

The Effect of Interpersonal Relationship with Peers on Student's Academic Performance

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Abstract

Academic performance is often used as an important criteria of a student's performance at school. And it's affected by many different factors of students themselves, parents and teachers. In this paper we want to find out whether student's relationships with their peers have a significant casual effect on student's scores at exams in the junior high school. We use a data set from CEPS, and do causal identification and statistical learning, using OLS, second-degree polynomial, natural spline, random forest, and neural network. We find that both Chinese and English score is a reverse-U shape with respect to the number of friends, the score will increase as the number of friends increase if the number of friends is below to 6, otherwise, the score will decrease. But the friends effect on mathematics score is not much clear as the other two subjects. We find that students tend to have highest mathematical scores when they don't have any close friends, while it's much more difficult to classify the relationship in other situations.

1 Introduction

An interpersonal relationship is a strong, deep, or close association or acquaintance between two or more people that may range in duration from brief to enduring. The context can vary from family or kinship relations, friendship, marriage, relations with associates, work, clubs, neighborhoods, and places of worship. Relationships may be regulated by law, custom, or mutual agreement, and form the basis of social groups and of society as a whole¹. For students in junior high school, they mainly get along with their classmates and teachers when they're staying at school. While students are generally reluctant to have much contact with teachers, their relationship with classmates and other students is relatively important among their interpersonal relationships. Since the interpersonal relationships are abstract and elusive, it's necessary for us to find a way to quantify it. The relationship between students and their peers is not as complicated as adults, in most cases the number of friends can measure the degree of his interpersonal relationship. Thus, we focus on the number of best friends of every student and use it as a criterion to judge his interpersonal relationship with peers.

Academic performance is the extent to which a student, teacher or institution has achieved their short or long-term educational goals². It's commonly measured through examinations or continuous assessments. For students, the most important factor in judging their performances in school is their academic achievement. However, there are inconclusive results over which individual factors successfully predict academic performance, elements such as test anxiety, environment, motivation, and emotions can have potential impact on student's performance at exams. Furthermore, it's suggested that the peer relationships and support that develop in extracurricular activities often affect how individuals perform in school (Eccles & Templeton, 2002). On the basis of what other research has found, we want to further find out whether there is a significant casual relationship between peer relationship and student's academic performance.

The rest of the paper is organized as follows. In section II, we present a review of the literature. And in section III we'll introduce the data and variables. Section IV explains the identification and estimation methodologies. Finally we detail our results and conclusions in section V.

¹Interpersonal Relationship, Wikipedia, https://en.wikipedia.org/wiki/Interpersonal_relationship

²Academic Achievement, Wikipedia, https://en.m.wikipedia.org/wiki/Academic_achievement

2 Literature Review

2.1 Factors are affected by interpersonal relationship

The interpersonal relationships of school students are simple, including parent-child relationship, peer relationship and teacher-student relationship. In recent years, there are many researches about the parent-child relationship and teacher-student relationship. The study done by Ridwan Maulana³ reveals that the relationship between teacher interpersonal behavior and student motivation is more strongly connected to influence than to proximity.

As for peer relationship, many researchers assert that peers do influence each other on many important behaviors, including aspirations, achievements, values and attitudes, social skills, and appropriate sex roles (D. W. Johnson, 1981)⁴. Others have made clear that how much friends influence each other has been overestimated because of the missing data on friends' similarities prior to selection (Kimberly A. Maxwell, 2002)⁵. So, when we research the peer relationship we need to control students' characteristics and other relevant information about their parents and teacher. Jason M. Fletcher and Marta Tienda⁶ provide suggestive evidence that minority academic benefits from larger high school cohorts are greater for minority compared with white students . Many studies show that children and adolescents pick friends similar to themselves on selected characteristics, such as gender, race, achievement, age, and interests.

2.2 Factors affect academic performance

There are a lot of research focusing on the student academic performance, such as, parental involvement. William⁷ uses a meta-analysis to analysis the effect of parental involvement on overall measure of all components of academic achievement combined, grades, standardized tests, and other measures including teacher rating scales and indices of academic attitudes and behaviors, finding that the influence of parental involvement overall is significant for secondary school children. Xitao and Michael⁸ found that parental aspiration or expectation for children's education achievement has the strongest relationship, whereas parental home supervision has the weakest relationship. But all of them focus on the relationship between parents and children rather than children and his fellow students.

