博士論文

Essays on Teacher Effects on Students' Academic Outcomes and Preference Formation

(生徒の学業成績と選好形成に対する教員効果についての研究)

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Acknowledgements

I would first like to express my sincere gratitude to my advisor and committee chair, Professor TANAKA Ryuichi for his continuous support and guidance during these past three years. Without his guidance and help, I would not be able to make it this far. I would like to thank the rest of thesis committee: Professor KONDO Ayako, Professor KAWAGUCHI Daiji, Professor SHOJI Masahiro and Professor AKABAYASHI Hideo for their thoughtful advices.

I wish to thank Ms. WEI Cuiyun, Ms. CHEN Yao, my girlfriend Ms. TAO Jin and every student and teacher who took part in the survey for their assistant in helping me obtaining the data for this project.

I am also grateful to my classmates, Mr. HUANG Yuheng and Mr. CHEN Jiazhe for always be there to discuss my work and to provide me with important feedback.

Finally, I would like to thank my loving family, my parents. They have made so many sacrifices in supporting me throughout this long journey and always offered me their unconditional support and love.

Contents

Chapter 1

Introduction

My dissertation focuses on school teacher effects on students' outcomes from three perspectives: 1) the effect of teachers' pastoral and managerial role on students' academic outcomes, 2) the correlation between teachers' preferences and teacher quality, and 3) the transmission of teachers' preferences to students' preferences. The existed studies show that teachers play crucial role on both short-term outcomes and long-term outcomes of students. However, the mechanism behind the teacher effects is far from clear. Therefore, this dissertation expands new dimensions, considering pastoral and managerial role, preferences of teachers, and preferences of students, to investigate how teachers impact on various students' outcomes.

In chapter 2, I review the education system in China and explain the data I used in this dissertation. The most important aspect to my study is the randomization of class assignment from students to teachers in middle schools. The randomization is used as the basis for the identification strategy in the following analyses. Then, I explain the data used in all analyses of this dissertation. All data of this dissertation are obtained from the education ministry of Qiyang county, Hunan province, China. The education bureau implemented a survey to all students in grade 7 and 8 and their teachers in 5 middle schools at the end of school year on July 2018. Student survey includes students' characteristic information and their attitudes toward each subject. Teacher survey consists of teachers' demographics. Besides the survey, I also measure and collect the preferences of both students and teachers using Chinese version of global preferences survey designed by Falk et al.(2016). The questionnaire has 8 dimensions of preferences which are risk-taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity, self-assessment of math ability and procrastination. I match these surveys to 3 waves of students' test scores including the entrance baseline test score and two waves test scores of final exam, and get the student-teacher matched panel data used in this dissertation.

In chapter 3, I examine the effect of teachers' pastoral and managerial support from outside the class on students' academic outcome. I take advantage of classroom teacher in China who are responsible for both students' academic achievement and students' non-academic well-being to investigate the effect. I find that classroom teachers have a significant positive impact on their students' test scores in their specific subjects: a student's test score in a subject taught by his or her classroom teacher will increase by a standard deviation of 0.163 compared with those subjects taught by other teachers. I also investigate the possible mechanisms that might drive this "classroom teacher effect." I find that classroom teachers tend to have more interaction with their own class than with other classes they teach both inside class and outside class beyond teaching or giving lectures. Students are willing to spend more time on the subjects taught by their classroom teachers and are also more likely to obey their classroom teachers. Moreover, I find that the impact of a classroom teacher varies by subject, student characteristics and quantile of test score. These results suggest that classroom teachers are better able to improve their students' academic performance through both their teaching behaviors and their non-academic interactions with the students.

In chapter 4, I investigate the correlation between teachers' preferences and teacher quality in addition to estimate the magnitude of teacher value-added. I provide a new dimension, teacher preference, to identify a good teacher. I find that teachers have a significant impact on students' academic outcomes. One standard deviation (SD) improvement in teacher value-added significantly raises normalized test scores by approximately 0.025 SD in math and 0.093 SD in English. However, we do not find any evidence that increasing teacher value-added by one standard deviation increase test scores in Chinese. Moreover, I examine the correlation between teachers' preferences and teacher value-added. I find that more altruistic teachers have a higher teacher value-added, while teachers who like to take risks have a lower teacher value-added. I further investigate possible mechanisms to explain how altruism and risk-taking are associated with the teacher value-added by mediation analysis. I find that criticisms and communication explain 5% and 49% of the total correlation between altruism and teacher value-added, respectively. However, based on the data of teacher behaviors currently available, I find that none of these behaviors can explain how risk taking coming into play. These results suggest that teachers' preferences can be predictors of teacher value-added.

In chapter 5, I explore the transmission of teachers' preferences to students' preferences. For this purpose, I calculate the correlation between preferences of teachers and students. I find a strong and significant correlation between the procrastination and risk attitudes of classroom teachers and their students. In other words, classroom teachers who are more likely to postpone tasks, or who are more willing to take risks, raise their students with similar traits. Then, I verify the correlation we found above is a direct relationship between classroom teachers' preferences and students' preferences rather than driven by other confounders such as: sex and age of teachers and students. Moreover, I do not find any evidence that a significant correlation in preferences between subject teachers and their students. This result indicates that there is no preference sorting at school or region level and that, more importantly, transmission may occur beyond teaching or giving lectures inside the class. Overall, chapter 5 provides a new field of study to understand mechanism of teacher effectiveness through preference transmission from teachers to students.

Based on the all findings, I conclude in the chapter 6. Teachers have impacts not only on students' academic outcomes through behaviors and preferences of teachers but also on students' preference formation. I hope these findings open a new field to help us understand the mechanism behind teacher effects.

Chapter 2

Institutional Background and Data Source

2.1 Education System in China

In China, education is compulsory for nine years. The "Compulsory Education Law of the People's Republic of China," passed at the fourth meeting of the Sixth National People's Congress on April 12th, 1986. It requires provinces, autonomous regions, and municipalities to determine the procedures for the implementation of compulsory education, based on the economic and cultural development of the specific region. The law came into effect on July 1st of the same year. This is arguably the most important educational law since the founding of the People's Republic of China. These nine years of compulsory education are designed to ensure that all citizens of China have the opportunity to receive nine years of free education, thereby improving the overall level of education throughout the population.

Compulsory education consists of six years of primary education and three years of secondary education.[1] Children aged 12 as of September 1st in a given year start the 7th grade in middle school after graduating from primary school. One school year consists of two semesters. The first (Fall) semester runs from September to January. The second (Spring) semester runs from February to July. At the end of each semester, the ministry of education in each district (or

[1] Though a few school systems use a five year cycle for primary school and four years for junior secondary education.

county) implements a unified final examination for the students in that region.

Entrance examination during compulsory education is gradually phased out. Prior to 1990, secondary schools recruited students on the basis of an entrance examination. To emphasize the compulsory nature of middle schools, and as a part of the effort to orient education away from examination performance and towards a more holistic approach to learning, the government has replaced the entrance examination with a policy of mandatory enrollment based on area of residence (Organization for Economic Cooperation and Development (OECD), 2016).[2]

In each middle school in China, students are given lectures in the unit of class whose size is typically less than 50. Students generally assigned randomly into classes relied on a computer programs that can incorporate information on class size, gender, migration status and more to ensure proper balance in the randomization process when they get into the first grade of middle school due to advocacy for the equity and comprehensive growth of students during their compulsory years of education in recent years. This was also mandated by the revised "Compulsory Education Law," which came into effect on September 1, 2006. This law stipulates that compulsory education is an issue of public welfare and therefore must be guaranteed by the state.

Once student assignments have been determined, schools will randomly assign one teacher to each class who is called classroom teacher. Classroom teacher typically teaches one of three core subjects. Alongside teaching, classroom teachers are in charge of an entire class of their own. This involves caring for students' physical and mental health, cooperating with subject teachers, coordinating the trilateral relations between students, families and school, orga-

[2]Students are assigned to a public school nearby in their residential area in principle according to the document "Implementation Opinion on Further Allowing Primary Students to Enter Middle Schools Near their Homes and without Exam*s*," issued by the ministry of education on January 26, 2014. The document requires that the education departments (commissions) of all provinces, autonomous regions and municipalities directly under the Central Government should investigate the population of all school-age children, as well as the distribution of schools, the scale of schools and the traffic conditions before allocating primary schools for each junior high school according to streets, road sections, house numbers and village groups. This should be based on the principle of the nearby enrollment policy.

One may be concerned by the student sorting due to the nearby enrollment policy, that is parents with excellent social backgrounds move thier house to the fancy middle school nearby. However, this is not a big concern in our context. First, according to Hunan Provincial Statistical Yearbook 2019, Qiyang County has a registered population of 1.06 million and a permanently settle population of 0.88 million. More than 83% of registered population stay in the county from their birth, so it can be inferred that the population movement in Qiyang County is not large. More importantly, we control for various pre-determined variables of students in our regression analysis to reduce the impact of potential student sorting.

nizing class activities, and managing class discipline. In other words, classroom teachers are also responsible for the students' livelihood and wellbeing outside of their academic achievement. Besides classroom teachers, schools randomly assign subject teachers as well. Subject teachers are responsible only for their subject teaching.

The current classroom teacher system in China was born out of the system established by the Soviet Union in 1934, due to China's adoption of the politics of the Soviet Union (Chen, 2004; Huang, 2017). The rules of classroom teaching in China were determined by the document entitled "The Requirement for Classroom Teacher's Work" enacted by the ministry of education in 1979. This document lays out regulations regarding the recruitment, qualification, responsibility, salary, rights, assessment and training of teachers, alongside other detailed rules such as rewards and punishments. Subsequently, the former State Education Commission issued the "Provisional Regulations on the Work of Classroom Teachers of Primary and Middle Schools" in 1988. This document outlines the basis for the instruction of classroom teachers, which is undertaken by education administration departments and schools. "Work Regulations for Classroom Teachers in Primary and Middle Schools" issued by the ministry of education in August, 2009, further strengthened the role of classroom teachers in primary and middle schools.

Once the classes have been formed, all students and teachers are fixed in their respective classes. Thus, in principle it is not possible to change the class before graduation. This looping feature of classroom formation in China ensures that 7th- and 8th-graders should have one and two years interaction with their teachers at the end of school year, respectively.

As for the tutoring outside the school, The Ministry of Education in China has announced a new regulation that bans any paid make-up classes organized by primary schools or middle schools. As of March 2015, among the 31 provinces in China, 16 provinces have unconditionally prohibited compulsory education teachers from engaging in paid make-up lessons, and 8 provinces have conditionally prohibited paid make-up lessons. "Standardization of Primary and Secondary School Teachers' Occupational Ethics" (revised in 2008) issued by the Ministry of Education requires that teachers in primary and secondary school consciously resist paid make-up lessons and do not use their positions for personal gain. "The Measures for the Handling of Violations of Professional Ethics by Primary and Secondary School Teachers" promulgated in 2014 further stipulates that for teachers who organize and require students to participate in paid make-up lessons inside and outside the school, or organize or participate in extracurricular training institutions for paid make-up lessons for students will be punished according to the seriousness of the circumstances. On June 29, 2015, the Ministry of Education promulgated the "The Regulations on Paid Make-up Lessons for Primary and Secondary Schools and Teachers of Primary and Secondary Schools on the Job", which puts forward "three strict prohibitions" for teachers of primary and secondary schools on the job: it is strictly forbiddened to organize, recommend, and induce students to participate in paid supplementary courses inside and outside the school, and strictly prohibited to participate in training institutions outside the school or paid supplementary lessons organized by other teachers, parents, and parent committees, and strictly bans to introduce the source of students or to provide relevant information to external training institutions. For teachers who violate the rules, depending on the severity of the circumstances, they will be given to educational criticism, admonishment talks, order inspection, or the corresponding administrative sanctions. Meanwhile, Qiyang county is no exception to the rule. The Ministry of Education in Qiyang county issued the "Measures for Handling of Violations of Paid Make-up Lessons for In-service Teachers in Elementary and Secondary School of Qiyang County." The "Handling Measures" issued by the ministry of education in Qiyang county is to implement the spirit of the documents above and to further strengthen the construction of teachers' morality in primary and secondary schools, standardize teachers' teaching behaviors, and effectively rectify the phenomenon of illegal make-up lessons. Moreover, teachers are required to clarify the responsible subject. The "rectification behaviors" stipulated in the document include: in-service elementary and middle school teachers (including private school teachers) organize illegal make-up classes; in-service elementary and middle school teachers participate in illegal make-up classes organized by other teachers, parents or other personnel; in-service elementary and middle school teachers participate in illegal make-up courses organized by off-campus training institutions. Therefore, all in-service elementary and middle school teachers must unconditionally follow the rules.

