

The Impact of Low-Ability Peers on Cognitive and Non-Cognitive Outcomes:

Random Assignment Evidence on the Effects and Operating Channels

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Appendix (for online publication only)

Online Appendix 1

Principle Factor Analysis for the Non-Cognitive Outcomes

Following Gong, Lu, and Song (2018), we conduct a principle factor analysis to group the non-cognitive outcomes. Table 1 in Online Appendix 1 shows the principle factors, eigenvalues, and proportions of variance explained. We choose the first five factors as our principle factors based on their eigenvalues (equal to or larger than 1) and the cumulative explained variance (68.4%).

Online Appendix 1 Table 1

Principle Factor Analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	3.607	1.931	0.278	0.278
Factor2	1.676	0.194	0.129	0.406
Factor3	1.482	0.334	0.114	0.520
Factor4	1.147	0.162	0.088	0.609
Factor5	0.985	0.242	0.076	0.684
Factor6	0.743	0.169	0.057	0.742
Factor7	0.574	0.030	0.044	0.786
Factor8	0.544	0.033	0.042	0.828
Factor9	0.511	0.019	0.039	0.867
Factor10	0.492	0.063	0.038	0.905
Factor11	0.429	0.011	0.033	0.938
Factor12	0.418	0.024	0.032	0.970
Factor13	0.394	.	0.030	1

Table 2 in Online Appendix 1 presents the factor loadings after rotation. After examining the correlation between the factors and the original variables, we are able to group variables to different categories. We specifically focus on loadings larger than 0.6. The correlation suggests that variables “feeling down,” “depressed,” “unhappy,” “not enjoying life,” and “sad” can be grouped as the first factor, which indicate the level of mental stress. Variables “I am often late for school” and “I am often absent from school” can be grouped as the second factor. Similarly, variables “I seldom participate in school or

class activities” and “I do not feel close to people at this school” can be grouped as the third factor, and “I feel bored at school” and “I want to attend another school” can be grouped as the fourth. Lastly, variables “confidence about future” and “expected years of education” are grouped as the fifth factor. Together, the five factors explain most of the variation (68.4%) in the data. We further present the component loadings visually in Online Appendix 1 Figure 1 and find similar patterns.

The KMO test also supports the validity of our principle factor analysis (Online Appendix 1 Table 3). The overall KMO estimate is 0.8, which suggests that the sampling is meritorious (Kaiser 1974).

To summarize, we are able to group the thirteen non-cognitive outcomes into five categories using principle factor analysis. The first category measures the level of mental stress and includes feeling down, depressed, unhappy, not enjoying life, and sad. The second category measures school attendance and includes being late and absent from school. The third category measures school participation and includes level of participation in school activities and feeling not close with people in school. The fourth category measures the overall satisfaction with school experience and includes feeling bored and wanting to attend another school. The last category measures educational expectations and includes confidence about future and expected years of education. In our analysis, we combine the second to the fourth categories into one group given they are closely related and naturally fall into one category measuring overall school disengagement.

Online Appendix 1 Table 2

Contribution of Variables to Principle Factors

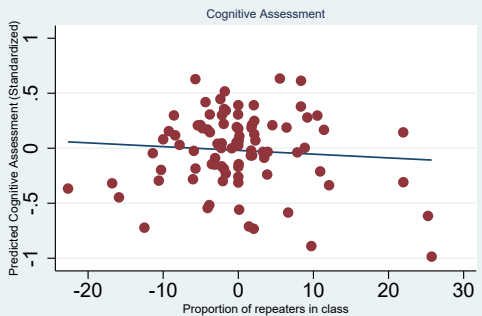
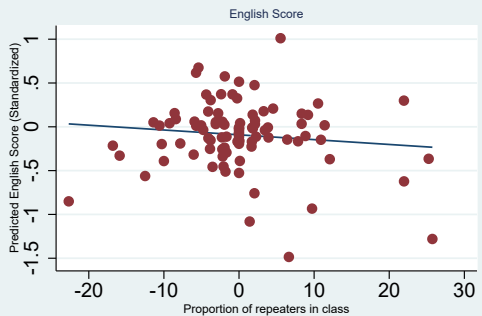
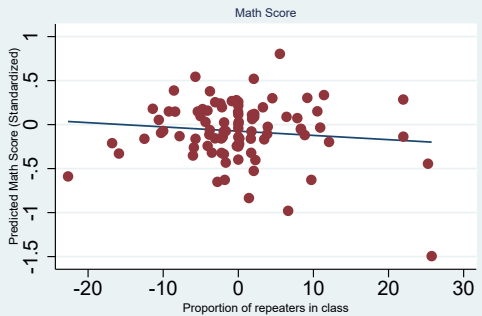
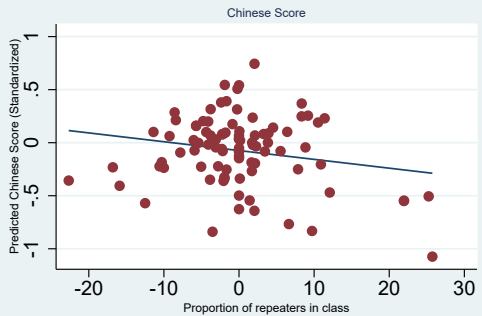
Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
Feeling down	0.805	0.028	0.003	0.047	0.007	0.349
Depressed	0.790	0.037	0.115	0.082	-0.002	0.354
Unhappy	0.792	0.019	0.112	0.087	-0.057	0.349
Not enjoying life	0.680	0.020	0.269	0.083	-0.097	0.448
Sad	0.783	0.041	0.048	0.035	-0.075	0.376
I am often late for school	0.046	0.884	0.050	0.056	0.001	0.211
I am often absent from school	0.022	0.881	0.084	-0.028	-0.045	0.213
I seldom participate in school or class activities	0.056	0.029	-0.036	0.857	-0.117	0.247
I do not feel close to people at this school	0.109	0.002	0.206	0.819	-0.026	0.275
I feel bored at school	0.148	0.077	0.808	0.139	-0.091	0.292
I want to attend another school	0.089	0.081	0.852	0.021	-0.001	0.260
Confidence about future	-0.231	-0.007	-0.126	-0.210	0.629	0.491
Expected years of education	0.009	-0.038	-0.022	-0.050	0.869	0.240