Other studies focus on the effect of different material supporting such as funding program (Edwin, Mikael, et al., 2007)⁹ or private tutoring expenditures (Deockhyun and Changhui, 2013)¹⁰, rather than the mental thing, relationship among children, which is quiet important. Kathryn¹¹ found that 3 aspects of social competence---socially responsible behavior, sociometric status, and self-regulatory processes are highly related with each other. And when accounting for student's IQ, sex, ethnicity, school absence, and family structure, socially responsible behavior mediates almost entirely the relations between student's grades and the other 2 aspects of social competence. The relationship among children indeed has some relation with the academic performance.

³Ridwan Maulana , Marie-Christine Opdenakker , Perry den Brok and Roel Bosker: "Teacher-student interpersonal relationships in Indonesia: profiles and importance to student motivation", 2011

⁴D. W. Johnson: "Cooperative Peer Interaction versus Individual Competition and Individualistic Efforts: Effects on the Acquisition of Cognitive Reasoning Strategies", 1981

⁵Kimberly A. Maxwell: "Friends: The Role of Peer Influence Across Adolescent Risk Behaviors",2002

⁶Jason M. Fletcher, Marta Tienda : "High School Classmates and College Success", 2009

⁷Jeynes, W. H .: "The Relationship Between Parental Involvement and Urban Secondary School Student Academic Achievement" , 2007

⁸Fan X , Chen M : "Parental Involvement and Students' Academic Achievement", 2001

⁹Edwin Leuven, Mikael Lindahl, Hessel Oosterbeek, Dinand Webbink: "The effect of extra funding for disadvantaged pupils on achievement", 2007

¹⁰Deockhyun Ryun, Changhui Kang: "Do Private Tutoring Expenditures Raise Academic Performance? Evidence from Middle School Students in South Korea", 2013

¹¹Kathryn R. Wentzel: "Relations between Social Competence and Academic Achievement in Early Adolescence", 2010

3 Data and Variables

3.1 Data source

For the educational system in China, middle school students are assigned to classrooms at the beginning of the seventh grade and take the same courses throughout their three years of middle school. Students are required to take three core subjects—Chinese, mathematics, and English—and a set of subsidiary subjects. During a regular school day, students remain at the same classroom all day, and different teachers come to the classroom to deliver subject-specific lectures.

We obtained data from the 2014 China Education Panel Survey (CEPS), a nationally representative survey that covers middle schools from 28 counties and city districts. Our sample includes 8175 students from the seventh to ninth grades across 208 distinct classrooms and 67 schools. Data for each student’s demographic characteristics are collected from student questionnaires.

3.2 Data management

In this study, we focus on schools in which students are randomly assigned to classrooms. We require that a school’s classroom-assignment procedure meet three conditions: (i) the school principal reports that students are randomly assigned to classrooms; (ii) after students have been assigned to classrooms at the beginning of the seventh grade, the school does not rearrange their classes for grades 8 and 9; and (iii) all head teachers in the same grade report that students in the respective grade are not assigned by test scores. Besides, we delete the outliers that are not reasonable and they are invalid questionnaires. After doing these steps, we found that about 59% of the schools in the 2014 CEPS database assign classrooms randomly, translating into a sample of 8175 students across 208 classrooms and 67 schools.

3.3 Variables

Our academic performances are student exam scores in the core subjects provided by their respective school administration offices. These subjects—Chinese, mathematics, and English—are compulsory and are the main components in the standard tests for admission to senior high school. Within a school, teachers who teach the same subject use the same syllabus and give the same exams during a common testing period. Test scores in the core subjects are therefore a consistent measure of academic achievement across students from the same grade in the same school.

Our main interest variable is the number of the best friends the student has. The outcome variables is the standardized scores of Chinese, math and English. In addition, we obtain information from student questionnaires about each student’s characteristics as the control variables, including student’s sex, their mom’s education, dad’s educational level and so on. And we also acquire information from parents’ and teacher’s questionnaires and take their characteristics as the control variables, like family income, time spent in helping children do homework and the age of teacher, whether the teacher is married. All the variables are showed at Appendix Table 1.

4 Methodologies

There are two steps in our research, first step is causal identification, we use causal diagram to analyze the relationship among variables, second step is statistical learning, we use OLS, second-degree polynomial, natural spline, random forest, and neural network to estimate the effect of peer relationship.