2.2 Recruitment and Salary of Teachers

Candidates must apply personally for teaching positions at school level rather than being random assigned into each school. The Ministry of Education is in charge of planning the number of teacher posts and release the information through internet. In order to attract excellent teachers, the local education ministry may introduce relevant policies, such as the allocation of temporary housing subsidies. There may also be some related policies attracting talented teachers in each school, such as a higher classroom teacher fees, high-quality awards, etc. Candidates should follow the teacher recruitment information released by the local ministry of education or by schools through the internet. In general, candidates submit official identification documents, as well as an academic diploma or compliance certification from a teacher qualification examination.[3]

According to the Teacher's Law which issued and effective as January 1st, 1994, schools and other educational institutions should progressively adopt a system where teachers are recruited using employment contracts. The recruitment contract is issued by government at the county level and above, or by schools that demonstrate some special conditions. The whole recruiting process should be open and transparent, which makes the competition more equal.

Based on the teacher recruitment system in China, there may exist the concern of teacher sorting. Nevertheless, teacher sorting is not a big concern in our context because we control for school-by-grade fixed effects or teacher fixed effects in each chapter.

As for the salary of teachers, state budgetary allocation is the main source of funds for education in China. China's central treasury and local treasuries contribute to education funding. This arrangement is in line with a policy that encourages diverse resource mobilization, as delineated in Article 54 of the Education Law.

Teachers in China receive average salaries compared to other civil servants in the country.[4] Teacher salaries are guaranteed by the Teacher's Law. Teacher

[3]The qualification system has undergone reform recently. In the new system, the teacher's qualification examination is held nationally. Every certificate applicant has to pass the examination except the applicants for higher education. In the past, the examination was held at the provincial level mostly, and graduates from dedicated teacher training schools were allowed to skip the exam. Currently, there are separate examinations for pre-school, primary, secondary and vocational education, all of which consist of two parts: the written examination and the interview. The written examination is taken partly on paper and partly on a computer. The interview includes a structured interview and situational simulation. Interviewers may ask applicants to answer questions from randomly selected topics. Or candidates may be asked to prepare a course, answer questions about it, present the course, and create an evaluation for students based on the material.

[4]The average salaries for teachers in secondary schools of China in 2019 is 97,681 yuan (15,100 US dollars) per year, while the average salaries in Hunan province is 80,149 yuan per year (12,400 US dollars) according to the Hunan Provincial Statistical Yearbook 2020.

salary is composed of four parts: post salary, grade salary, performance salary, and allowance. Among them, post salary and grade salary are the basic salaries. They are determined according to a nationwide unified standard. Performance salary is related to performance and contribution, and it is a very flexible part of the total salary. The total amount of performance salary is regulated and controlled by the central government; the way it is distributed is delineated in several official documents. The performance salary of compulsory education is composed of a basic part and a bonus part. The basic part of performance salary makes up about 70% of the total amount of performance salary, and is determined by factors such as regional economic development level, local price level, and job responsibilities. The specific standard of allocation is determined by the personnel department, finance department, and education department of local government at the county level and above. The basic share of performance salary is paid monthly, for the most part. The bonus component of performance salary amounts to 30% of the total, and is mainly related to workload and actual contribution, which is not based on students' test scores. According to the actual situation in schools, items like allowances for class teachers, subsidies for teachers in rural schools, allowance for extra class hours, and bonuses for outstanding achievements are components of the performance salary. As for the allowance component, it mainly stands for allowances for teachers working in remote and underdeveloped areas, as well as allowances for special positions. The standard for allowances is developed by the central government and is uniform nationwide. The allowance for special positions of teachers in primary and secondary schools is composed of seniority allowance, senior teacher allowance, special education allowance, and school reform allowance.

2.3 Data Source

All data of this dissertation are from the education ministry of Qiyang county, Hunan province. Hunan is one of the most populous provinces of the People's Republic of China. At the end of 2019, the total population of Hunan was approximately 69.09 million, ranking 7th among 34 provinces and cities in the country. Hunan's per capita GDP in 2019 was 57,540 yuan (8,341 US dollars), ranking 14th among 34 provinces and cities.

Qiyang county locates in the south center part of Hunan province. As of March 2019, Qiyang county has a permanent population of 0.88 million, ranking 21st among 124 couty-level cities in Hunan province. Among permanent population in Qiyang county, there are 0.43 million urban residents and 0.45 million rural residents. Qiyang's per capita GDP in 2019 was 38,769 yuan (5,620 US dollars). There are 39 middle schools in Qiyang county which all locate in urban areas.[5]

The education bureau implemented a survey to all students in grade 7 and 8 and their teachers in 5 middle schools which agreed on the participation of survey at the end of school year on July 2018. The 5 schools are ordinary middle schools as others in China but have a larger size and a higher students' performance. The averge school size of these 5 schools is 2174 students, while that of other 34 schools is 696 students. As for the students' performance, those 5 schools are on the list with the rank of 1, 7, 8, 9, and 16, respectively, out of 39 middle schools according to the high school entrance examination performance in 2018.

The survey is divided by student survey and teacher survey. Student survey includes basic characteristic information and their attitudes toward each subject. As shown in Table 1A of Appendix, students should answer their student ID, gender, school and class infromation, and so on. Moreover, students are asked to answer questions about their attitudes toward each subject on a scale from 1 (Strongly disagree) to 4 (Strongly agree). Attitude part contains both student their own responds (such as, do you agree that you are willing to take more time on math compared to other subjects) and their attitudes toward behavior of each teacher (such as, do you agree that your math teacher always asks you questions in class). As for teacher survey, it also mainly targets at collecting some basic demographic of teachers and their teaching, and research status. As

[5]With the process of urbanization, all middle schools in Qiyang county have been in urban areas, but still recruit students with rural household registration.

Table 2A of Appendix shows, teachers should answer basic information such as thier working place, age, and gender. Then, they are asked to answer questions about their teaching and research, such as, how many times do you take part in the open class.

In addition to student and teacher surveys, I also measure and collect the preferences of both students and teachers using Chinese version of global preferences survey designed by Falk et al.(2016).[6] The questionnare has 8 dimensions of preferences which are risk-taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity, self-assessment of math ability, and procrastination.[7]

Finally, we get an electronic document of the key outcome variable, test scores of each student each subject, from the ministry of education. There are three waves of test scores in total, which are entrance baseline test score, test score of first semester and second semester in 2017-18 academic year. I match these surveys to 3 waves of students' test scores by student ID and get the student-teacher matched panel data used in this dissertation.

[6] The questionnaires of various languages can be downloaded at https://www.briq-institute.org/global-preferences/downloads.

[7] For the detail components of each preference, you can see the Table 4.1 in Chapter 4.

Chapter 3

Do Classroom Teachers Matter for Academic Achievement of Students?

3.1 Introduction

Understanding how teacher background affects student outcomes has always been one of main stream in the field of the economics of education. A large volume of studies focus on teacher education level, experience, sex, and race so far (Bradley and Green, 2020). However, there have been very few studies on the effect of teacher role on student outcomes. The main reason should be attributed to the fact that teachers pay much attention on taking on the role of subject teaching in class rather than support from outside the class in most countries. Meanwhile, in most western countries such as the US, student behavior (which includes such aspects as students' daily life outside school and their mental health) is generally managed by professional staff (Huang, 2017). As a result, a study of ninth grade teaching in the US revealed that there is a weak correlation between the impact that a teacher has on a student's test scores and the impact they have on student's behavior, such as their attendance, their likeliness to be suspended, their grades and their likelihood to repeat a year (Jackson, 2018).

We focus on the teacher role of support from outside the class. For example, Klem and Connell (2004) find that teacher support (e.g., support outside the class rather than teaching behaviors inside the class, such as: teachers care about how their students do in school; teachers think what their students say is important; teachers' expectations of their students are fair with them) is important to student engagement in school (e.g., the extent to which students exert on schoolwork, pay attention in class and so on). The authors also show that high levels of engagement are associated with higher attendance and test scores.

Support of teachers mentioned in the examples above are somewhat incoherent. However, in China and in several other countries like Russia, Japan, and Korea, there are certain teachers, known as classroom teachers, who are responsible for a complete series of support outside the class in addition to teaching role. In other words, classroom teachers are in charge of an entire class of their own including both students' livelihood and wellbeing outside the class and students' academic achievement in the class. We take advantage of the special role of classroom teachers to investigate the effect of teacher support outside the class on student outcomes.

This paper investigates whether classroom teachers, who take care of both academic and pastoral matters, are more effective than subject teachers in improving their students' academic performance. We refer to the difference in the levels of improvement achieved by the two types of teachers as the "classroom teacher effect". Furthermore, we also consider the mechanisms of this classroom teacher effect. In order to conduct regression analysis, we collect data concerning students who have been randomly assigned to teachers in classes at middle schools in Qiyang county, Hunan, China. This dataset contains information on all the students and teachers in five middle schools, allowing us to estimate a pure classroom teacher effect using a value-added model. It also allows us to control the teacher fixed effect, thereby eliminating any bias from teachers' unobserved abilities.

What we find are the followings. First, there is a positive and significant classroom teacher effect: a student's test score in a subject taught by his or her classroom teacher will increase by a standard deviation of 0.163 compared with those subjects taught by other teachers.

Second, in addressing the mechanisms behind this effect, our results show that both teacher behaviors and student responses can drive the classroom teacher effect. Specifically, classroom teachers ask more questions of their students, provide more praise and criticism, communicate more, care more, and manage their own classes better in comparison with the other classes they teach. Caring and managing class may suggest that teachers can improve students' academic outcomes in other ways outside the class. We also find that teaching behaviors (such as questioning and offering praise or criticism) vary across subjects. For example, math and Chinese teachers are more likely to criticize students in their own classes, whereas English teachers are more inclined to praise students in their own classes. Moreover, we find that more than 20% of the classroom teacher effect can be ascribed to the distinct roles played by a teacher in caring for and managing their class. Furthermore, students respond differently when they are taught by their classroom teacher: students are willing to spend more time on the subject taught by their classroom teacher and are more inclined to obey their classroom teacher.

Third, we examine how the classroom teacher effect varies by subject, student characteristics and quantile of test scores. We begin by estimating the classroom teacher effect of the three core subjects individually. The results show that there is a significant classroom teacher effect for math and English, but not for Chinese. People being learning their native language from the moment they are born, whereas most students only start learning English in middle school in the context of China. Thus, one will get a greater marginal gain in learning a new language than learning native language at the stage of middle school.

After assessing these heterogeneous effects across subjects, we divide the classroom teachers into four groups: math, Chinese, English and non-core classroom teachers. Then we compare students' academic outcomes under each group for the three core subjects, respectively. We set the students whose classroom teacher is a non-core teacher as base group. We do not find any evidence of a negative spillover effect on other core subjects driven by classroom teachers.

Subsequently, we estimate the classroom teacher effect of two grades separately. We find that the classroom teacher effect of grade 7, which reaches 0.198 standard deviation, is almost twice that of grade 8. One possible explanation for this is that the students in grade 8 may find it more important to balance all their subjects, rather than to prioritize the subject that their classroom teacher teaches. Students take their high school entrance exam in grade 9, which assesses them across all subjects, rather than just one specific subject.

