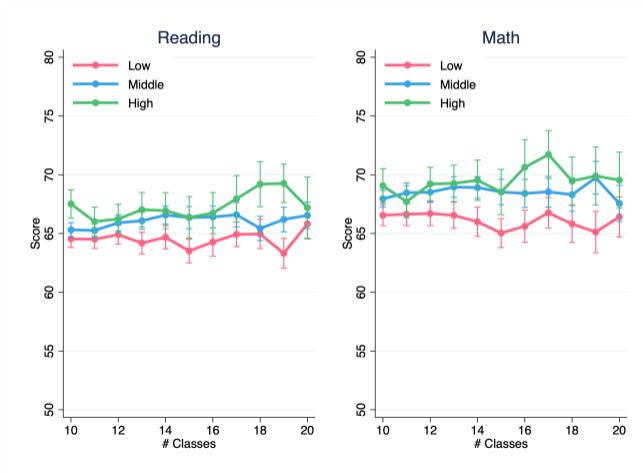
Referral tie strength

- 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?

Conditional Logit Model:

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

- 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:

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

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* (0.086)	-0.007 (0.101)	-0.007 (0.102)
High-SES	-0.293** (0.128)	-0.271* (0.139)	-0.275** (0.139)
Reading score		0.566*** (0.044)	0.513*** (0.048)
Tie		0.949*** (0.031)	0.939*** (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

- 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

- 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

- 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?

OLS Model:

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

- Premium_{ij} : Nominee j 's test score minus mean score of i 's network Distribution
- OwnBelief_i , OtherBelief_i : i 's beliefs on own and nominee test scores
- Score_i : Referrer i 's own test score
- 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

- 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

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

Reading (Alt.)

- 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.)

- 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** (0.153)	-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

Math (Alt.)

- 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

[Return](#)

	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

Score Premium distribution

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