4.1 Casual identification

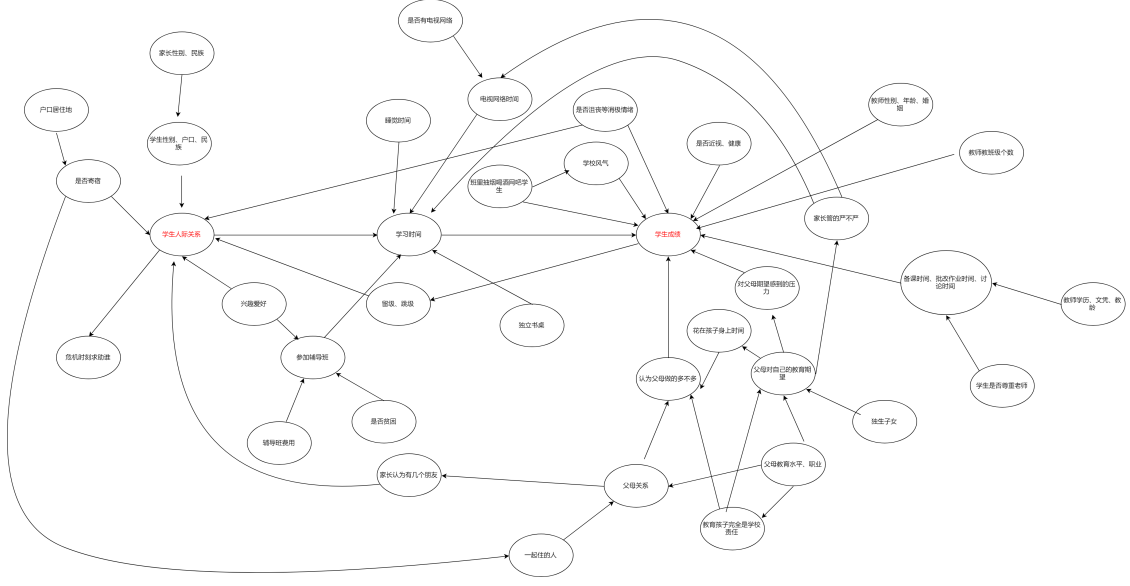


Figure 1: Casual Diagram

We want to figure out the relationship between interpersonal relationship especially the relationship with peers and student's academic outcomes. From the graph, both social network and student's scores are affected by many variables. From the perspective of students, their gender, hukou system and nationality determined by their parents, hobbies and interests can have an impact on the students' performance in the exam. Besides, how often students have negative emotions and whether to board depended on place of residence can influence the interpersonal relationship of students at school and after class. The interpersonal relationship can affect the time spent on learning of students and then affect the scores at the exam. And the student's learning time is determined by many other factors like sleeping time, parental supervision. It's also affected by the time on the internet or TV and time of attending a tutoring class which is related with family wealth, the tuition and student's interest.

For student marks, it's also influenced by students, parents, teachers and their schools. From the point view of student, myopia and health are important factors affecting student's scores. At the same time, whether students often feel depressed often has an influence on marks. From the perspective of parents, students are often sensitive to the expectation of parents and remember what their parents do for them. The expectation from parents can make students feel stressed and decides the time parents spend with them, which affects the children's impression of their parents. Meanwhile, those children whose parents hold the opinion "It is the responsibility of the school to educate children" often have a different cognition about their parents' contribution and expectation. And this opinion is mainly affected by the education and occupation of their parents. Besides, the only child tends to have higher expectation from their parents and is usually subject to stricter regularization. From the perspective of teacher and school, the gender, age and marital status all have potential influence on the student's academic outcomes. And the time teacher spending in preparing lessons and correcting assignments is crucial to student's performance, which is often affected by the attitudes of students and teacher's education, diploma and experience.

4.2 Statistical learning

Firstly, we use Group LASSO to reduce the complexity of learning model for different subjects. The results are showed in Appendix Table 2. We finally select 25 control variables for Chinese score, 21 control variables for mathematics, 23 control variables for English score. Then we construct statistical model to estimate the effect based on the selected control variables in this section.

4.2.1 OLS

We construct a linear model to learn the causal effect and analyze the causal effect on different subjects.