Finally, we also compared students in different test score quantiles and find that there are considerable differences between them. We find that an inverted U-shaped curve describes the impact of the classroom teacher effect on different test score quantiles in math and English. This means that a good math or English classroom teacher is most beneficial for the middle quartile students. On the other hand, the curve is quite flat for Chinese, which indicates that a good Chinese classroom teacher may not matter more to students from a particular quantile.

We also conduct robustness checks on our findings. We use a subjective score and an objective score for each specific subject, as well as a student's total test score for all subjects (rather than the score for each specific subject) as the dependent variables in each case.[8] We find that the results remain similar for the subjective score in all core subjects. The results also maintain stable when the objective score is taken as the dependent variable in all core subjects except Chinese. More specifically, Classroom teacher effect for Chinese appears if we use objective score of Chinese as dependent variable. One possible reason for this is that the objective part of the Chinese test includes questions regarding the pronunciation and meaning of Chinese characters or words, all of which have a fixed standard. It is therefore easy for teachers to teach this basic objective part, Chinese teachers or students who make an extra effort can lead to improvements in a student's Chinese test score. When the total test score of all subjects is taken as the dependent variable, we find that the classroom teacher effect disappears for math and Chinese classes. The classroom teacher effect for English decreases from 0.322 to 0.207 standard deviations.

A recent study by Gong et al. (2018) finds that having a female subject teacher improves girls' academic performance relative to boys, but no such effects have been found when it comes to having a female classroom teacher in middle school in China. This highlights the difference between classroom teachers and subject teachers. The authors attribute the result to the different roles played by classroom teachers and subject teachers.

Based on the argument above, we provide evidence that shows that classroom teachers do have an important impact on students' academic outcomes compared with subject teachers. Moreover, we provide a more generalized estimation which applies value added measurement and includes teacher fixed effect in order to get an unbiased classroom teacher effect on student's academic outcome.

The rest of this chapter is organized as follows. Section 3.2 explains our empirical strategy as part of this study. Section 3.3 presents the data and summary statistics. Section 3.4 reports the results and uncovers possible mechanisms to explain the classroom teacher effect. Section 3.5 examines the heterogeneous

[8] Subjective score is the score of the subjective part of the test. In this part, some questions may not have standard answers or fixed solutions, leaving them open to interpretation. On the contrary, the objective part consists of all questions with standard answers, such as multiple-choice questions. Therefore, one specific subject test score is equal to the subjective score plus the objective score.

effects. Section 3.6 conducts robustness checks. Section 3.7 provides a conclusion.

3.2 Empirical Strategy

Our research question concerns the effect of classroom teacher on students' outcomes. Understanding how students are matched to teachers and classrooms is therefore critical to our estimation and analysis. As mentioned in Chapter 2, an increasingly large number of schools have begun to employ random assignment to place students. Thus, we first to verify the rendomness of classroom assignments and then we estimate the classroom teacher effect on student academic outcomes.

First, to verify the randomness of classroom assignments for our sample, we conduct a balance test to investigate the classrooms with a math, Chinese, English and non-core classroom teacher using several baseline characteristics. More specifically, we separately regress the classroom with a math, Chinese, English and non-core classroom teacher dummy on students' baseline characteristics.[9] Table 3.1 reports the regression results. We find that none of the eight baseline characteristics are statistically significant except for "mother's schooling years" in the classroom with an English classroom teacher, which has a significance of 10%. An F-statistic shows that they are also jointly insignificant. Therefore, these results indicate that randomization ensures that student characteristics (especially the baseline score of the three core subjects) are uncorrelated with the classroom teacher assigned to the classroom. Moreover, the students already know which subject their classroom teacher teaches in advance of the baseline test,[10] but students did not perform any better in their classroom teacher's subject. This implies that the classroom teacher effect is caused by the interaction between a classroom teacher and their students.

[9] Non-core classroom teachers are classroom teachers who teach other subjects rather than three core subjects. Classroom teachers typically teach one of three core subjects, but still a few classroom teachers teach other subjects in reality.

[10] Baseline test is held in each school for all new students in Qiyang county after finishing class assignment. The aim of baseline test is only to provide information about each new student's ability for educators.

Table 3.1. Balancing Test

	Math classroom	Chinese classroom	English classroom	Non-core classroom
Math baseline score	0.009	-0.020	-0.004	-0.024
	(0.008)	(0.021)	(0.037)	(0.021)
Chinese baseline score	0.017	0.056	0.051	0.012
	(0.011)	(0.057)	(0.067)	(0.062)
English baseline score	-0.012	0.047	-0.001	0.023
	(0.016)	(0.043)	(0.011)	(0.032)
Student age	-0.077	0.083	-0.040	0.033
	(0.071)	(0.058)	(0.036)	(0.021)
Only child in family	0.052	0.061	-0.090	-0.027
	(0.061)	(0.070)	(0.047)	(0.037)
Female student	-0.032	-0.011	0.038	0.056
	(0.023)	(0.066)	(0.039)	(0.046)
Father's schooling years	-0.001	-0.009	-0.001	0.011
	(0.003)	(0.009)	(0.004)	(0.008)
Mother's schooling years	-0.003	0.003	0.005*	-0.011
	(0.003)	(0.008)	(0.002)	(0.006)
Test for joint significance				
F-statistics	0.679	0.982	1.552	1.208
p-value	0.691	0.443	0.146	0.395
School-by-grade fixed effects	YES	YES	YES	YES
Observations	3331	3331	3331	3331
Adjusted R-squared	0.287	0.323	0.484	0.243

Notes: Each cell presents the coefficient and standard error (in parentheses) for the listed student and the pre-determined variables from the regressions in which the dependent variable is a dummy of the classroom with a math, Chinese, English or non-core classroom teacher, separately. The independent variables are all the student baseline characteristics. All baseline scores are normalized by subject, grade, and school. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

Then, to estimate the effect of classroom teacher on student academic outcomes, we use the following regression model Equation (3.1) as our baseline estimation:

$$y_{ijz} = \beta D_{iz} + \mathbf{X_i}\gamma + FE_z + FE_j + \tau_{sg} + \epsilon_{ijz} \tag{3.1}$$

where y_{ijz} is the subject z's academic outcome of student i who are taught by the teacher j, D_{iz}, our interested dummy variable, is set to 1 when the subject z of student i is taught by her classroom teacher and otherwise is set to 0. $\mathbf{X_i}$ is a set of student controls (i.e., the student characteristics used in the balance test in Table 3.1 which are baseline teset scores, age, only child in family or not, gender, and parental educations). FE_z is subject fixed effect to distinguish three core subjects. It is worth noting that we control teacher fixed effect to eliminate the threat of identification caused by the different abilities of teachers. Particularly, there are two possible cases in which D_{iz} is equal to 0: one is that the student i is taught by a teacher who acts as a classroom teacher but not the student i's;[11] While the other is the case that the student i is taught by subject teacher who is not assigned to any class as a classroom teacher. One may argue that the difference of academic outcomes between students who are taught by their classroom teacher and students who are taught by subject teacher is accounted for the different teaching ability between classroom teachers and subject teachers. Therefore, we include teacher fixed effect to eliminate the threat of identification caused by the different abilities of teachers. Finally, we include school-by-grade fixed effects τ_{sg} in the regression because randomization is conducted within each grade of each school.

β is the classroom teacher effect, thus capturing that the different academic outcomes between one specific teacher teaches students in her own class and students in other classes she teaches after including the teacher fixed effect. An unbiased estimation of β requires that the conditions on the controls and on Diz are exogenous. As mentioned in the previous section, this is verified by the fact that classrooms are randomly assigned. Moreover, we include the baseline test score in $\mathbf{X_i}$, so β is estimated using the value-added measurement which removes the selection bias.

[11] Notice that a classroom teacher is still a classroom teacher of only one class, he or she is just a subject teacher from the perspective of students of other classes he or she teaches. As far as I know, no school arranges teachers to be classroom teachers of two or more classes due to the complicated works.

3.3 Data

Our data was obtained from the education bureau of Qiyang county in Hunan province, China. The education bureau implemented a survey of both students and teachers in five schools in July 2018, at the end of 2017-18 school year. The survey for students asked them to provide information about their characteristics, such as their student ID, gender, age, number of siblings and parents' education. The survey also asked them to describe their attitudes to all their subjects, asking them to what extent they agreed with a series of statements on a scale from 1 (strongly disagree) to 4 (strongly agree). The statements include the behaviors of teachers in class and outside class, and also include the responses of students (details are presented in Section 5.2 or Appendix).

The teachers were asked to answer questions relating to their attitudes to teaching, as well as to provide information regarding their characteristics such as gender, age, education years, and the level of publication of teacher.[12] Finally, they were asked to provide information about which classes and which subjects they taught.

We collected baseline test score from the unified exam that is held in each school for all new students in Qiyang county after finishing class assignment. The aim of baseline test is only to provide information about each new student's ability for educators. At the end of each semester, there is a unified final exam across the whole county. We also collected final exam scores of the second semester (Spring semester) in the 2017-18 school year for the 7th and 8th grades. We focused on the three core subjects taken by 7th and 8th grade students.

We matched the survey and the test score dataset together by student ID. Our sample included 3801 students and 271 teachers in the 7th and 8th grades across 67 distinct classrooms and 4 schools.[13][14] Due to the lack of educational resources in remote areas of China, the average class size is 57. This is about two times bigger than the average in the U.S at the stage of middle school.[15]

[12]The level of publication refers to the highest level of publication achieved by a teacher. The levels are shown as followed: 1. None 2. County Level 3. Province Level 4. National Level. In academic title appraisal, priorities are often given to the teachers who have obtained certain research achievements. At the end of the academic year, schools count teachers' publication, which is a major indicator of evaluation (Gu et al., 2017).

[13]As mentioned above, students and teachers are fixed in their respective classes before graduation in principle in the context of China, but still there are some changes in reality. Therefore, we exclude transfer students and students who changed the class, we also omit the corresponding test score of the students whose teachers of the specific subject are changed in the school year 2017-18.

[14]One school is dropped due to the huge turnover rate of teachers.

[15]Organization For Economic Co-operation and Development reported that the average

Furthermore, one teacher typically teaches two or more classes. This is especially true in the rural areas in China where our data comes from. In our data, the average teacher teaches 2.6 classes. We pooled three core subjects together for our main analysis.

The summary statistics for our main outcomes and control variables are shown in Table 3.2. As shown in Table 3.2, 26% of teachers served as classroom teachers. From the student control variable, it is clear that the proportion of children with no siblings is just 8%. This is mainly due to the deregulation of the one-child policy in rural and remote areas and the dismantlement of the one-child policy in recent years. The proportion of female students is just 39%. This is due to gender discrimination and the strong preference for sons in the rural or remote areas of China (Li et al., 2004). As for teachers, 84.6% of classroom teachers teach one of the three core subjects. About 57% of teachers are female. The average age of teachers is about 41 years old. The publications of teacher reach county level on average. Teachers typically have 16 years of education.

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number of students per class in U.S is 25.7 in 2018.

Table 3.2. Summary Statistics

	Mean	Standard deviation	Observation
Panel A : Outcome variable			
Test score (pooled subjects)	0.47	0.85	11240
Panel B : Regressor of interests			
Classroom teacher dummy	0.26	0.44	11243
Panel C : Pre-determined variables			
Student Controls			
Age	13.47	0.76	3646
Only child in family	0.08	0.27	3753
Female student	0.39	0.50	3450
Math baseline score	0.08	1.02	3751
Chinese baseline score	-0.01	1.00	3746
English baseline score	0.04	0.96	3749
Mother's education	10.45	3.53	3688
Father's education	10.11	2.47	3695
Teacher Controls			
Female teacher	0.57	0.49	269
Age	40.96	8.26	267
Level of publication	2.27	1.02	253
Education years	16.02	2.15	265

Notes: Test score of final exam is normalized by subject and grade across the whole county. The level of publication in teacher controls refers to the highest level of publication achieved by a teacher. The level is shown as followed: 1. None 2. County Level 3. Province Level 4. National Level.

