Comparing Predictors of Student Outcome

Christina Chen
STA 440

The U.S. School Funding Debate

- 1966: "Equality of Educational Opportunity" by James S. Coleman
  - Biggest determinants: student's family background and diverse socioeconomic mix
  - Not as big: Physical amenities or school funding
  - Achievement gap
- 2015: 10% increase in spending per student leads to
  - 0.27 more completed years of education
  - 7.25% higher wages
  - Effects were greater for low socioeconomic students
- 2018: school finance reforms in low-income school districts lead to improvement in test scores

Which environment - familial or educational - is a larger determinant of student success?

Data

- Education Longitudinal Study of 2002 from the National Center for Education Statistics (NCES)
  - 2002: High School Sophomores
  - 2006: Two years after graduation
  - 2012: Eight years after graduation
- ~16000 observations on the student level
- Using mostly Base Year data for predictors
- Imputed around 3000-4000 missing observations for some variables

Familial

SES Status Composite

Push from Parents

Race
Family Composition
Parent Education
Technology Access

Educational

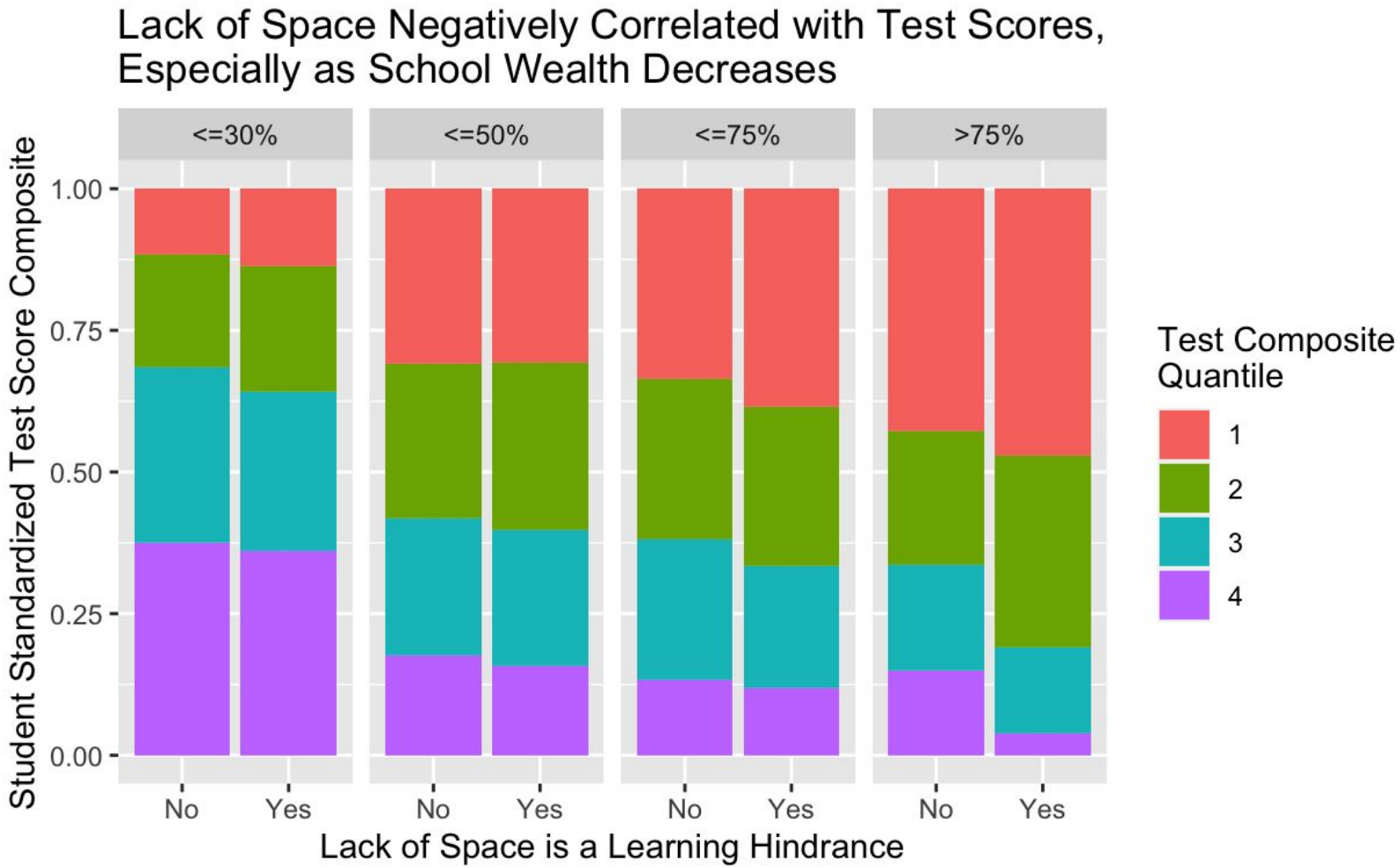
School Type
Lowest Teacher Salary
Students with Free Lunch