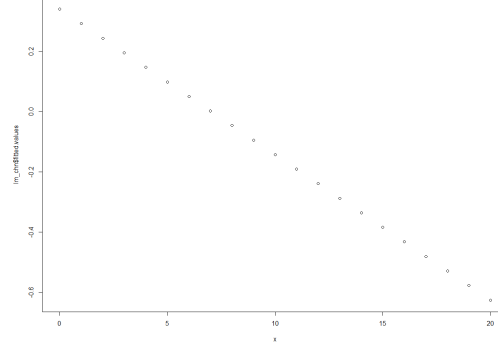


Figure 2: Linear Model for Chinese

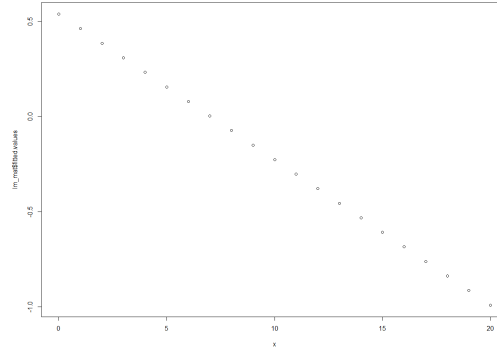


Figure 3: Linear Model for Mathematics

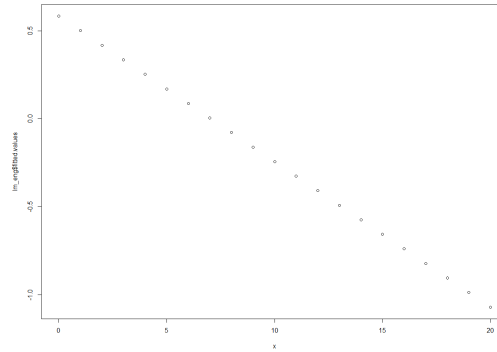


Figure 4: Linear Model for English

All of the coefficients are negative and statistical significant at 1% level, which indicates that when the number of friends increases, the scores of Chinese, Mathematics and English all will decrease.

4.2.2 Second-degree Polynomial

Then we construct a second-degree polynomial on the interest variable, that is, the number of friends.

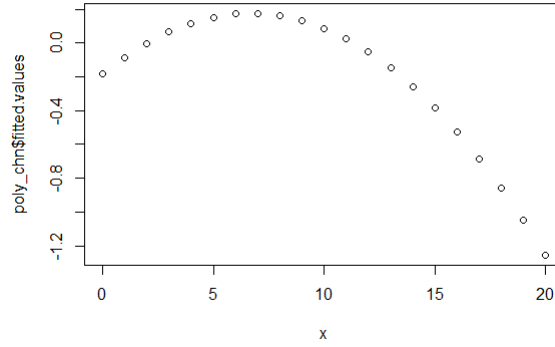


Figure 5: 2-degree Polynomial for Chinese

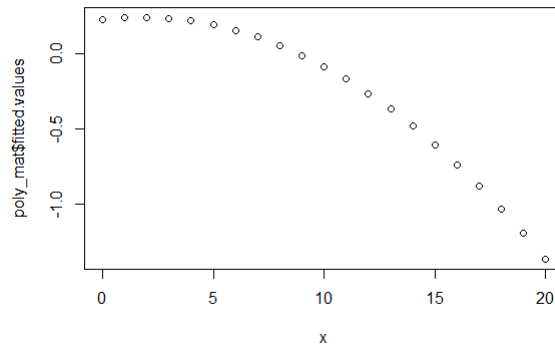


Figure 6: 2-degree Polynomial for Mathematics

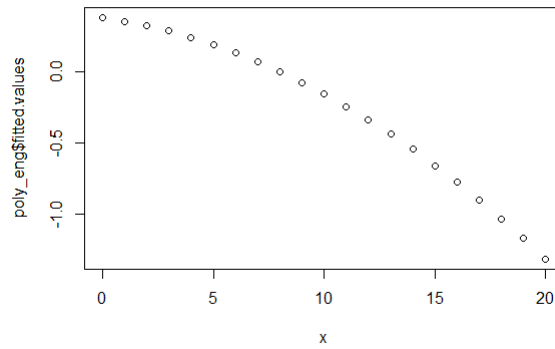


Figure 7: 2-degree Polynomial for English

The result shows that all of the subject are like reverse-u shape curve. But the peak of the curve is different. Chinese score will increase as the number of friends increases when the number is less than 6, but decrease when it is more than 6. Mathematics score will maintain the highest level when the number of friends is nearly zero, and decrease when the number of friends increases. English score will sharply decrease when the number of friends increases.