3.4 Results

3.4.1 The Magnitude of Classroom Teacher Effect

Table 3.3 presents our estimates of the classroom teacher effect on students' academic performance. All test scores for final exams are normalized by subject and grade in Qiyang county because the students in each grade answer the same questions throughout the whole county.

Table 3.3. The Effect of Classroom Teacher on Academic Outcomes

	Equation (1) (With Teacher Fixed Effect)	Equation (1) (Without Teacher Fixed Effect)
Classroom teacher effect (β)	0.163***	0.196***
	(0.017)	(0.017)
Subject fixed effects	YES	YES
Teacher fixed effects	YES	NO
Student controls	YES	YES
Observations	9293	9108
Adjusted R-squared	0.462	0.420

Notes: Test score of final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in both regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

As seen in Table 3.3, we find that there is a positive and significant classroom teacher effect of 0.163. This means that a classroom teacher will increase students in her own class by 0.163 standard deviations on average for a given subject, compared with students in other classes she teaches. The finding confirms the existence of a classroom teacher effect in China and gives a specific quantitative magnitude for the effect.

When we remove the teacher fixed effect, we find that the classroom teacher effect increases to 0.196 standard deviations. This implies that certain unobservable such as the teaching ability of a given classroom teacher are more influential than they are for subject teachers.

3.4.2 Mechanism

In the previous part, Table 3.3 shows that when a classroom teacher teaches a specific subject, this is likely to improve a student's test score in that subject. In this section, we will investigate the possible mechanisms which might cause this classroom teacher effect. We divide the channels into two parts: teacher behavior and student response. For the regression, we replace the test score by the responses of each channel as dependent variables in turn. The independent variables are the same as those used in the baseline estimation.

3.4.2.1 Teacher Behavior

First, we investigate teacher behavior, which can be further broken down into the teaching behavior and distinct role of the classroom teacher. As mentioned above, in a series of surveys students were asked to answer five questions about their feelings with regard to their teachers. The first three are about teaching behavior with regards to class questioning and provision of praise and criticism. The last two concern the distinct role of the classroom teacher with respect to their communication with students or parents and their ability to care for and manage the class.[16] We expect that teachers may treat their own class differently to the other classes they teach.

As we can see in Table 3.4, all the coefficients of teacher behavior channels (the left three columns of "pooled subjects" and "each subject") are positive and significant. This means that teachers pay more attention to their own class not only in terms of their distinct roles but also when it comes to their teaching behavior. Furthermore, Math and Chinese classroom teachers seem to prefer to criticize the students in their own class rather than praise them whereas the opposite is true for English classroom teachers. Another interesting point is that the coefficients of the distinct role of the classroom teacher (the right two columns of "pooled subjects" and "each subject") are much larger than that of the other channels. This suggests that classroom teachers and subject teachers play different roles and that teachers can improve their students' academic performance in ways that extend beyond simply teaching or giving lectures.

[16] The five items asked students to rate how much they agree with the following statements on a scale from 1 (strongly disagree) to 4 (strongly agree): (1) The math/Chinese/English teacher always asks me to answer questions in class. (2) The math/Chinese/English teacher always praises me in class. (3)The math/Chinese/English teacher always criticizes me in class. (4) The math/Chinese/English teacher communicates with me and my parents frequently. (5) The math/Chinese/English teacher cares about my daily life and manages the class well. Questions were implemented separately, so each student needed to answer these five questions for every subject. In the regression analyses, we normalized each variable to have a mean of zero and a standard deviation of one, which follows Gong et al. (2018). Thus, the absolute magnitude of the coefficients do not have any meanings, but the relative magnitude can be used for analyses.

Table 3.4. Mechanism: Teachers' Behavior

	Pooled subjects					Math				
	Class questioning	Praises	Criticisms	Communication	Care	Class questioning	Praises	Criticisms	Communication	Care
Classroom teacher effect	0.128***	0.057*	0.171***	0.827***	0.770***	-0.126*	0.076	0.165**	0.748***	0.760***
	(0.026)	(0.026)	(0.027)	(0.025)	(0.024)	(0.058)	(0.058)	(0.060)	(0.052)	(0.053)
Subject fixed effect	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	9230	9146	9119	9202	9156	3077	3079	3077	3090	3085
Adjusted R-squared	0.114	0.086	0.085	0.221	0.231	0.188	0.137	0.096	0.309	0.340

Notes: For the regression, we replace the dependent variable test score by answers for each channel. The independent variables are all the same as that in the base estimation. All answers from 1 to 4 are normalized by each channel to have a mean of zero and a standard deviation of one. Thus, the absolute magnitudes of the coefficients do not have any meanings, but the relative magnitudes can be used for analysis. For the detailed meanings of each channel, please see footnote 8. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

Table 3.4. Mechanism: Teachers' Behavior (Continued)

	Chinese					English				
	Class questioning	Praises	Criticisms	Communication	Care	Class questioning	Praises	Criticisms	Communication	Care
Classroom teacher effect	0.114	0.038	0.311***	0.775***	0.769***	0.365***	0.273***	0.046	0.967***	0.688***
	(0.064)	(0.064)	(0.065)	(0.061)	(0.057)	(0.067)	(0.071)	(0.070)	(0.063)	(0.062)
Subject fixed effect	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3083	3073	3066	3094	3083	3070	2994	2976	2935	2988
Adjusted R-squared	0.107	0.104	0.117	0.211	0.318	0.227	0.112	0.126	0.303	0.364

Notes: For the regression, we replace the dependent variable test score by the answers for each channel. The independent variables are all same as that in the base estimation. All answers from 1 to 4 are normalized by each channel to have a mean of zero and a standard deviation of one. Thus, the absolute magnitudes of the coefficients do not have any meanings, but the relative magnitudes can be used for analysis. For the detailed meanings of each channel, please see footnote 8. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

One may argue that other channel of teacher behaviors may be the fact that classroom teachers have more class hours for her own class than other classes she teaches. This is one possible channel. Generally speaking, the class hours of the three core subjects are equalized in the timetable that is designed by the academic dean in each school. However, classroom teachers can take over her own class for an absent teacher, meaning that the classroom teacher may give more lectures to her own class students than to other classes she teaches . Unfortunately, it is quite difficult to obtain reliable data about these substitutions, so we do not include class hours as control variables in our estimations.

3.4.2.2 Student Response

Regarding student responses, each student was asked to answer three questions about their attitudes to subjects and teachers. These questions concerned the usefulness of the subjects, the students' willingness to spend more time on a given subject and their obedience to their teachers.[17] It is possible that students may perceive teachers differently based on the teacher's title (classroom teacher or subject teacher). For example, classroom teachers may have a greater impact on students' attitudes than subject teachers. Classroom teachers may be more of a role-model for their students than subject teachers.

The results of the student responses are shown in Table 3.5. We find that, except for in English, classroom teachers are no more likely than subject teachers to change students' attitudes about the usefulness of a particular subject. However, students are more likely to obey their classroom teacher than their subject teachers. This trend regarding obedience is consistent with the results of Gao's (2013) study, which explored the relationship between classroom teachers' authority and the academic achievement of students in China.

[17]The three items asked students to rate how much they agree with the following statements on a scale from 1 (strongly disagree) to 4 (strongly agree): (1) Math/Chinese/English is useful for my future. (2) I am willing to take more time on math/Chinese/English (3) I am inclined to obey my math/Chinese/English teacher. Note that these question were implemented separately, so each student needed to answer these three questions about each subject. In the regression analysis, we normalized each variable to have a mean of zero and standard deviation of one, which follows Gong et al. (2018). Thus, the absolute magnitude of the coefficients do not have any meanings, but the relative magnitude can be used for analysis.

Table 3.5. Mechanism: Students' Responses

	Pooled subjects			Math		
	Usefulness	Willingness	Obedience	Usefulness	Willingness	Obedience
Classroom teacher effect	0.021 (0.026)	0.116*** (0.026)	0.292*** (0.026)	0.031 (0.058)	0.111 (0.057)	0.361*** (0.058)
Subject fixed effect	YES	YES	YES	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES
Observations	9227	9232	9192	3100	3104	3094
Adjusted R-squared	0.136	0.115	0.100	0.163	0.189	0.148

Notes: For the regression, we replace the dependent variable test score by the answers for each channel. The independent variables are all same as that in the base estimation. All answers from 1 to 4 are normalized by each channel to have a mean of zero and a standard deviation of one. Thus, the absolute magnitudes of the coefficients do not have any meanings, but the relative magnitudes can be used for analysis. For the detailed meanings of each channel, please see footnote 9. student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level.***Significant at the 1% level,ignificant at the 1% level, **5% level, *10% level.

Table 3.5. Mechanism: Students' Responses (Continued)

	Chinese			English		
	Usefulness	Willingness	Obedience	Usefulness	Willingness	Obedience
Classroom teacher effect	0.041 (0.063)	0.108 (0.064)	0.286*** (0.063)	0.325*** (0.066)	0.334*** (0.065)	0.272*** (0.066)
Subject fixed effect	NO	NO	NO	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES
Observations	3098	3099	3080	3029	3029	3018
Adjusted R-squared	0.108	0.111	0.106	0.207	0.237	0.188

Notes: For the regression, we replace the dependent variable test score by the answers for each channel. The independent variables are all same as that in the base estimation. All answers from 1 to 4 are normalized by each channel to have a mean of zero and a standard deviation of one. Thus, the absolute magnitudes of the coefficients do not have any meanings, but the relative magnitudes can be used for analysis. For the detailed meanings of each channel, please see footnote 9. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level.***Significant at the 1% level, **5% level, *10% level.

3.4.2.3 Breaking Down Classroom Teacher Effect by Channel

To quantify how much each of the parts explored in the previous part explains the effect of classroom teachers, we employ a decomposition method modelled off Gelbach (2016). Specifically, we denote m^k_{ijz} as the mechanism variable k answered by student i for subject z and consider the channel estimation specification which is called auxiliary model in Gelbach (2016) as follows,

$$m^k_{ijz} = \alpha^k D_{iz} + \mathbf{X_i}\gamma^k + FE_z + FE_j + \tau_{sg} + \epsilon^k_{ijz} \tag{3.2}$$

Next, we consider a long specification. That is, we incorporate all the mechanism variables into the baseline estimation. Hence, the full specification is as follows,

$$y_{ijz} = \beta^{'} D_{iz} + \sum_k \lambda^k m^k_{ijz} + \mathbf{X_i}\gamma^{'} + FE_z + FE_j + \tau_{sg} + \epsilon_{ijz} \tag{3.3}$$

Gelbach (2016) shows that

$$\hat{\beta} = \hat{\beta}' + \sum_k \hat{\lambda^k}\hat{\alpha^k} = \hat{\beta}' + \sum_g \hat{\delta^g} \tag{3.4}$$

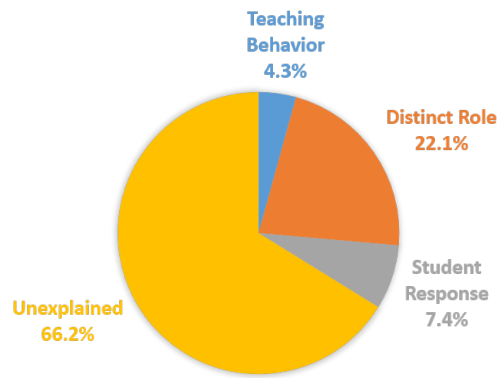
where $\hat{\delta^g} = \sum_{k\ in\ group\ g} \hat{\delta^k} = \sum_{k\ in\ group\ g} \hat{\lambda^k}\hat{\alpha^k}$. Here we have three groups (teaching behavior, distinct role and student response), so $g = 1, 2, 3$. The mechanism group g as a component of classroom teacher effect is $\hat{\delta^g}$ and the remaining unexplained part is $\hat{\beta}'$. For each group, we compute its explanatory power by $\hat{\delta^g}/\hat{\beta}$.[18]

Figure 3.1 presents our estimation of the classroom teacher effect on academic outcomes when broken down into teaching behavior, distinct role of classroom teacher, and student response. Thus the impact of the classroom teacher effect on test scores can be explained proportionately by the following factors: teaching behavior (4.3%), distinct role of classroom teacher (22.1%), student response (7.4%). Other factors account for the remaining impact and

[18] We apply the method of "sum-first-regress-later," as proposed by Gelbach (2016), to get the explanatory power of each group. A practical drawback to the conventional approach is that there will often be many covariates. In our case, there are total 8 covariates (channels). A simple alternative approach is available: rather than estimating 8 regressions and then creating 3 groups, one can sum $\lambda^k m^k_i$ for each observation i over all covariates k in group g first, and then regress the sum on D_{ij} in the auxiliary model for each group later. The coefficients on D_{ij} in the regression step exactly equal $\hat{\delta^g}$. The "sum-first-regress-later" method not only has the benefit of computational convenience but also has an intuitive element of interpretation in the decomposition. Thus, we follow this suggestion and get the result of each group's explanatory power.

together the 8 channels totally explain the classroom teacher effect of 33.8%. Thus, the distinct role of classroom teacher accounts for a large proportion of the classroom teacher effect.