Push from Teachers
College Prep Enrollment

Learning Hindered (Space, Building, Resources)

Measures of Success

- **Standardized Test Composite Score**
- **Highest Level of Education Attained**
- **Socioeconomic Status Quantile**
  10 years after base year survey (10th grade)


Lack of Space Negatively Correlated with Test Scores, Especially as School Wealth Decreases
<=30%
<=50%
<=75%
>75%
Student Standardized Test Score Composite
1.00
0.75
0.50
0.25
0.00
No
Yes
Lack of Space is a Learning Hindrance
Test Composite Quantile
1
2
3
4

Methodology

Modeling:

- Test Composite Score - OLS
- Level of Education Attained
  - Dropped out of High School - Logistic Regression
  - Attained Bachelor's Degree - Logistic Regression
- SES Quantile - Ordinal Logistic Regression

How to Compare Familial vs Educational Predictors?

- Coefficient sizes and significance within the 3 axes

Composite Score

	Familial Predictors	Educational Predictors
Financial		
Motivation		
Conditions		

Table 1: Results: OLS Model for Test Composite Score

	Coef	Std. Error	P-value
Intercept	28.795	0.589	<0.001
Race=API	-1.085	0.295	<0.001
Race=Black	-3.339	0.278	<0.001
Race=Hispanic	-2.313	0.275	<0.001
Race=White	1.507	0.244	<0.001
Has Two Parents	0.069	0.137	0.614
SES	1.966	0.144	<0.001
# Years Parents Education	-0.104	0.036	0.004
# Years Education Parents Push	0.451	0.029	<0.001
Has Computer and Internet	0.907	0.149	<0.001
Is Public School	0.203	0.161	0.206
# Years Education Math Teacher Pushes	1.386	0.035	<0.001
# Years Education English Teacher Pushes	1.159	0.034	<0.001
% Sophomores in College Prep	0.005	0.001	0.001
Lowest Teacher Salary (thousands)	-0.002	0.012	0.867
Majority Students Have Free Lunch	-0.910	0.236	<0.001
LH by Lack of Space	0.052	0.152	0.731
LH by Poor Building Conditions	-0.953	0.165	<0.001
LH by Poor Heating/Air/Light	0.420	0.159	0.008
LH by Lack of Text/Supplies	-0.096	0.142	0.498
LH by Poor Facilities	-0.466	0.155	0.003
LH by Poor Technology	0.009	0.153	0.955
Majority Free Lunch:LH by Lack of Space	-0.558	0.297	0.060

Dropping Out

	Familial Factors	Educational Factors
Financial		
Motivation		
Conditions		Only with lack of space