4.2.3 Natural Spline

After doing these, we construct a natural cubic spline with degree of freedom equals to 5 on the interest variable holding other control variable additive.

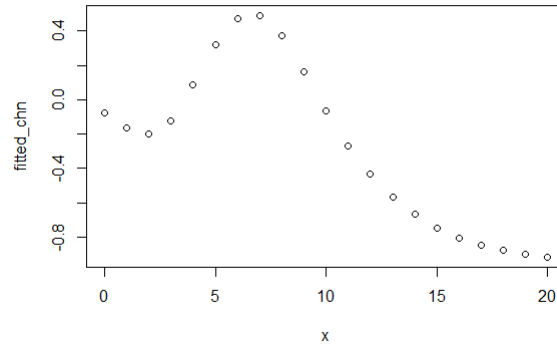


Figure 8: Natural Spline for Chinese

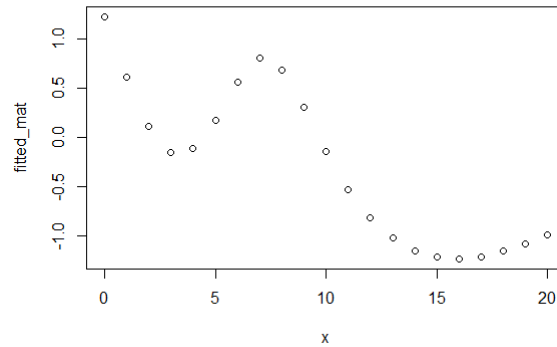


Figure 9: Natural Spline for Mathematics

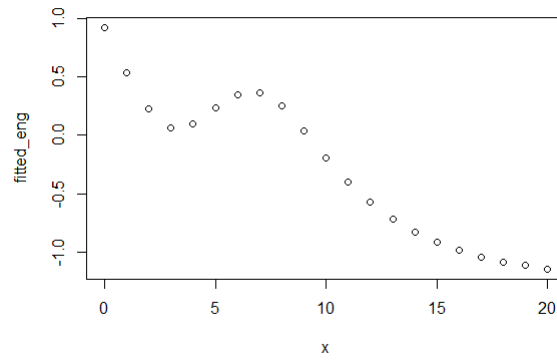


Figure 10: Natural Spline for English

From Figure 7-10, Chinese score will decrease at the beginning, and rise in the following, but decrease when the number of friends is high, getting on the peak when the number of friends get 6. For both Mathematics and English, the highest score are achieved when there is no friends. But English is less variant than math, with another top at number of friends equals to 6. When the amount of friends is large enough, the mathematics performance will increase with the number of friends rising.

4.2.4 Random Forest

We construct a random forest to estimation the effect of interest variable, with number of variable picked at each node equals to 15.