Figure 3.1. Breaking Down Classroom Teacher Effects by Group



Notes: The figure presents the estimated decomposition of classroom teacher effects on academic outcomes. The effects on test score can be explained by teaching behavior (4.3%), the distinct role of the classroom teacher (22.1%), student response (7.4%) and other factors.

3.5 Heterogeneous Effects

Our main findings are reported in Table 3.3, capturing the average effects of the classroom teacher effect. In this section, we examine whether the effect varies by subject, student characteristics and quantile of test scores.

3.5.1 Heterogeneous Effects Across Subjects

First, we estimate the three core subjects separately. The results of this are presented in the right three columns of Table 3.6. The largest classroom teacher effect is observed in English, amounting to 0.322. The smallest one is in Chinese, which is only 0.024 and statistically insignificant. One possible explanation for this is the concavity of the production function of human capital. One begins learning a native language at birth, so the human capital production function of one's native language is quite flat by the time one reaches middle school. However, in China, most students only start learning English in middle school, particularly in rural areas such as Qiyang county where our data comes from. Thus, English is a totally new subject for most middle school students, meaning that a little extra help from an English classroom teacher will likely have considerable benefits for a class.

Finally, we do not find any evidence of negative spillover effect on other core subjects driven by classroom teachers. We divide the classroom teachers into four groups: math, Chinese, English and non-core classroom teachers. Students under a non-core classroom teacher should not be affected by their classroom teachers in terms of treating three core subjects. We then compare academic outcomes of each subject of students who are in these four groups. We set the base group as the students whose classroom teacher is a non-core teacher.[19] Table 3.7 shows the results. We find that all the coefficients of the core subjects are positive and that some of them are significant, which implies that those students under core subject classroom teachers, in fact, do not suffer negative spillover effects on other subjects compared with the corresponding test scores of students under a non-core classroom teachers.

[19] Note that a student is assigned to a classroom whose classroom teacher is either a core subject classroom teacher or a non-core subject teacher, so in total there are four cases: either one's classroom teacher is a math teacher, or a Chinese teacher, or an English or a non-core subject teacher. Here, we use those whose classroom teacher is a non-core classroom teacher as base group, then estimate the regression as follows:

$$y_{ijz} = \beta_1 D_{i,math} + \beta_2 D_{i,chi} + \beta_3 D_{i,eng} + X_i\gamma + FE_j + \tau_{sg} + \epsilon_{ijz}$$

where $D_{i,math}$, $D_{i,chi}$ and $D_{i,eng}$ are dummies indicating whether the student i's classroom teacher is a math teacher, Chinese teacher, or English teacher, respectively.

Hence, β_1, β_2 and β_3 capture the difference of test score if the student switches from a non-core classroom teacher's class to a math classroom teacher's class, to a Chinese classroom teacher's class and to a English classroom teacher's class, respectively.

Table 3.6. The Effect of Classroom Teacher on Student's Test Score, by Subject

	Test score			
	Pooled subjects	Math	Chinese	English
Classroom teacher effect	0.163*** (0.017)	0.157** (0.056)	0.024 (0.023)	0.322*** (0.070)
Female student	0.174*** (0.036)	-0.076** (0.024)	0.183** (0.056)	0.261*** (0.065)
Math baseline score	0.111** (0.039)	0.312*** (0.067)	0.040* (0.017)	-0.026 (0.040)
Chinese baseline score	0.084*** (0.017)	0.021 (0.039)	0.185*** (0.043)	0.057 (0.040)
English baseline score	0.251*** (0.047)	0.135** (0.044)	0.102*** (0.026)	0.497*** (0.052)
Subject fixed effect	YES	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES
Student controls	YES	YES	YES	YES
Observations	9293	3204	3100	2989
Adjusted R-squared	0.462	0.421	0.380	0.575

Notes: The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

Table 3.7. The Effect of Classroom Teacher on Students' Test Scores Using the Students in the Non-core Classroom Teacher's Class as a Base Group

	Test score		
	Math	Chinese	English
Math classroom (β_1)	0.261**	0.054	0.081***
	(0.087)	(0.031)	(0.022)
Chinese classroom (β_2)	0.076	0.076*	0.083*
	(0.153)	(0.036)	(0.034)
English classroom (β_3)	0.182***	0.029**	0.380***
	(0.017)	(0.010)	(0.061)
Teacher fixed effects	YES	YES	YES
Student controls	YES	YES	YES
Observations	3204	3100	2989
Adjusted R-squared	0.430	0.380	0.575

Notes: A student is assigned into a classroom whose teacher either a core subject classroom teacher or a non-core subject teacher, so there are a total of four cases: one's classroom teacher is a math teacher, a Chinese teacher, an English teacher, or a non-core classroom teacher. Here, we use those whose classroom teacher is a non-core classroom teacher as a base group, then estimate the regression as follows:

$$y_{ijz} = \beta_1 D_{i,math} + \beta_2 D_{i,chi} + \beta_3 D_{i,eng} + \mathbf{X_i}\gamma + FE_j + \tau_{sg} + \epsilon_{ijz}$$

where $D_{i,math}$, $D_{i,chi}$ and $D_{i,eng}$ are dummies indicating whether the student i's classroom teacher is a math teacher, Chinese teacher, or English teacher, respectively.
The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

3.5.2 Heterogeneous Effects Across Different Student Characteristics

Then, we estimate the classroom teacher effect of two grades separately. Table 3.8 presents the estimated results. We find that the classroom teacher effect of grade 7 is almost twice that of grade 8. The first possible reason for this is that students in grade 8 may find it important to balance all of their subjects, rather than just focus on the subject that their classroom teacher teaches, because they will take the high school entrance exam in grade 9 and this evaluates students in every subject, not just the subject of their classroom teacher.

Table 3.8. The Effect of Classroom Teacher on Students' Test Scores, by Grade

	Test score	
	7th grade	8th grade
Classroom teacher effect	0.198***	0.107***
	(0.025)	(0.025)
Subject fixed effect	YES	YES
School fixed effects	YES	YES
Teacher fixed effects	YES	YES
Student controls	YES	YES
Observations	3499	5794
Adjusted R-squared	0.493	0.371

Notes: The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. Standard errors are clustered at the school level.***Significant at the 1% level, **5% level, *10% level.

Table 3.9. Heterogeneous Effects of Classroom Teacher on Test Scores by Gender and Family Size

	Male students	Female students	With siblings	Only Child
Classroom teacher effect	0.164** (0.023)	0.147*** (0.024)	0.167*** (0.018)	0.126* (0.056)
Subject fixed effect	YES	YES	YES	YES
Teacher fixed effects	YES	YES	YES	YES
Student controls	YES	YES	YES	YES
Observations	5669	3624	8550	743
Adjusted R-squared	0.448	0.519	0.460	0.566

Notes: The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

As shown in Table 3.9, the classroom teacher effect is similar for male and female students. The results indicate that classroom teachers improve academic outcomes equally for boys and girls, which is consistent with the findings of Gong et al. (2018), who noted the absence of any gender matching effect of classroom teachers. We also find that the classroom teacher effect for students with siblings is slightly greater than for students without siblings. The parental investments for students with siblings is lower than that for students who are the only child in their families (Rosenzweig and Zhang, 2009; Becker and Lewis, 1973). Students with a lower investment will get a greater marginal gain when an extra input by a classroom teacher is provided.

3.5.3 Heterogeneous Effects Across Quantile of Test Scores

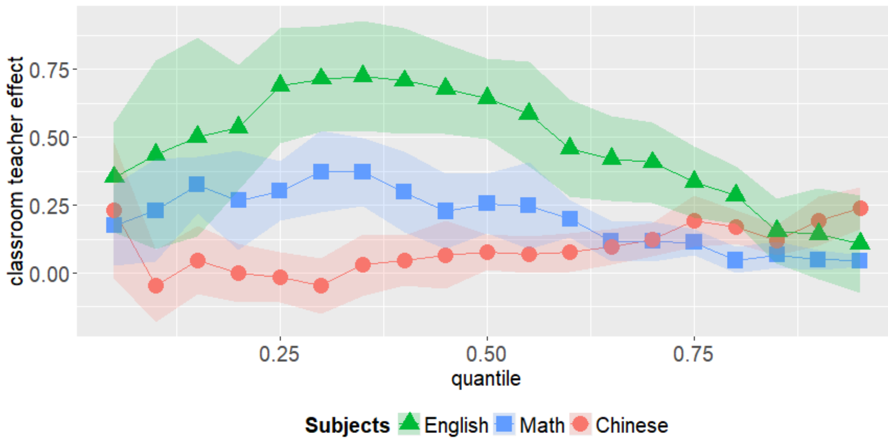
Students with different quantile of test scores may benefit different classroom teacher effect. To explore the classroom teacher effect for students with different final exam test scores, we implement a quantile regression. For the sake of simplicity, we simply show the classroom teacher effect on students whose test scores belong to the first, second, and third quartiles. This is shown in Table 3.10. Figure 3.2 provides a visual overview of the classroom teacher effect on different quantiles of test score. It seems that math and English follow a similar pattern in which classroom teachers provide the most benefit to students whose test scores are in the middle. This pattern probably occurs because the students whose test scores are in the lower quartile may either lose interest in studying the subject or really have no talent for it, whereas the students whose test scores are higher than the median average will likely have a good strategy for learning or be very talented at the subject. These students at either end of the spectrum will likely therefore not benefit as much from the classroom teacher effect. However, the graph seems quite flat for Chinese, which indicates that a Chinese classroom teacher may not matter too much for students in any particular quantile.

Table 3.10. Heterogeneous Effects of Classroom Teacher on Different Quartiles of Test Scores

	Math			Chinese			English		
	$\tau =$ 0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
Classroom teacher effect	0.302*** (0.056)	0.255*** (0.056)	0.113*** (0.024)	-0.016 (0.055)	0.076** (0.037)	0.192*** (0.043)	0.691*** (0.108)	0.644*** (0..076)	0.334*** (0.067)
Teacher fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3204	3204	3204	3100	3100	3100	2989	2989	2989

Notes: The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and a standard deviation of one. τ is the quartile of the students' final exam test score. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

Figure 3.2. Heterogeneous Effects of Classroom Teacher on Different Quantile of Test Score



Notes: We implement a quantile regression to see the classroom teacher effect on different quantile of test score. X-axis is the quantile of test scores and the y-axis is the classroom teacher effect. The shadow represents the confidence interval of the estimated classroom teacher effect. The test score of the final exam is normalized by subject and grade across the whole county to obtain a mean of zero and standard deviation of one.