Online Appendix 1 Table 3

Kaiser-Meyer-Olkin Measure for Sampling Adequacy

Variable	KMO
Feeling down	0.850
Depressed	0.869
Unhappy	0.874
Not enjoying life	0.892
Sad	0.877
I am often late for school	0.549
I am often absent from school	0.539
I seldom participate in school or class activities	0.646
I do not feel close to people at this school	0.707
I feel bored at school	0.753
I want to attend another school	0.720
Confidence about future	0.863
Expected years of education	0.723
Overall	0.794

The Relationship between First Differences in Average Predicted Outcomes of Non-repeaters and First Differences in the Proportion of Repeaters



Online Appendix 1 Figure 1

Online Appendix Table 2

Impacts of Repeaters on Non-repeaters' Cognitive and Noncognitive Outcomes: Results by Survey Items

	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Academic performance</i>					
Chinese midterm	-0.027** (0.009)	-0.024** (0.008)	-0.024** (0.008)	-0.021** (0.007)	6939
Math midterm	-0.026** (0.010)	-0.023** (0.008)	-0.018* (0.007)	-0.015* (0.007)	6939
English midterm	-0.035*** (0.008)	-0.031*** (0.007)	-0.030*** (0.007)	-0.027*** (0.006)	6939
<i>Panel B: Cognitive assessment</i>					
Cognitive assessment	-0.025** (0.008)	-0.023** (0.008)	-0.026*** (0.007)	-0.023*** (0.006)	7062
<i>Panel C: Mental stress</i>					
Feeling down	0.008+ (0.005)	0.008+ (0.004)	0.006 (0.005)	0.005 (0.005)	6904
Depressed	0.002 (0.004)	0.001 (0.004)	0.000 (0.004)	-0.001 (0.004)	6904
Unhappy	0.003 (0.004)	0.002 (0.004)	0.001 (0.004)	-0.000 (0.003)	6904
Not enjoying life	0.011* (0.005)	0.010* (0.004)	0.007+ (0.004)	0.006+ (0.003)	6904
Sad	0.008 (0.005)	0.007 (0.005)	0.003 (0.005)	0.004 (0.005)	6904
<i>Panel D: School disengagement</i>					
I am often late for school	0.005 (0.004)	0.004 (0.004)	0.004 (0.003)	0.004 (0.003)	6969
I am often absent from school	0.002 (0.005)	0.002 (0.005)	0.001 (0.003)	0.000 (0.003)	5825
I seldom participate in school or class activities	0.011** (0.004)	0.009* (0.004)	0.006+ (0.003)	0.007+ (0.004)	7029
I do not feel close to people at this school	0.016*** (0.004)	0.015*** (0.004)	0.011** (0.004)	0.011** (0.004)	7029
I feel bored at school	0.014* (0.006)	0.014* (0.005)	0.011* (0.005)	0.012* (0.005)	7029
I want to attend another school	0.012+ (0.006)	0.012+ (0.006)	0.007 (0.006)	0.008 (0.006)	7013
<i>Panel E: Educational expectation</i>					
Expected years of education	-0.014* (0.006)	-0.011+ (0.006)	-0.006 (0.005)	-0.003 (0.004)	7020
Confidence about future	-0.012** (0.004)	-0.010** (0.004)	-0.004 (0.004)	-0.004 (0.004)	7020
School fixed effects	Yes	Yes	Yes	Yes	—
Individual controls	No	Yes	Yes	Yes	—
Homeroom teacher controls	No	No	Yes	Yes	—
Classroom average peer controls	No	No	No	Yes	—

Note: All outcome variables are standardized within non-repeaters within each school. Individual controls, homeroom teacher controls, and classroom average peer controls are added progressively in each specification. Individual, homeroom teacher, and classroom average peer controls are the same with previous analyses. School FE models. Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 3