Table 3: Results: Logistic Regression for Odds of Dropping Out of HS

	Coef	Exp(Coef)	Std. Error	P-value
Intercept	2.551	12.822	0.286	<0.001
Race=API	-0.039	0.962	0.14	0.781
Race=Black	-0.232	0.793	0.118	0.049
Race=Hispanic	-0.172	0.842	0.117	0.144
Race=White	-0.495	0.609	0.108	<0.001
Has Two Parents	-0.231	0.794	0.061	<0.001
SES	-0.129	0.879	0.068	0.057
# Years Parents Education	-0.016	0.984	0.016	0.338
# Years Education Parents Push	-0.016	0.984	0.013	0.201
Has Computer and Internet	-0.202	0.817	0.061	0.001
Is Public School	0.429	1.536	0.11	<0.001
# Years Education Math Teacher Pushes	-0.297	0.743	0.017	<0.001
# Years Education English Teacher Pushes	-0.309	0.734	0.017	<0.001
% Sophomores in College Prep	-0.002	0.998	0.001	0.008
Lowest Teacher Salary (thousands)	-0.008	0.992	0.006	0.195
Majority Students Have Free Lunch	-0.253	0.776	0.108	0.019
LH by Lack of Space	0.004	1.004	0.077	0.956
LH by Poor Building Conditions	0.036	1.037	0.079	0.647
LH by Poor Heating/Air/Light	-0.077	0.926	0.078	0.322
LH by Lack of Text/Supplies	0.032	1.032	0.066	0.633
LH by Poor Facilities	-0.078	0.925	0.077	0.314
LH by Poor Technology	0.048	1.049	0.076	0.533
Majority Free Lunch:LH by Lack of Space	0.367	1.444	0.132	0.005

Attaining Bachelor's

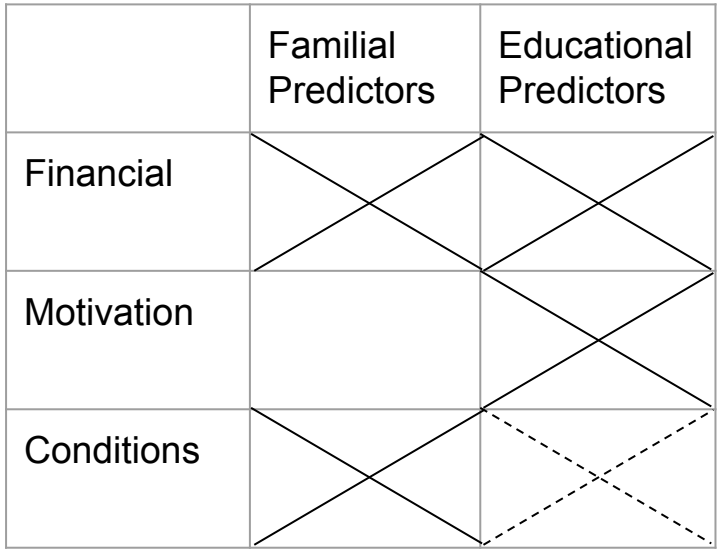


Table 4: Results: Logistic Regression for Odds of Attaining Bachelor's

	Coef	Exp(Coef)	Std. Error	P-value
Intercept	-6.981	0.001	0.237	<0.001
Race=API	0.354	1.425	0.107	0.001
Race=Black	0.120	1.128	0.106	0.257
Race=Hispanic	-0.039	0.961	0.105	0.708
Race=White	0.288	1.334	0.09	0.001
Has Two Parents	0.042	1.043	0.052	0.422
SES	0.402	1.495	0.053	<0.001
# Years Parents Education	0.035	1.035	0.013	0.01
# Years Education Parents Push	0.078	1.081	0.011	<0.001
Has Computer and Internet	0.308	1.36	0.062	<0.001
Is Public School	-0.357	0.7	0.054	<0.001
# Years Education Math Teacher Pushes	0.340	1.405	0.014	<0.001
# Years Education English Teacher Pushes	0.330	1.391	0.014	<0.001
% Sophomores in College Prep	0.002	1.002	0.001	0.001
Lowest Teacher Salary (thousands)	0.009	1.009	0.004	0.037
Majority Students Have Free Lunch	-0.061	0.941	0.092	0.507
LH by Lack of Space	-0.014	0.986	0.054	0.791
LH by Poor Building Conditions	-0.098	0.907	0.061	0.11
LH by Poor Heating/Air/Light	0.067	1.07	0.058	0.248
LH by Lack of Text/Supplies	0.028	1.029	0.053	0.592
LH by Poor Facilities	-0.026	0.974	0.056	0.639
LH by Poor Technology	-0.126	0.882	0.055	0.023
Majority Free Lunch:LH by Lack of Space	-0.171	0.843	0.118	0.147