3.6 Robustness Checks

In this section, we use the subjective score and objective score of each specific subject, as well as the total test score of all subjects (rather than the total score of each specific subject) as dependent variables, respectively, to conduct robustness checks[20].

3.6.1 Subjective Score as Dependent Variable

As shown by the left four columns in Table 3.11, we find that the effects of a classroom teacher for pooled subjects and for each subject individually remain similar across the board. Except in English, the results becomes a little larger in the case of the subjective score compared with the total score. It could be

[20] Subjective score is the score of the subjective part of the test. In this part, some questions may not have standard answers or fixed solutions, leaving them open to interpretation. On the contrary, the objective part consists of the all questions with standard answers, such as multiple-choice questions. Therefore, one specific subject test score is equal to the subjective score plus the objective score. Both types of test score are normalized by subject, grade and type (subjective and objective) across the whole county in order to obtain a mean of zero and standard deviation of one.

argued that the reason why classroom teacher effect has a greater influence on the subjective part of the test is down to cheating by teachers when it comes to grading. The classroom teachers may be more lenient towards their own class students. For example, Jacob and Levitt (2003) show that serious cases of teachers or administrators cheating on standardized tests occur in a minimum of 4-5% of public elementary schools in Chicago each year. However, there is no proof that this is true on our case. When the final exam is graded, all test papers should be submitted by grade and by subject, then information about the name and class should be covered, to prevent teachers from knowing whose test they are grading. However, it might still be possible for teachers to identify a student's paper through their handwriting, strategy or solutions.

Table 3.11. The Effect of Classroom Teacher on Subjective Test Scores and Objective Test Scores

	Subjective test score				Objective test score			
	Pooled subjects	Math	Chinese	English	Pooled subjects	Math	Chinese	English
Classroom teacher effect	0.179*** (0.043)	0.180*** (0.028)	0.026 (0.024)	0.321*** (0.036)	0.139*** (0.027)	0.101*** (0.027)	0.104** (0.036)	0.312*** (0.038)
Subject fixed effect	YES	NO	NO	NO	YES	NO	NO	NO
Teacher fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Student controls	YES	YES	YES	YES	YES	YES	YES	YES
Observations	9293	3204	3100	2989	9293	3204	3100	2989
Adjusted R-squared	0.318	0.280	0.380	0.575	0.387	0.443	0.305	0.557

Notes: Subjective score is the score of the subjective part of the test, in which one can express opinions and in which some questions may not have standard answers or fixed methods. On the other hand, the objective part consists of questions with standard answers, such as multiple-choice questions. Both types of test score are normalized by subject and grade and type (subjective and objective) across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

3.6.2 Objective Score as Dependent Variable

From the right four columns of Table 3.11, it is clear that the effects of a classroom teacher for pooled subjects and for each subject individually remain similar across the board, except for in Chinese. The increase of the Chinese classroom teacher effect is due to the particularity of the Chinese subject. The objective part of the Chinese test includes questions on the pronunciation and meaning of Chinese characters or words, all of which are standardized. It is easy for teachers to teach their students this basic objective part. Hence, an extra effort made by Chinese teachers can positively impact on objective part of Chinese exam scores.

3.6.3 Total Score of All Subjects as Dependent Variable

Finally, we use the total test score of all subjects as the dependent variable instead.[21] Table 3.12 shows the results. We find that the classroom teacher effect disappears for math and Chinese, but not for English. In English, the classroom teacher effect decreases from 0.322 to 0.207 standard deviations, but it is still significant. This suggests that having an English classroom teacher improves a rural middle school student's total test score by 0.207 standard deviations relative to a non-English classroom teacher. However, the language gap between students in an English classroom and students in a non-English classroom may not so significant in urban areas, such as Beijing and Shanghai. Children start to learn English from an early age in those places, so learning English may not such a novel experience when they get to middle schools.

[21]For 7th grade students, all subjects means math, Chinese, English, biology, geography, politics and history. For 8th grade students, all subjects means math, Chinese, English, physics, politics and history. We normalized the total test score by grades across the county to obtain a mean of zero and standard deviation of one.

Table 3.12. The Effect of Classroom Teacher on the Total Test Score of All Subjects

	Total test score of all subjects		
	Math classroom	Chinese classroom	English classroom
Classroom teacher effect	0.037	-0.043	0.207***
	(0.024)	(0.026)	(0.031)
Teacher fixed effects	YES	YES	YES
Student controls	YES	YES	YES
Observations	2981	2981	2981
Adjusted R-squared	0.545	0.545	0.552

Notes: The three coefficients are obtained from three regressions where the dependent variable is the total test score of all subjects and the independent variables are the dummy variables "Math classroom", "Chinese classroom" and "English classroom." Respectively, these variables indicate whether the student is in a math teacher's classroom, a Chinese teacher's classroom, or an English teacher's classroom. Student controls and teacher fixed effects are also included. For 7th grade students, all subjects means: math, Chinese, English, biology, geography, politics and history. For 8th grade students, all subjects means: math, Chinese, English, physics, politics and history. Total test score is normalized by grade across the whole county to obtain a mean of zero and a standard deviation of one. Student controls include the student's baseline test score in the three core subjects, as well as their age, mother's education, father's education and two dummy variables indicating gender and whether the student is an only child or not. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***Significant at the 1% level, **5% level, *10% level.

3.7 Conclusion

This paper sheds light on how support of teacher from outside the class impacts students' academic outcomes. We use the random assignment of students to waive concerns about self-selection when it comes to student-teacher matching. Our results show that a student's test score will increase by 0.163 standard deviations in the subject taught by their classroom teacher. Additional estimations suggest some unobservable factors, such as the fact that the teaching ability of classroom teachers is greater than that of subject teachers.

We also uncover the mechanisms that drive these results. Our results show that classroom teachers behave differently towards their own class. Specifically, classroom teachers ask more questions, provide more praise and criticism, communicate more, care more and manage their students better in their own class compared with the other classes they teach. The last channel suggests that teachers can improve the academic outcomes of their students through methods other than teaching or giving lectures. Moreover, students respond differently when they are taught by their classroom teacher: students are willing to spend more time on the subject taught by their classroom teacher and are more inclined to obey their classroom teacher. It is worth mentioning that we find that more than 20% of the classroom teacher effect can be ascribed to the distinct roles played by a teacher in caring for and managing their class.

Moreover, we also find that classroom teacher effect varies by subject, student characteristics and test score quantile of students. The results show that the classroom teacher effect has the greatest impact in English, and the smallest impact is in Chinese. We also find that classroom teacher effect of grade 7 is almost twice that of grade 8. Furthermore, we find that a good math or English classroom teacher is most beneficial for the middle two quantiles of students. Importantly, we do not find any evidence that shows negative spillover effect on other core subjects driven by classroom teachers.

Our study has a number of implications for educators and policy makers. First, our findings provide useful information for policy makers who seek to balance the comprehensive growth of students. There is a trade-off between the ex-ante and ex-post perspectives in equality. Under the current regulations, ex-ante equality is guaranteed by the randomization class assignment. However, as an alternative policy to enhance the ex-post equality, schools could assign students who are weaker in one specific subject to the corresponding subject classroom teacher's class.

Second, our results provide insights for teachers regarding the differential impact of classroom actions, such as questioning, praising and criticizing students, as well as caring for or managing a class. In particular, beyond teaching or giving lectures, teachers can also communicate with students to get more information of students. To achieve the goal, policy makers can provide some teaching trainning programs which are focus on the teachers' actions both inside and outside the class.

Chapter 4

Do Teacher Preferences Matter for Teacher Quality?

4.1 Introduction

Teacher quality always attracts the interest of researchers and policymakers. The most important educational input, teachers, are crucial to both short-term outcomes and long-term outcomes of students (Chetty et al., 2014). It is reported that the benefit of improving teacher quality from an average level to the 85th percentile is comparable to a 33% reduction in class size (Rockoff, 2004) and replacing a teacher whose value-added measured by test score of student in the bottom 5 percent with an average teacher would increase the present value of students' lifetime income by approximately $250,000 per classroom (Chetty et al., 2014). Hence, it is important from students' perspectives to find good teachers.

Although finding good teachers are crucial to students' outcomes, it is not easy at all to identify good teachers. It is because researchers have found little association between observable teacher characteristics and student outcomes. For example, Hanushek (1997, 2003) documents most studies related to teacher value-added show that a master's degree and teacher experience has no significant relationship to teacher quality as measured by student outcomes. It is difficult even for school principals to distinguish teacher quality between teachers who produce the middle (i.e., the middle 60%-80%) of standardized achievement gains in their schools (Jacob and Lefgren, 2008).

In this chapter, we investigate whether teachers' preferences can serve as predictors of teacher quality. For this purpose, first, we estimate the magnitude of teacher value-added measured by the normalized test scores of students. Then, we examine the correlation between estimated teacher value-added and teachers' preferences which include eight preferences: risk-taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity, self-assessment of math skill, and procrastination according to the questionnaire designed by Falk et al.(2016).

In the estimations of this chapter, we use the data from middle schools in Qiyang county, Hunan province of China. Using Chinese dataset has at least two advantages. First, because most schools assign students and teachers to classes randomly in nine-year compulsory education, we can eliminate the selection bias from estimating teacher value-added. Second, all students and teachers are fixed in each class until graduation in principle in Chinese education context, it is easy to track matched teacher-student data in multiple periods.

What we find are followings. First, we find that teachers have impacts on students' academic outcomes. Having an English teacher with the value-added at 85th percentile instead of that at 50th percentile for one semester (half year) would increase the English score by 0.093 standard deviation. Math teacher effect on math test score is 0.025, meaning that having a math teacher with value-added at the 85th percentile instead of that at 50th percentile for one semester would increase math scores by roughly 0.025 standard deviation. Teacher value-added on Chinese test score is the smallest and insignificant, which is just 0.019 standard deviation.

Second, we investigate the correlation between teacher preferences and teacher value-added. We find that more altruistic teachers have a higher teacher value-added, while teachers who like to take risks have a lower teacher value-added.

Finally, we also uncover teacher behaviors (class questioning, provision of praise and criticism, and communication with students) to explain how altruism and risk-taking are associated with the teacher value-added by mediation analysis. The results show that criticisms and communication respectively explain 5% and 49% of the total correlation between altruism and teacher value-added. However, based on the data of teacher behaviors currently available, we do not find how risk-taking comes into play.

This paper contributes to the literature in three ways. First, we find that teacher preferences can serve as a good predictor of teacher value-added. Preceding studies found little variation between teacher quality and commonly observed teacher characteristics, such as teacher education and teacher experiences. Hanushek (1997, 2003) documents a remarkable finding that 91% of 34 studies related to teacher value-added show that a master's degree has no systematic relationship to teacher quality as measured by student outcomes. Moreover, he also finds that teacher experience has a more positive relationship with student achievement, but still the overall picture is not that strong. Only 44% of 37 studies show a statistically significant correlation between teacher experience and teacher quality. Different from previous studies, we measure and collect the information on teachers' preferences and find evidence of a significant correlation between altruism and risk-taking and teacher value-added controlling for other teacher characteristics such as level of education, age and gender.

Second, we expand the context of research which study the correlation between workers' personality and wage in labor market. There is an increasing awareness of the importance of personality traits as determinants of labor market success. Individuals' personality may result in job performance differentials. For example, Groves (2005) shows that traits such as locus of control, aggression, and withdrawal are all statistically significant factors in the wage determination models of white women. Heineck (2007) documents that there is no clear patterns for openness, conscientiousness, and extraversion. However, the results suggest wage penalties for neuroticism and agreeableness for both male and female workers in the UK. Nyhus and Pons (2005) find that emotional stability is positively associated with the wage of both women and men, while agreeableness is significantly associated with lower wages for women. Nevertheless, there is few such studies in teacher labor market. Different from workers in labor market, teacher salary is difficult to be used as a measure of teacher productivity due to teacher salary schedule based mainly on the position and grade of teachers. Therefore, we employ teacher value-added to measure the teacher productivity and examine the relationship between teacher personality and teacher productivity.