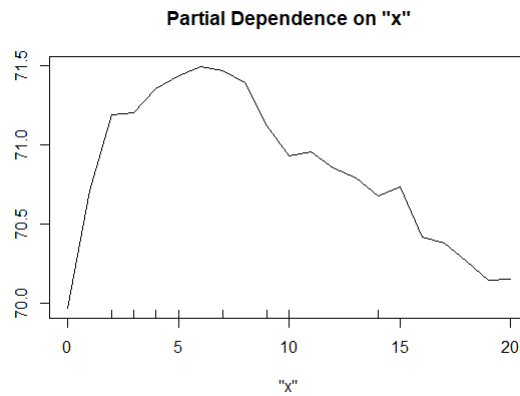


Figure 11: Random Forest for Chinese

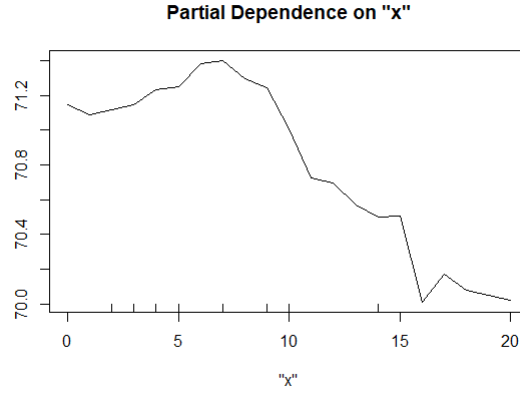


Figure 12: Random Forest for Mathematics

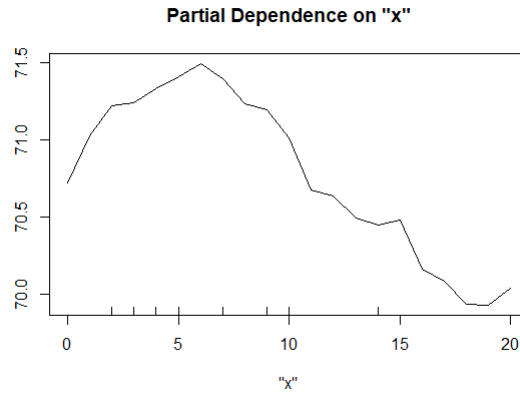


Figure 13: Random Forest for English

From the results, Chinese score is nearly reverse-U shape, that is, only if the number of friends is less than 6, Chinese score will increase as the number of friends increase. If the number of friends is 6, math score will a little bit higher than the intercept, then score will decrease as the number of friends increase. English is much similar to Chinese.

4.2.5 Neural Network

We construct a neural network with 15 nodes to estimation the effect of interest variable.

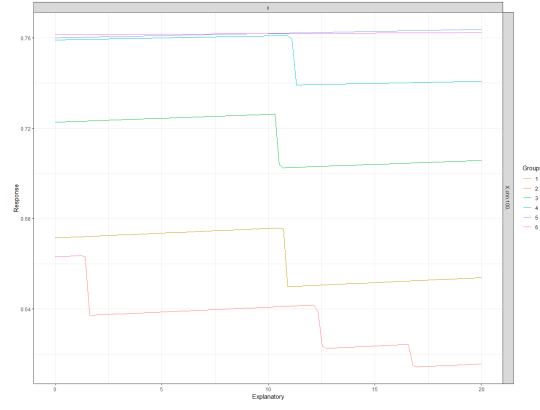


Figure 14: Neural Network for Chinese

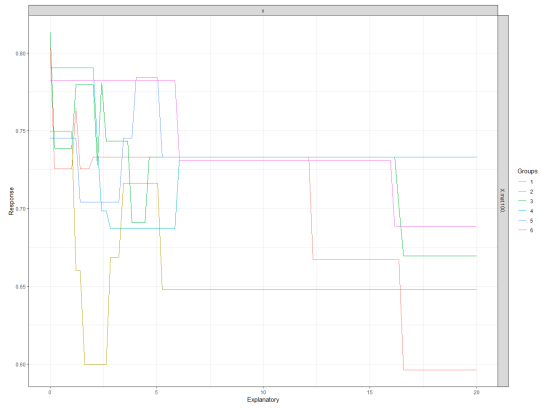


Figure 15: Neural Network for Mathematics

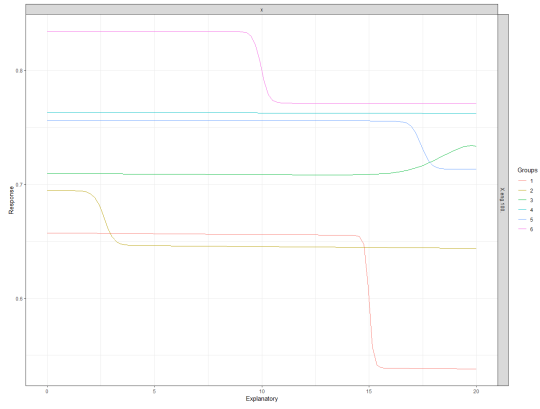


Figure 16: Neural Network for English

From the results, Chinese and English score are similarly like random forest, while mathematics score is a little bit complex and unstable. The effect of number of friends is not clear on the mathematics score in neural network estimation methods.

5 Results & Conclusion

In this paper, we use a data set from CEPS to analysis the effect of peer relationship on the student academic performance. We use standardized Chinese score, standardized Mathematics score and standardized English score to measure student academic performance. After controlling all of the back door path, we find that the number of friends indeed affects the academic performance. For Chinese performance, if the number of friends is less than 6, score will increase as the number of friends increase, if the number of friends is more than 6, score will decrease as the number of friends increase. For English performance, score will decrease as the number of friends increase. For mathematics performance, score maintains at high level when he or she has no friend, and decrease as number of friends increase, with a small peak around 6 friends.