SES Quantile

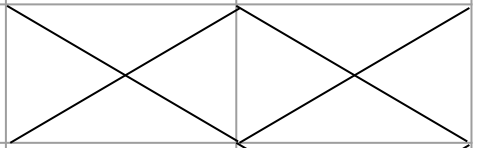
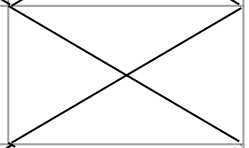
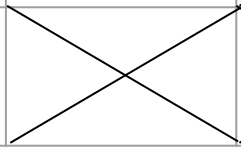
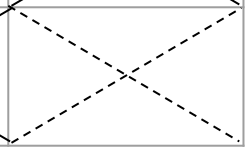
	Familial Predictors	Educational Predictors
Financial		
Motivation		
Conditions		

Table 2: Results: Ordinal Logistic Regression for SES Status

	Coef	Exp(-Coef)	Std. Error	P-value
Race=API	0.098	0.907	0.080	0.218
Race=Black	0.032	0.968	0.075	0.667
Race=Hispanic	0.017	0.983	0.074	0.819
Race=White	0.214	0.807	0.066	0.001
Has Two Parents	0.085	0.918	0.037	0.020
SES	0.321	0.725	0.038	<0.001
# Years Parents Education	-0.012	1.012	0.010	0.221
# Years Education Parents Push	0.046	0.955	0.008	<0.001
Has Computer and Internet	0.276	0.758	0.040	<0.001
Is Public School	-0.244	1.277	0.043	<0.001
# Years Education Math Teacher Pushes	0.232	0.793	0.010	<0.001
# Years Education English Teacher Pushes	0.226	0.797	0.009	<0.001
% Sophomores in College Prep	0.001	0.999	0.000	0.002
Lowest Teacher Salary (thousands)	0.004	0.996	0.003	0.178
Majority Students Have Free Lunch	-0.187	1.206	0.063	0.003
LH by Lack of Space	-0.101	1.106	0.041	0.013
LH by Poor Building Conditions	-0.125	1.133	0.044	0.005
LH by Poor Heating/Air/Light	0.089	0.915	0.043	0.036
LH by Lack of Text/Supplies	-0.014	1.014	0.038	0.713
LH by Poor Facilities	-0.059	1.061	0.041	0.154
LH by Poor Technology	-0.019	1.019	0.041	0.648
Majority Free Lunch:LH by Lack of Space	0.062	0.940	0.079	0.438
Intercept (SES Quartile <= 1)	2.362	0.094	0.158	<0.001
Intercept (SES Quartile <= 2)	3.732	0.024	0.160	<0.001
Intercept (SES Quartile <= 3)	5.120	0.006	0.162	<0.001

Conclusions

Financial Predictors

Familial

Test Composite Score

Educational

Dropping Out of HS

Both

Attaining Bachelor's

Socioeconomic Status

Conclusions

Motivation Predictors

Familial

Educational

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Both

Conclusions

Conditions Predictors

Familial

Test Composite Score

Educational

Both

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Socioeconomic Status

Limitations and Future Analysis

- Independence of observations
  - Mixed effects models
- Using proxies for school spending
  - Using direct data of school funding
- Imputed data, lots of categorical variables, methods to encode variables
  - Sensitivity analysis
- Axes of factor groupings
  - Might not be completely separated groupings
- Model using test composite score

Sources

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