Third, our results add to the growing body of evidence showing the application of teacher value-added estimates to a Chinese context. There is abundant information regarding teacher value-added in the United States (e.g., Rockoff 2004; Rivkin, Hanushek, and Kain 2005; Chetty, Friedman, and Rockoff, 2014), the same is not true of the Chinese educational system where empirical evidence of teacher quality is extremely limited. We use middle school data in China to estimate the teacher effect applying the value-added approach.

The rest of this chapter is organized as follows. Section 4.2 explains our empirical strategy of this study. Section 4.3 presents the data and summary statistics. Section 4.4 reports the main results. Section 4.5 concludes.

4.2 Empirical Strategy

4.2.1 Estimation of Teacher Value-Added

To estimate the teacher value-added, we follow the convention in the teacher value-added literature with Equation (4.1)

$$y_{zicjst} = \boldsymbol{X_{icjst}\gamma} + \tau_{st} + e_{zicjst} \tag{4.1}$$

where y_{zicjst} is the test score of subject z of student i in classroom c with teacher j in school s in period t, $\boldsymbol{X_{icjst}}$ includes students' and classroom level controls (i.e., student prior test score, preferences, gender, age, only child or not, parental education years, and those of classroom level controls). τ_{st} is school-by-period fixed effects to account for transitory school and period shocks. We estimate $\boldsymbol{\gamma}$ using both within- and between-teacher variation as our base estimation. According to Chetty et al. (2014a), we also estimate $\boldsymbol{\gamma}$ using within-teacher variation by including teacher fixed effects in the Equation (4.1) as a robustness check.

Removing the influence of observables yields $e_{zicjst} = y_{zicjst} - \boldsymbol{X_{icjst}\gamma} - \tau_{st}$. This student-level residual consists of teacher value-added (θ_{zj}), a random classroom-level shock (ε_{zcjst}), and random student-level error (ε_{zicjst}), such that $e_{zicjst} = \theta_{zj} + \varepsilon_{zcjst} + \varepsilon_{zicjst}$. We denote $\bar{e}_{zj}$ as the average of these student-level residuals over time for a given teacher j. It is an unbiased estimate of teacher j's value-added on subject z under the randomization of class assignment.

To avoid mechanical endogeneity, we should not estimate teacher value-added using the same students among whom longer run outcomes are being compared, even though $\bar{e}_{zj}$ is an unbiased estimate of teacher j's value-added on subject z. Therefore, we follow Jackson (2018) and Chetty, Friedman and Rockoff (2014a) to use leave-period-out method. The estimate for teacher j in period t is the teacher's average residual based on all other periods of data ($-t$) as follows: [22]

[22]Due to the feature of fixing students and teachers in China, the composition of students and teachers in each class should be the same during 3-year secondary schooling. It is hard to remove the threat that using the same students to form both the treatment and the outcome

$$\hat{\theta}_{zj,-t} = \bar{e}_{zj,-t} \tag{4.2}$$

Estimate $\hat{\theta}_{zj,-t}$ is an unbiased estimate of θ_{zj} and minimizes mean square estimation error. Nevertheless, $\hat{\theta}_{zj,-t}$ is not the optimal predictor of out-of sample due to $\hat{\theta}_{zj,-t}$ is estimated with noise. According to Gordon, Kane, and Staiger (2006), Kane and Staiger (2008), Chetty et al. (2014a), and Jackson (2018), we should form empirical Bayes estimates to minimize mean squared prediction errors. The basic idea of the empirical Bayes approach is to multiply a noisy estimate of teacher value added by an estimate of its reliability, where the reliability of a noisy estimate is the ratio of signal variance to signal plus noise variance. Thus, less reliable estimates are shrunk back toward the mean (zero, since the teacher estimates are normalized to be mean zero). Therefore, leave-period-out empirical Bayes estimate of teacher j's value-added is given by

$$\hat{\mu}_{zjt} = \hat{\theta}_{zj,-t}\lambda_{zj} \tag{4.3}$$

where λ_{zj} is an estimate of its reliability.[23]

under Chinese education context, because it is still the same cohort students even leave one specific year out. However, we still use this leave-year-out measure to prevent mechanical endogeneity.

[23] We follow Gordon et al. (2006), Kane and Staiger (2008), Jackson and Bruegmann (2009), Jackson (2013), and Jackson (2018),

$$\lambda_{zj} = \frac{\sigma^2_{\theta_{zj}}}{\sigma^2_{\theta_{zj}} + \{\sum_{m_j}[1/(\sigma^2_{\varepsilon_{zcjst}} + \sigma^2_{\varepsilon_{zicjst}}/n_{cj})]\}^{-1}}$$

where n_{cj} is the number of students in class c with teacher j, and m_j is the number of classrooms for teacher j. The parameters $\sigma^2_{\theta_{zj}}$, $\sigma^2_{\varepsilon_{zcjst}}$, and $\sigma^2_{\varepsilon_{zicjst}}$ are replaced by empirical estimates under the assumption

$$cov(\theta_{zj}, \varepsilon_{zcjst}) = cov(\theta_{zj}, \varepsilon_{zicjst}) = cov(\varepsilon_{zicjst}, \varepsilon_{zcjst}) = 0$$

the assumption is reasonable under the randomness of class assignment. Under this assumption, we have $var(e_{zicjst}) = \sigma^2_{\varepsilon_{zicjst}} + \sigma^2_{\theta_{zj}} + \sigma^2_{\varepsilon_{zcjst}}$.

Then, $\sigma^2_{\varepsilon_{zicjst}}$, the empirical estimate of the variance of the student-level errors, is estimated using within-classroom variance in e_{zicjst}:

$$\sigma^2_{\varepsilon_{zicjst}} = var(e_{zicjst} - \bar{e}_{zcjt})$$

$\sigma^2_{\theta_{zj}}$, the empirical estimate of the variance of teacher component, is estimated by the covariance between the average residual in a teacher's class in year t and year t'.

$$\sigma^2_{\theta_{zj}} = cov(\bar{e}_{zcjt}, \bar{e}_{zc'jt'})$$

To estimate $\sigma^2_{\theta_{zj}}$, we compute mean residuals ($\bar{e}_{zcjt}$) for each classroom. Then we pair every classroom with another random classroom for the same teacher ($\bar{e}_{zc'jt'}$) (t' can be equal to t because teacher typically teaches multiple classes in one period.) and compute

Furthermore, in order to see the statistical significance of teacher value-added on each subject test score, we estimate Equation (4.4),[24]

$$y_{zicjst} = \boldsymbol{X_{icjst}}\gamma + \delta_z \cdot (\varrho_z \hat{\mu}_{zjt}) + \nu_{zicjst} \tag{4.4}$$

For ease of interpretation, the teacher value-added estimates are multiplied by scaling factor ϱ_z such that the coefficient δ_z identify the effect of increasing teacher value-added on test scores by one standard deviation.[25]

To account for the fact that individual teachers have multiple students, standard errors are adjusted for one-way clustering at the teacher level following Cameron, Gelbach, and Miller (2011).

4.2.2 Correlation and Mechanism

In previous section, we estimate teacher value-added of each teacher. In this section, we will use mediation analysis to investigate whether preferences can be a good predictor of their teacher value-added. If it is true, then we uncover some possible teacher behaviors to explain the channels that how teacher preferences influence the teacher value-added.

Before getting into the mediation analysis, we check the correlation between all 8 preferences to check whether these preferences are not highly correlated with each other. This check is to guarantee that each preference is a distinct

the covariance of the mean residuals across these classrooms. Note that the equation above assumes the student residuals are independent across a teacher's classrooms. There are same classes even in the two different period due to, the special Chinese education system, fixed compenent of students and teachers. Thus, the pair pool for $\bar{e}_{zcjt}$ consists of the classes teacher j teaches but excludes classroom c both in period t and in period t'. We replicate this procedure 200 times and take the median of the estimated covariance as the parameter estimate.

Finally, we can obtain an empirical estimate of $\sigma^2_{\varepsilon_{zcjst}}$, the variance of the classroom-level shocks, using the variance of the total residual, $var(e_{zicjst})$, minus the empirical estimates of $\sigma^2_{\varepsilon_{zicjst}}$ and $\sigma^2_{\theta_{zj}}$:

$$\sigma^2_{\varepsilon_{zcjst}} = var(e_{zicjst}) - \sigma^2_{\varepsilon_{zicjst}} - \sigma^2_{\theta_{zj}}$$

[24]We drop the teachers who teach only one class in the two semesters due to pair the same class may lead average random shock of students correlated.

[25]To obtain the scaling index for each outcome we first estimate the following equation below for each subject z:

$$y_{zicjst} = \boldsymbol{X_{icjst}\beta_z} + \pi_z \cdot \hat{\mu}_{zjt} + u_{zicjst}$$

The scaling index is $\varrho_z = |\hat{\pi}_z / \hat{\sigma}_{\theta_{zj}}|$, where $\hat{\pi}_z$ is the coefficient estimate from the equation above and $\hat{\sigma}_{\theta_{zj}}$ is the estimated standard deviation of true teacher value-added on subject z described in Table 4.3. This rescaling is done separately by subject.

preference rather than a proxy for other preferences.

Then, following mediation analysis (MacKinnon, 2008; Gelbach, 2016), we first to check an overall correlation between teacher preferences and teacher value-added. We pool all three subjects together to increase the sample size and include subject fixed effect and teacher controls into the following regression.[26]

$$\hat{\mu}_{zj} = \boldsymbol{pref_{zj}\beta} + Tea_{zj} + Sub_z + \epsilon_{zj} \tag{4.5}$$

where Prf_{zj} includes 8 preferences which are risk taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity procrastination, and self-assessment of math ability,[27] Tea_{zj} and Sub_z are teacher controls (teacher gender, teacher education and teacher age) and subject fixed effect, respectively.

Next, we examine how teacher preferences influence teacher behaviors. More specifically, we regress each teacher behavior on teacher preferences, respectively.

$$m^k_{zj} = \boldsymbol{pref_{zj}\eta^k} + Tea_{zj} + Sub_z + \varepsilon^k_{zj},\ k = 1, 2, 3, 4 \tag{4.6}$$

where m^k_{zj} is the kth teacher behavior (class questioning, provision of praise and criticism, and communication with students) which is measured by the mean of evaluations by his/her students such that the regression is estimated at teacher level which is consistent with the level in Equation (4.5).

Finally, we regress teacher value-added on both teacher behaviors and teacher preferences to confirm that the teacher behaviors are significant predictor of teacher value-added, and check whether magnitude of teacher preferences in Equation (4.5) are greatly reduced after controlling the teacher behaviors. The regression is given by Equation (4.7).

$$\hat{\mu}_{zj} = \boldsymbol{pref_{zj}\beta'} + \sum_{k=1}^{4} m^k_{zj}\kappa^k + Tea_{zj} + Sub_z + \varepsilon_{zj} \tag{4.7}$$

According to mediation analysis, we have the fact that overall effect equals

[26] We do not use leave-year-out measure of $\hat{\mu}_{zj}$ here because there is no mechanical endogeneity with the absence of students in the right hand side in the Equation (4.5). Therefore, $\hat{\mu}_{zj}$ without subscipt t is given by $\hat{\theta}_{zj}\lambda_{zj}$, which means that each teacher has just one fixed teacher value-added.