Descriptive Statistics of Homeroom Teacher and Classroom Characteristics

	Mean (SD)
Homeroom teacher female	0.689 (0.464)
Homeroom teacher age in years	36.150 (7.196)
<i>Education level</i>	
Professional college education	0.093 (0.291)
Adult higher education	0.366 (0.483)
College education or higher	0.541 (0.500)
Graduated from a normal university	0.907 (0.291)
Have a teaching certificate	0.995 (0.074)
Teaching experience in years	14.210 (9.010)
<i>Teaching title</i>	
No title	0.115 (0.320)
Level 2 or 3	0.361 (0.482)
Level 1	0.377 (0.486)
Senior teacher or higher	0.148 (0.356)
<i>Teaching award</i>	
School level or no award	0.262 (0.441)
County or district level	0.366 (0.483)
City level	0.257 (0.438)
Provincial or national level	0.115 (0.320)
Class size	46.360 (12.780)
Observations	183

Notes: Data are collapsed to class level. A normal university is a type of 4-year university in China that specializes in teacher workforce training. Standard deviations in parentheses.

Online Appendix Table 4

Differences between Classrooms in Schools that Used Random Assignment and Those that Did Not

	Random assignment (1)	Non-random assignment (2)	Raw gap (3)
<i>Panel A: School-level characteristics</i>			
Located in rural regions	0.344 (0.478)	0.562 (0.512)	-0.218+ (0.131)
School size	990.600 (693.600)	910.400 (553.800)	80.238 (194.704)
Average class size	45.640 (12.430)	45.880 (13.070)	-0.240 (3.597)
School funding in the current year per student (RMB)	1074.200 (835.100)	872.000 (410.700)	202.167 (220.568)
<i>Panel B: Student composition at school</i>			
Proportion of female students in school	0.468 (0.076)	0.454 (0.036)	0.013 (0.019)
Proportion of urban hukou students in school	0.473 (0.263)	0.392 (0.277)	0.081 (0.072)
Proportion of only-child students in school	0.432 (0.271)	0.439 (0.257)	-0.007 (0.073)
Student average age in school	13.580 (0.335)	13.570 (0.272)	0.005 (0.088)
Average mother education in years in school	9.659 (2.157)	9.598 (1.682)	0.062 (0.567)
Average father education in years in school	10.390 (1.824)	10.180 (1.662)	0.205 (0.488)
Proportion of low-income students in school	0.196 (0.164)	0.264 (0.186)	-0.068 (0.045)

Online Appendix Table 4

Differences between Classrooms in Schools that Used Random Assignment and Those that Did Not (Continued)

	Random assignment (1)	Non-random assignment (2)	Raw gap (3)
<i>Proportion of each mother occupation in school</i>			
Civil servants and government officials	0.030 (0.041)	0.027 (0.032)	0.003 (0.011)
Executive and managerial	0.054 (0.062)	0.034 (0.043)	0.020 (0.016)
Teachers, engineers, doctors, and lawyers	0.058 (0.055)	0.047 (0.041)	0.011 (0.014)
Technicians (including drivers)	0.043 (0.038)	0.045 (0.030)	-0.002 (0.010)
Manufacturing workers	0.117 (0.109)	0.103 (0.075)	0.014 (0.028)
Marketing, sales, and service	0.151 (0.080)	0.142 (0.106)	0.010 (0.023)
Self-employed	0.156 (0.099)	0.109 (0.102)	0.047+ (0.027)
Farmers	0.200 (0.248)	0.355 (0.308)	-0.155* (0.070)
Unemployed	0.089 (0.056)	0.075 (0.061)	0.013 (0.015)
Other	0.073 (0.059)	0.041 (0.027)	0.032* (0.015)
<i>Proportion of each father occupation in school</i>			
Civil servants and government officials	0.046 (0.054)	0.036 (0.037)	0.010 (0.014)
Executive and managerial	0.087 (0.098)	0.0493 (0.066)	0.038 (0.026)
Teachers, engineers, doctors, and lawyers	0.068 (0.050)	0.056 (0.033)	0.012 (0.013)
Technicians (including drivers)	0.173 (0.082)	0.198 (0.078)	-0.025 (0.022)
Manufacturing workers	0.094 (0.082)	0.084 (0.062)	0.010 (0.021)
Marketing, sales, and service	0.082 (0.046)	0.082 (0.058)	0.000 (0.013)
Self-employed	0.161 (0.109)	0.100 (0.098)	0.061* (0.029)
Farmers	0.174 (0.222)	0.305 (0.283)	-0.131* (0.063)
Unemployed	0.025 (0.025)	0.024 (0.015)	0.002 (0.007)
Other	0.061 (0.045)	0.047 (0.040)	0.014 (0.012)

Online Appendix Table 4

*Differences between Classrooms in Schools that Used Random Assignment and Those that Did Not
(Continued)*