References

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- [10] Interpersonal Relationship, Wikipedia, https://en.wikipedia.org/wiki/Interpersonal_relationship
- [11] Academic Achievement, Wikipedia, https://en.m.wikipedia.org/wiki/Academic_achievement

Appendix

Table 1

Variable	Obs	Mean	Std. Dev.
A.outcome variables			
Standardized Chinese Score	8,175	70.90451	9.38057
Standardized Mathematics Score	8,175	70.87547	9.531671
Standardized English Score	8,175	70.90995	9.552329
B.interest variable			
Number of friends	8,175	10.7781	14.51643
C.Students' control variables			
Female	8,175	0.5054434	0.500001
Minority	8,175	0.0899083	0.2860678
Local Hukou	8,175	0.8386544	0.3678719
Rural Hukou	8,175	0.5250153	0.4994044
Short-sighted	8,175	0.3946177	0.4887983
Health	8,175	0.9602446	0.1953958
Depressed	8,175	0.4066055	0.4912301
Blue	8,175	0.2817125	0.4498615
Unhappy	8,175	0.4044037	0.4908063
Pessimistic	8,175	0.1955963	0.3966833
School Life is fulfilling	8,175	0.2943119	0.4557607
Only child in family	8,175	0.4562691	0.4981144
Education years for Mother	8,175	9.589358	3.561863
Education years for Father	8,175	10.37419	3.119831
Have desk or not	8,175	0.8105199	0.3919135
Have network or not	8,175	0.6059939	0.488666
Time spent on doing homework	8,175	88.64514	118.3803
Have interest or not	8,175	0.8787768	0.3264065
Relationship with mother	8,175	0.7470336	0.4347384
Relationship with father	8,175	0.6310703	0.4825444
Repeat grade or not	8,175	0.1491131	0.3562218
Skip grade or not	8,175	0.0116208	0.1071782
Board or not	8,175	0.311315	0.4630596
D.Parents' control variables			
Money spent for extra-curricular class	8,175	1219.518	3923.617
Help children do homework	8,175	0.9749235	0.1563669
Strict with being home	8,175	0.9455657	0.2268864

Strict with making friends	8,175	0.8846483	0.3194654
Strict with clothes	8,175	0.8656881	0.341008
Strict with time on Internet	8,175	0.9612232	0.1930743
Strict with time on TV	8,175	0.9494801	0.2190285
Time spent on child	8,175	3.186997	3.198729
Conversation with child	8,175	0.3406728	0.4739645
Parents' confidence on child	8,175	0.8905199	0.3122598
Education duty	8,175	0.1028746	0.3038136
Score requirement	8,175	0.7946177	0.4040054
Rich	8,175	0.7975535	0.4018478

E. Teachers' control variables

Pressure on teaching	8,175	1.431193	3.244974
Time spent on teaching	8,175	12.66239	7.668203
Time spent on homework	8,175	11.88318	8.580107
Talk about teaching method	8,175	0.9724771	0.1636114
Smoking student	8,175	0.0014679	0.0382873
Gaming room student	8,175	0.0642202	0.2451598
Conversation with students	8,175	120.0999	99.95769
Female	8,175	0.6338838	0.4817712
Age	8,175	37.41028	7.27473
Married or not	8,175	0.9096024	0.286768
Have certification or not	8,175	0.916208	0.2770926
Teaching experience	8,175	16.06532	8.108612
Administration duties	8,175	0.8428135	0.3639988
Reward for teaching	8,175	0.9231804	0.2663212
Atmosphere	8,175	0.6855046	0.464343
School management	8,175	0.7942508	0.4042728

Table 2

Subject		Chinese	Mathematics	English
Selected Variables	Control	Gender, Local, Rural, Eye, Single-Child, Father-education, Assistance, Expectation-education, Skip a grade, Board, Money, Homework, Internet, Timespent, Parent confidence, Education duty, Expectation Score, Other classes, Teach method, Smoke, Conversation, Female teacher, age, teacher-certificate, Atmosphere	Rural, Eye, Upset, Single-Child, Live together, Desk, Network, Expectation-education, confidence, Repeat a grade, Skip a grade, Board, Homework, Time spent, Parent confidence, Score, Parents Occupation, Talk to each, Smoke, Female teacher, Teacher Certificate.	Gender, Minor, Eye, Father-education, Network, Talk, Expectation-education, Confidence, repeat a grade, Board, Money, Homework, Go home, Timespent, Parent confidence, Expectation Score, Time prepare lesson, Teach method, Smoke, Female teacher, age, teacher-certificate, Atmosphere