	Random assignment (1)	Non-random assignment (2)	Raw gap (3)
<i>Proportion of each family risk factor in school</i>			
At least one parent is absent from home	0.234 (0.170)	0.209 (0.139)	0.026 (0.045)
Father gets drunk regularly	0.079 (0.052)	0.089 (0.042)	-0.010 (0.014)
Parents always quarrel	0.091 (0.045)	0.099 (0.025)	-0.007 (0.012)
<i>Panel C: Teacher composition at school</i>			
Proportion of female homeroom teachers in school	0.688 (0.345)	0.625 (0.342)	0.063 (0.093)
Homeroom teacher average age in years	36.130 (5.769)	38.970 (4.808)	-2.834+ (1.528)
<i>Proportion of each educational level in school</i>			
Professional college education	0.097 (0.236)	0.125 (0.224)	-0.028 (0.063)
Adult higher education	0.366 (0.362)	0.469 (0.386)	-0.103 (0.099)
College education or higher	0.538 (0.392)	0.406 (0.417)	0.131 (0.107)
Proportion graduated from a normal university	0.903 (0.212)	0.875 (0.224)	0.028 (0.058)
Proportion having a teaching certificate	0.995 (0.052)	1.000 (0.000)	-0.005 (0.013)
Average teaching experience in years	14.250 (6.862)	17.030 (5.617)	-0.005 (0.013)
<i>Proportion of each teaching title in school</i>			
No title	0.118 (0.289)	0.000 (0.000)	0.118 (0.073)
Level 2 or 3	0.360 (0.371)	0.406 (0.375)	-0.046 (0.101)
Level 1	0.376 (0.381)	0.469 (0.386)	-0.092 (0.103)
Senior teacher or higher	0.145 (0.282)	0.125 (0.289)	0.020 (0.076)

Online Appendix Table 4

Differences between Classrooms in Schools that Used Random Assignment and Those that Did Not (Continued)

	Random assignment (1)	Non-random assignment (2)	Raw gap (3)
<i>Proportion of each teaching award in school</i>			
School level or no award	0.263 (0.318)	0.281 (0.315)	-0.018 (0.086)
County or district level	0.366 (0.339)	0.344 (0.352)	0.022 (0.092)
City level	0.258 (0.300)	0.156 (0.239)	0.102 (0.079)
Provincial or national level	0.113 (0.246)	0.188 (0.310)	-0.075 (0.069)
Class size	46.310 (13.050)	47.120 (7.588)	-0.819 (3.363)
<i>Panel D: Student average cognitive and noncognitive outcomes in school</i>			
Academic performance	77.350 (14.680)	80.200 (14.500)	-2.845 (3.967)
Cognitive assessment	10.680 (1.859)	10.550 (1.480)	0.131 (0.490)
Mental stress	2.002 (0.197)	2.015 (0.126)	-0.013 (0.051)
School disengagement	1.858 (0.0744)	1.834 (0.0607)	0.025 (0.020)
Expected years of education	16.080 (1.190)	15.980 (1.257)	0.093 (0.325)
Confidence about future	3.284 (0.189)	3.279 (0.168)	0.005 (0.050)
Observations	93	16	109

Notes: Data collapsed to school level. Three schools have a missing value on the random assignment status variable and are excluded. Columns (1) and (2) present the means of each variable with standard deviations in parentheses. In column (3), we regress each variable on the random assignment dummy to examine the raw gap between the schools that used random assignment and the schools that did not. The variables in Panel A are from the school administrator’s questionnaire. The variables in Panels B, C, and D are calculated by taking the average score of the two classrooms per school in our sample.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 5

Missing Patterns of Selected Outcome Variables

	Missing English midterm	Missing “not enjoying life”	Missing “I am always absent from school”	Missing “I am not close with people in my school”	Missing expected years of education	Missing “My homeroom teacher always praises me”	Missing “My class is in good atmosphere”	Missing “Having friends with general disciplinary problems”
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion of repeaters	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.001)
Female	-0.001 (0.003)	-0.007+ (0.004)	0.001 (0.001)	0.001 (0.001)	-0.014** (0.005)	0.002 (0.001)	0.003 (0.002)	-0.006+ (0.003)
Urban hukou	-0.004 (0.005)	-0.001 (0.004)	0.002 (0.002)	0.002 (0.002)	-0.000 (0.006)	0.001 (0.001)	0.000 (0.002)	-0.002 (0.004)
Only child	-0.010* (0.005)	0.000 (0.005)	-0.001 (0.002)	-0.001 (0.002)	-0.006 (0.006)	-0.001 (0.001)	0.000 (0.002)	-0.001 (0.003)
Student age in years	0.003 (0.002)	0.004 (0.004)	0.003 (0.002)	0.004+ (0.002)	0.004 (0.005)	0.004 (0.002)	0.006* (0.003)	0.003 (0.003)
Mother education in years	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.000)	-0.001 (0.000)	0.000 (0.001)	-0.001 (0.000)	-0.001+ (0.001)	-0.001 (0.001)
Father education in years	-0.000 (0.001)	0.000 (0.001)	0.001 (0.000)	0.000 (0.001)	-0.002 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.001)
Low income	-0.004 (0.005)	0.005 (0.007)	-0.005* (0.002)	-0.005* (0.002)	-0.005 (0.007)	-0.005+ (0.002)	-0.006* (0.002)	-0.009* (0.004)
<i>Mother occupation</i>								
Executive and managerial	0.008 (0.007)	0.007 (0.009)	0.000 (0.004)	-0.001 (0.007)	-0.018 (0.017)	0.003 (0.002)	-0.001 (0.007)	0.001 (0.010)
Teachers, engineers, doctors, and lawyers	0.009 (0.008)	-0.007 (0.012)	0.003 (0.005)	0.000 (0.006)	-0.021 (0.017)	0.004+ (0.002)	0.002 (0.007)	0.011 (0.011)
Technicians (including drivers)	0.005 (0.008)	0.004 (0.012)	-0.002 (0.004)	-0.005 (0.007)	-0.038* (0.015)	0.002 (0.002)	-0.005 (0.007)	0.003 (0.011)
Manufacturing workers	0.009 (0.008)	0.008 (0.011)	0.000 (0.004)	-0.004 (0.006)	-0.014 (0.016)	0.003 (0.003)	-0.003 (0.007)	0.004 (0.011)
Marketing, sales, and service	0.001 (0.006)	0.000 (0.009)	-0.000 (0.004)	-0.003 (0.006)	-0.028+ (0.015)	0.003 (0.002)	-0.003 (0.006)	0.006 (0.010)
Self-employed	0.011+ (0.006)	0.003 (0.010)	-0.000 (0.004)	-0.004 (0.006)	-0.019 (0.015)	-0.000 (0.002)	0.000 (0.007)	0.003 (0.011)
Farmers	0.015 (0.009)	-0.017 (0.014)	-0.007 (0.006)	-0.011 (0.008)	-0.021 (0.015)	-0.003 (0.004)	-0.011 (0.008)	-0.009 (0.013)
Unemployed	0.014+ (0.008)	0.006 (0.011)	0.000 (0.004)	-0.004 (0.006)	-0.020 (0.015)	0.001 (0.002)	-0.001 (0.007)	0.008 (0.011)
Other	-0.006 (0.007)	-0.009 (0.011)	0.002 (0.004)	-0.002 (0.006)	0.002 (0.016)	0.004 (0.003)	-0.002 (0.007)	0.010 (0.011)

Online Appendix Table 5

Missing Patterns of Selected Outcome and Mechanism Variables (Continued)

	Missing English midterm	Missing “not enjoying life”	Missing “I am always absent from school”	Missing “I am not close with people in my school”	Missing expected years of education	Missing “My homeroom teacher always praises me”	Missing “My class is in good atmosphere”	Missing “Having friends with general disciplinary problems”
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Father occupation</i>								
Executive and managerial	0.006 (0.008)	0.011 (0.007)	0.000 (0.002)	-0.001 (0.005)	0.001 (0.011)	0.001 (0.001)	0.000 (0.005)	0.001 (0.007)
Teachers, engineers, doctors, and lawyers	-0.001 (0.007)	0.013 (0.010)	-0.002 (0.002)	-0.004 (0.004)	0.006 (0.011)	-0.001 (0.001)	-0.003 (0.004)	-0.003 (0.008)
Technicians (including drivers)	0.003 (0.007)	-0.003 (0.007)	0.003 (0.003)	0.001 (0.004)	-0.007 (0.011)	-0.000 (0.001)	0.001 (0.004)	0.007 (0.007)
Manufacturing workers	0.000 (0.008)	0.002 (0.007)	0.004 (0.003)	0.002 (0.004)	-0.006 (0.012)	-0.000 (0.001)	0.001 (0.005)	0.004 (0.007)
Marketing, sales, and service	0.003 (0.008)	0.004 (0.007)	0.004 (0.003)	0.004 (0.004)	0.009 (0.012)	0.004 (0.002)	0.005 (0.005)	0.014+ (0.008)
Self-employed	-0.010 (0.007)	-0.002 (0.007)	0.003 (0.003)	0.000 (0.004)	0.004 (0.011)	0.002 (0.001)	-0.003 (0.004)	-0.000 (0.007)
Farmers	-0.023 (0.014)	0.004 (0.011)	0.008+ (0.005)	0.006 (0.006)	-0.010 (0.012)	0.003 (0.002)	0.005 (0.005)	0.006 (0.008)
Unemployed	-0.011 (0.009)	0.027 (0.017)	-0.001 (0.002)	-0.003 (0.004)	-0.012 (0.018)	-0.002 (0.002)	-0.005 (0.004)	-0.001 (0.012)
Other	0.015+ (0.009)	0.031* (0.015)	0.006+ (0.003)	0.003 (0.004)	-0.003 (0.011)	0.004+ (0.002)	0.008 (0.005)	0.008 (0.008)
<i>Family risk factors</i>								
At least one parent is absent from home	0.007 (0.004)	-0.005 (0.005)	-0.003 (0.003)	-0.004 (0.003)	0.010 (0.007)	-0.002 (0.003)	-0.004 (0.003)	-0.003 (0.005)
Father gets drunk regularly	-0.001 (0.006)	0.003 (0.006)	-0.001 (0.003)	-0.001 (0.003)	0.033* (0.013)	-0.001 (0.002)	-0.002 (0.003)	0.002 (0.007)
Parents always quarrel	-0.003 (0.006)	-0.008 (0.005)	-0.000 (0.003)	-0.000 (0.003)	0.031** (0.011)	-0.001 (0.002)	-0.002 (0.003)	0.010 (0.008)
Observations	7062	7062	7062	7062	7062	7062	7062	7062

Note: Standard errors in parentheses. School FE models with student, teacher, and classroom peer controls. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 6

The Correlation between School Characteristics and School-level Variation in Repeater Assignment

	Proportion of repeaters in school
Located in rural regions	-1.346 (3.255)
School size	-0.005* (0.003)
Average class size	0.142 (0.147)
Proportion of rural hukou students	-0.009 (0.090)
School funding in the current year per student	-0.001 (0.002)
Proportion of low-income families	0.377** (0.126)
Average mother education	-3.732 (2.338)
Average father education	0.559 (3.151)
Observations	93
R ²	0.608

Note: Located in rural regions, school size, average class size, and school funding in the current year per student (RMB) are from the school administrator's questionnaire. Proportion of rural hukou students, proportion of low-income families, average mother education, and average father education are calculated by taking the average score of the two classrooms per school in our sample. Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 7

Impacts of Repeaters on Non-repeaters excluding Schools that Assigned Students Based on Parents' Requests: Outcomes and Mechanisms

	77 schools
<i>Panel A: Cognitive and noncognitive outcomes</i>	
Academic performance	-0.020*** (0.005)
Observations	5770
Cognitive assessment	-0.016* (0.007)
Observations	5889
Mental stress	0.001 (0.004)
Observations	5766
School disengagement	0.009** (0.003)
Observation	5859
Educational expectations	-0.001 (0.004)
Observations	5847
<i>Panel B: Mechanisms</i>	
Positive student-teacher interaction	-0.004 (0.003)
Observations	5867
Positive student-student interaction	-0.005 (0.005)
Observations	5847
After-school study time (hours)	-0.007 (0.004)
Observations	5401
Having friends with general disciplinary problems	0.001 (0.002)
Observations	5783
Having friends who go to internet cafés	0.003+ (0.002)
Observations	5771

Note: We exclude 16 schools in which school administrators reported that parents requested the school to assign students to selected classrooms. Individual controls, homeroom teacher controls, and classroom average peer controls are added in each specification. Individual, homeroom teacher, and classroom average peer controls are the same with previous analyses. Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 8

Randomization Check of Student Assignment with Predicted Cognitive Outcomes

	Fitted values for Chinese score (1)	Fitted values for math score (2)	Fitted values for English score (3)	Fitted values for cognitive assessment (4)
Proportion of repeater peers (%)	-0.014 (0.008)	-0.016 (0.011)	-0.018+ (0.009)	-0.011 (0.009)
Observations	6939	6939	6939	7062
R ²	0.515	0.723	0.667	0.734

Note: We create fitted values for Chinese, math, English, and cognitive assessment scores by regressing each score on all the controls, including individual controls, homeroom teacher controls, and classroom average peer controls. All models are school FE models. Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 9

Correlation between Homeroom Teacher Characteristics and Classroom Average Student Characteristics

	Homeroom teacher female (1)	Homeroom teacher age in years (2)	Homeroom teacher college degree (3)	Homeroom teacher experience in years (4)
Female	0.961 (1.502)	13.427 (18.250)	-0.778 (1.517)	19.113 (27.200)
Urban hukou	1.179 (1.015)	-8.759 (16.521)	0.280 (1.093)	-8.069 (20.093)
Only child	-0.490 (1.179)	-4.188 (15.102)	0.362 (1.059)	-1.656 (23.742)
Student age in years	-1.026 (0.895)	-6.012 (10.709)	0.080 (0.888)	5.217 (16.690)
Mother education in years	-0.088 (0.232)	-1.069 (2.882)	0.275 (0.189)	1.485 (4.086)
Father education in years	-0.048 (0.203)	1.091 (3.156)	-0.292 (0.193)	0.087 (3.963)
Low income	-1.904 (1.317)	1.599 (19.685)	1.240 (1.824)	-13.234 (25.683)
<i>Mother occupation</i>				
(Reference group: Civil servants and government officials)				
Executive and managerial	1.494 (2.652)	20.595 (32.554)	0.802 (2.574)	13.232 (51.767)
Teachers, engineers, doctors, and lawyers	-0.142 (1.989)	-31.244 (35.495)	-0.691 (2.419)	-17.506 (47.681)
Technicians (including drivers)	0.778 (2.307)	-19.488 (30.961)	0.767 (2.802)	-14.817 (38.513)
Manufacturing workers	1.794 (1.479)	-11.576 (20.287)	0.205 (1.548)	-35.420 (27.603)
Marketing, sales, and service	-1.130 (1.497)	17.841 (24.766)	1.152 (1.776)	17.139 (34.494)
Self-employed	0.740 (1.848)	-5.692 (23.725)	1.531 (2.152)	1.848 (43.905)
Farmers	0.470 (2.080)	32.525 (31.168)	-1.449 (2.230)	48.419 (41.664)
Unemployed	-1.751 (1.805)	-0.797 (23.230)	-2.236 (2.002)	10.127 (37.700)
Other	-2.252 (2.623)	-2.218 (25.908)	-0.079 (2.119)	-23.072 (35.997)

Online Appendix Table 9

*Correlation between Homeroom Teacher Characteristics and Classroom Average Student Characteristics
(Continued)*

	Homeroom teacher female (1)	Homeroom teacher age in years (2)	Homeroom teacher college degree (3)	Homeroom teacher experience in years (4)
<i>Father occupation</i>				
(Reference group: Civil servants and government officials)				
Executive and managerial	-0.080 (2.688)	7.553 (37.509)	0.100 (2.636)	12.707 (67.195)
Teachers, engineers, doctors, and lawyers	-1.355 (2.545)	-14.075 (41.680)	-0.614 (3.046)	-40.718 (71.332)
Technicians (including drivers)	-1.657 (2.358)	-22.633 (38.734)	0.264 (2.336)	-30.509 (57.062)
Manufacturing workers	-1.090 (2.294)	-51.706 (38.282)	1.806 (2.755)	-49.126 (58.775)
Marketing, sales, and service	0.389 (3.416)	-17.886 (50.106)	0.763 (2.935)	-48.128 (74.075)
Self-employed	-2.203 (2.392)	-33.811 (33.771)	-0.057 (3.016)	-30.561 (50.875)
Farmers	-1.875 (2.878)	-70.828 (50.471)	2.649 (3.107)	-71.939 (68.948)
Unemployed	-1.960 (4.746)	-58.813 (61.740)	-1.813 (4.796)	-35.244 (82.773)
Other	3.035 (4.678)	-14.868 (51.027)	4.082 (3.785)	46.546 (97.446)
<i>Family risk factors</i>				
At least one parent is absent from home	-0.231 (1.074)	-22.344 (17.527)	-0.723 (1.212)	-17.655 (24.849)
Father gets drunk regularly	0.384 (2.299)	8.898 (35.601)	-1.322 (1.882)	14.350 (46.059)
Parents always quarrel	-0.203 (1.749)	31.342 (27.228)	-1.073 (1.657)	66.381+ (37.258)
Observations	183	182	183	181

Note: Data collapsed to class level, so each observation is one class. 1 teacher is missing on age and 2 teachers are missing on experience. School FE models. Unstandardized coefficients. Standard errors in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 10

Correlation between School Characteristics and Within-School Variation in the Share of Repeaters

	Within-school variation
Located in rural regions	-0.393 (1.574)
School size	-0.001 (0.001)
Average class size	-0.010 (0.073)
Proportion of rural hukou students in school	0.002 (0.043)
School funding in the current year per student (RMB)	-0.000 (0.001)
Proportion of low-income families in school	0.016 (0.059)
Average mother education	-1.524 (1.098)
Average father education	0.492 (1.489)
Constant	16.948+ (9.613)
Observations	90
R ²	0.242

Note: The variables located in rural regions, school size, average class size, and school funding in the current year per student (RMB) are from the school administrator's questionnaire. Proportion of rural hukou students in school, proportion of low-income families in school, average mother education, and average father education are calculated by taking the average score of the two classrooms per school in our sample. Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 11

Multiple Hypotheses Testing of Main Outcomes and Mechanisms for all Repeaters, Male Repeaters, and Female Repeaters

	Treatment: All repeaters		Treatment: Male repeaters		Treatment: Female repeaters	
	Original <i>p</i> -value (1)	Adjusted <i>p</i> -value (2)	Original <i>p</i> -value (3)	Adjusted <i>p</i> -value (4)	Original <i>p</i> -value (5)	Adjusted <i>p</i> -value (6)
<i>Panel A: Cognitive and non-cognitive outcomes</i>						
Academic performance	0.000	0.009	0.000	0.004	0.220	0.524
Cognitive assessment	0.000	0.009	0.004	0.027	0.014	0.075
Mental stress	0.472	0.437	0.786	0.774	0.476	0.601
School disengagement	0.020	0.061	0.061	0.146	0.226	0.524
Educational expectations	0.179	0.273	0.098	0.166	0.409	0.601
<i>Panel B: Mechanisms</i>						
Positive student-teacher interaction	0.406	0.695	0.693	0.649	0.222	0.375
Positive student-student interaction	0.496	0.695	0.085	0.140	0.149	0.375
After-school study time (hours)	0.004	0.034	0.028	0.088	0.142	0.375
Having friends with general disciplinary problems	0.563	0.695	0.002	0.029	0.014	0.064
Having friends who go to internet cafés	0.362	0.695	0.010	0.054	0.625	0.610

Note: *p*-values of coefficients are shown in this table. *P*-value adjustments are for regressions with the full set of controls and school FE in Tables 4, 5, and 7.

Online Appendix Table 12

Impacts of Repeaters on Non-repeaters for Urban and Rural School Subsamples: Outcomes and Mechanisms

	Schools located in rural regions (1)	Schools located in urban regions (2)
<i>Panel A: Cognitive and noncognitive outcomes</i>		
Academic performance	-0.026** (0.007)	-0.029*** (0.008)
Observations	2039	4900
Cognitive assessment	-0.023** (0.008)	-0.024** (0.008)
Observations	2073	4989
Mental stress	0.006 (0.005)	0.012** (0.005)
Observations	2031	4873
School disengagement	0.007* (0.003)	0.007 (0.005)
Observations	2062	4967
Educational expectations	-0.011 (0.006)	-0.010* (0.004)
Observations	2064	4956
<i>Panel B: Mechanisms</i>		
Positive student-teacher interaction	-0.005 (0.006)	-0.009* (0.004)
Observations	2065	4973
Positive student-student interaction	-0.002 (0.005)	-0.014* (0.006)
Observations	2058	4958
After-school study time (hours)	-0.010 (0.006)	-0.001 (0.006)
Observations	1936	4562
Having friends with general disciplinary problems	0.005 (0.002)	0.004 (0.003)
Observations	2046	4897
Having friends who go to internet cafés	0.002 (0.002)	0.002 (0.002)
Observations	2042	4887

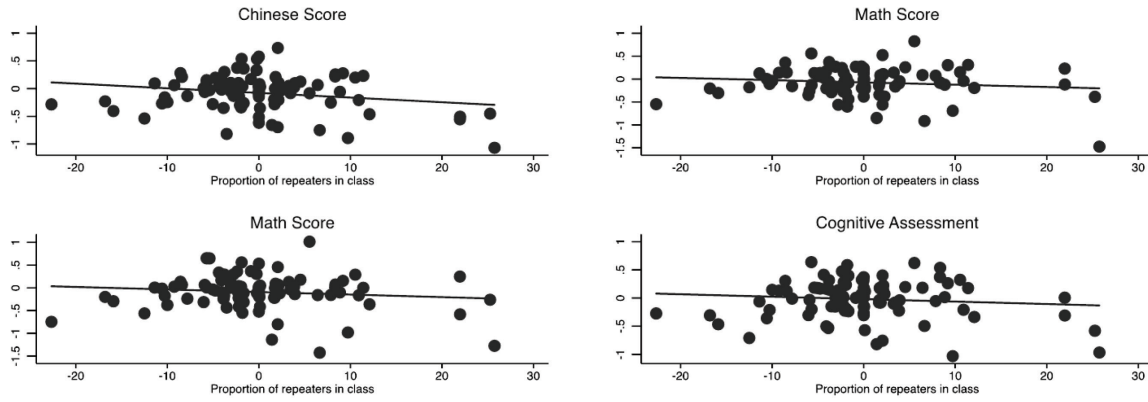
Note: All outcome variables are standardized within non-repeaters within each school. Individual controls, homeroom teacher controls, and classroom average peer controls are included in each specification. Individual controls include gender, hukou status, only child, age, parental educational attainment, parental occupations, family income, and family risk factors. Homeroom teacher controls include gender, age, educational level, graduated from a normal university, have a teaching certificate, teaching experience in years, teaching title, and teaching award. Classroom average peer controls include class size, percentage of boys, percentage of low-income families, and percentage of students who have at least one family risk factor. School FE models. Standard errors in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Online Appendix Table 13

Descriptive Statistics of Outcome and Mechanism Variables by Gender

	Repeaters		Non-repeaters	
	Male (1)	Female (2)	Male (3)	Female (4)
Academic performance	66.136 (22.100)	73.610 (20.958)	77.129 (22.234)	84.501 (19.492)
Cognitive assessment	9.175 (3.301)	8.852 (3.153)	11.043 (3.504)	11.126 (3.345)
Mental stress	2.152 (0.815)	2.217 (0.750)	1.958 (0.841)	1.985 (0.769)
School disengagement	1.829 (0.502)	1.750 (0.475)	1.580 (0.471)	1.523 (0.443)
Educational expectations	14.943 (3.591)	15.626 (3.189)	16.534 (3.178)	16.927 (2.721)
Confidence about future	3.112 (0.764)	3.144 (0.744)	3.338 (0.690)	3.321 (0.677)
Positive student-teacher interaction	2.534 (0.633)	2.597 (0.621)	2.731 (0.634)	2.764 (0.605)
Positive student-student interaction	2.982 (0.772)	3.027 (0.777)	3.186 (0.766)	3.317 (0.691)
After-school study time (hours)	1.174 (1.192)	1.288 (1.018)	1.302 (1.024)	1.364 (0.993)
Having friends with general disciplinary problems	0.461 (0.499)	0.151 (0.359)	0.288 (0.453)	0.091 (0.287)
Having friends who go to internet cafés	0.325 (0.469)	0.055 (0.228)	0.137 (0.344)	0.032 (0.177)
Observations	785	561	3558	3386

Note: Standard deviations in parentheses. Observations are restricted to students who are non-missing on gender.



Online Appendix Figure 1

Prediction of Main Outcomes for Non-Repeaters based on the Proportion of Repeaters in Class

Note: School FE models. We also tested other outcome variables, finding a flat line for each variable.