[27] All preference indices are obtained from the instruction of Falk et al.(2016). According to the survey designed by Falk, Becker, Dohmen, Huffman and Sunde, each preference has two measurements except trust, procrastination and self-assessment of math ability, one is qualitative item and another is quantitative item. In first step, we need to normalize all raw value of two items. Then, we multiply the corresponding weights which are given in Falk et al. (2016) to each item such that each preference has only one measurement. Finally, we normalize the measurement in step two again to get the final indices we used in the regression.

to unexplained part plus explained part by the teacher behaviors in our data. This idea is given by Equation (4.8).

$$\hat{\boldsymbol{\beta}} = \hat{\boldsymbol{\beta}}' + \sum_{k=1}^{4} \boldsymbol{\eta}^{\boldsymbol{k}} \kappa^k \tag{4.8}$$

For kth mechanism of pth preference, we compute its explanatory power (EP) by pth element in $\boldsymbol{\eta}^{\boldsymbol{k}}$ multiply κ^k divided by pth element in $\hat{\boldsymbol{\beta}}$, which is given by

$$EP_{kp} = \frac{\eta_p^k \kappa^k}{\hat{\beta}_p} \tag{4.9}$$

4.3 Data

Our data consists of two parts. First part is the basic information of students and teachers which are obtained from ministry of education of Qiyang county in Hunan province, China. Second part is the preference information of students and teachers obtained from the questionnaire designed by Falk et al.(2016). Matching these two datasets, we get final sample used in this paper.

We obtain information about students and teachers in middle schools in Qiyang county from a survey conducted by the Ministry of Education of Qiyang county at the end of 2017-18 school year on July 2018. Student information including three waves of test scores: baseline test score,[28] test score of first semester and second semester in 2017-18 academic year and students' gender, age, parents' education, only child or not of each student in grade 7 and grade 8. Meanwhile every student has to answer a questionnaire, the survey asks students to answer several attitudes to all subjects using the question that how much do you agree with the following statements on a scale from 1 (strongly disagree) to 4 (strongly agree).[29]Teacher information contains the information of which classes they teach, gender, level of publications, education, and age.

We measure and collect the preference information of students and teachers by Chinese version of preference questionnaire designed by Falk et al.(2016).[30] The questionnaire aims at measuring eight preferences: risk-taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity, self-assessment of math ability and procrastination. The components of each preference are shown in Table 4.1 below.

Finally, we match this preference dataset with characteristic dataset by student ID and get a matched student-teacher panel data we used in this chapter. Our sample includes 1903 students and 153 teachers in 7th and 8th grades, across 38 distinct classrooms and 2 schools after matching.

The summary statistics is shown as Table 4.2. It is shown that test scores of

[28]A unified baseline test is hold in each middle school of Qiyang county after finishing class assignment. The test is just aim to investigate the level of each student's ability at the beginning of each school year (September).

[29]There are 4 statements about evaluating teachers' behaviors, (1) The math/Chinese/English... teacher always asks me to answer questions in class. (2) The math/Chinese/English... teacher always praises me in class. (3) The math/Chinese/English... teacher always criticizes me in class. (4) The math/Chinese/English... teacher communicates with me or my parents frequently out of class. Note that in the questionnaire, those questions are implemented separately by each subject.

[30]Questionnaires of various languages can be downloaded at https://www.briq-institute.org/global-preferences/downloads.

all core subjects have a big jump from 0.10~0.11 standard diviation to 0.77~0.92 standard diviation. The possible reason is that these two schools are the top list in the whole county with a greater quality of teachers than that in other middle schools in Qiyang county. From the student control variable, it is clear that the proportion of children with no siblings is just 14%. This is mainly due to the deregulation of the one-child policy in remote areas and the dismantlement of the one-child policy in recent years. The proportion of female students is 43%. The average of parental education is just above the nine years of compulsory education year. As for teachers, about 57% of teachers are female. The average age of teachers is about 41 years old. This indicates that educational resources are deficient in remote areas as it is hard to attract young teachers (Xu and Sun, 2019). The publications of teacher reach county level on average. Teachers typically have 16 years of education.

Table 4.1. Components of Each Preference

Preference	Module Items
Risk Taking	1. Please tell me, in general, how willing or unwilling you are to take risks. 2. Staircase measure (five interdependent choices between a lottery and a safe option)
Time Discounting	1. How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future? 2. Staircase measure (five interdependent choices between an early and a delayed amount of money)
Trust	1. I assume that people have only the best intentions.
Altruism	1. How willing are you to give to good causes without expecting anything in return? 2. Hypothetical donation.
Positive Reciprocity	1. When someone does me a favor I am willing to return it. 2. Hypothetical choice: size of a "thank-you"-gift.
Negative Reciprocity	1. If I am treated very unjustly, I will take revenge at the first occasion, even if there is a cost to do so 2. How willing are you to punish someone who treats you unfairly, even if there may be costs for you? 3. How willing are you to punish someone who treats others unfairly, even if there may be costs for you?
Self-assessment of math ability	1. I am good at math.
Procrastination	1. I tend to postpone tasks even if I know it would be better to do them right away.

Notes: Most preferences are measured with one qualitative and one quantitative item. Each preferene begin with a qualitative measure, respondents are asked to self-assess their preference "in general" on an 11-point (0-10)scale for the qualitative items. Respondents are also required to answer quantitative items which typically included a hypothetical version of the incentivized choice experiment. For details of these experiments, you can check the questionnare of global preference survey at https://www.briq-institute.org/global-preferences/downloads.

Table 4.2. Summary Statistics

	Mean			Standard Deviation			Observation		
Test score	Math	Chinese	English	Math	Chinese	English	Math	Chinese	English
Second semester	0.82	0.79	1.43	0.64	0.58	0.83	1903	1903	1903
First semester	0.90	0.77	0.92	0.80	0.57	0.79	1902	1903	1903
Baseline	0.10	0.10	0.11	0.91	0.93	0.85	1902	1902	1902
Student controls									
Male student		0.57			0.49			1859	
Age		13.3			0.75			1854	
Only child		0.14			0.35			1850	
Father education		10.65			3.11			1732	
Mother education		10.15			3.15			1738	
Teacher controls									
Female teacher		0.57			0.43			152	
Age		41.23			7.39			151	
Level of publication		2.36			1.26			138	
Education years		16.24			2.24			145	

4.4 Main Results

We show the results of teacher effects on test scores and mechanism. First, we examine the magnitudes of teacher value-added on the test scores.[31] We follow Kane and Staiger (2008) and Jackson (2018), using the covariance between mean classroom residuals for the same teacher as a measure of the variance of the persistent component of teacher value-added for each subject. The square roots of estimated variances for each subject are presented in Table 4.3.

Table 4.3. Covariance-Based Estimates of the Variability of Teacher Value-Added

	Test score					
	Math	Chinese	English	Math	Chinese	English
Standard deviation of teacher value-added on test score	0.025	0.019	0.093	0.024	0.019	0.091
Teacher Fixed Effects (FE) in Equation (4.1)		No			Yes	

Notes: The estimated standard deviations are the square root of the estimated covariances in mean residuals from Equation 4.1 across classrooms for the same teacher. Specifically, we pair each classroom with a randomly chosen different classroom for the same teacher and estimate the covariance. We replicate this 200 times and take the median estimated covariance as the parameter estimate. We then take the square root of this estimated covariance parameter as the estimated standard deviation of teacher value-added.

In order to see the significance of these estimates, we regress Equation (4.4),

$$y_{zicjst} = \boldsymbol{X_{icjst}\gamma} + \delta_z \cdot (\varrho_z \hat{\mu}_{zj}) + \nu_{zicjst} \quad (4.4)$$

where δ_z can be interpreted as the effect of increasing teacher value-added on test scores by one standard deviation because we used rescaled teacher value-added. To account for the fact that individual teachers have multiple students, standard errors are adjusted for one-way clustering at the teacher level. Table 4.4 presents the coefficients on the rescaled value-added estimates.

[31] All test scores of each subject are normalized by subject, grade in the whole county, and therefore have means zero and standard deviations of one.

Table 4.4. Effects of Teacher Value-Added on Test Score of Each Subject

	Math score	Chinese score	English score	Math score	Chinese score	English score
δ_z	0.025***	0.019	0.093***	0.024***	0.019	0.091***
	(0.007)	(0.126)	(0.014)	(0.006)	(0.192)	(0.020)
School-by-period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Teacher FE in Equation (4.1)	No	No	No	Yes	Yes	Yes
Observation	3409	3410	3410	3409	3410	3410
Adjusted R squared	0.664	0.491	0.786	0.625	0.458	0.823

Notes: Robust standard errors are in parenthesis adjusted for one-way clustering at the teacher level. Test scores are normalized by subject, grade in the whole county to obtain a mean of zero and standard deviation of one. ***significant at the 1% level, **5% level, *10% level.

The results show that the standard deviation of English teacher value-added on English test score is the largest, 0.091-0.093, (p-value$<$0.01) so that increasing English teacher test score value-added by one standard deviation increases English test score by $0.091\sigma - 0.093\sigma$. On the contrary, the standard deviation of Chinese teacher value-added on Chinese test score is the smallest, just 0.019 and insignificant. Therefore, it seems that a good mother tongue teacher cannot help students' mother tongue a lot at the stage of middle school, while a good foreign language teacher can improve students' foreign language significantly. A similar result also is found in Bau and Das (2020). They find that teacher effects are higher for math and English compared to Urdu, the vernacular of Pakistan. Moreover, we also find that having a math teacher one standard deviation teacher quality up can improve students' math test score by $0.024\sigma - 0.025\sigma$ (p-value$<$0.01).

The possible explanations for the different teacher effect of each subject are followings. Firstly, according to Jackson et al. (2014), the fraction of learning taking place in school results in the heterogeneous teacher effect of each subject, whereas mathematics and English are almost exclusively learned in the classroom, Chinese is learned to a great extent outside of school in the Chinese education context. Secondly, teachers' impact on test scores fade out very rapidly in subsequent years (Rothstein 2010; Carrell and West 2010; Jacob, Lefgren, and Sims 2010). Our data comes from remote area in China where most of students may begin to learn English at the stage of middle school, so the English teacher effect may quite large at the beginning of the English learning.

Overall, we find that teacher effect of all subjects are much smaller than that in U.S. The main reason is that most U.S. studies only estimated teacher effect for full school years, while we estimate teacher effect for one semester, half school year, because students are tested every semester in Chinese education context. A sencond reason may be the deficiency in quantity of teachers, especially in remote area in China. Therefore, it is hard for good teachers to improve their value-added when facing numerous students in class.

After illustrating the magnitude of teachers' impact, we will show the results of mechanism part. Firstly, let's check the correlations between these teacher preferences so that each preference is a distinct preference rather than a proxy for other preferences. As shown in Table 4.5, all preferences are weakly correlated with each other.

Table 4.5. Correlations Between Teacher Preferences

	Trust	Patience	Altruism	Negative reci-procity	Positive reci-procity	Risk taking	Self-assessment of math ability	Procrast-ination
Trust	1							
Patience	-0.149	1						
Altruism	0.394	0.219	1					
Negative reciprocity	0.205	0.225	0.234	1				
Positive reciprocity	0.049	-0.052	0.049	-0.183	1			
Risk taking	-0.203	0.127	0.179	0.130	-0.183	1		
Self-assessment of math ability	0.178	0.241	0.154	0.179	0.259	0.097	1	
Procrastination	0.077	0.175	0.167	0.159	-0.077	0.189	0.043	1

Notes: Three core subjects teacher preferences are pooled together to get a larger sample. All preferences are obtained by following the instruction of Falk et al. (2016) such that each preference have a mean of zero and standard deviation of one.

Then we estimate Equation (4.5) to investigate the correlation between teacher preferences and teacher value-added. We pool three core subjects together for a larger sample size. The result of Equation (4.5) is shown in Table 4.6.

$$\hat{\mu}_{zj} = \boldsymbol{pref_{zj}\beta} + Tea_{zj} + Sub_z + \epsilon_{zj} \ (4.5)$$

Table 4.6. Correlation Between Teacher Preferences and Teacher Value-Added

	Outcome variable: Teacher value-added	
Trust	-0.77	-0.63
	(0.96)	(0.81)
	[0.55]	[0.63]
Patience	0.90	1.25
	(0.78)	(1.47)
	[0.50]	[0.63]
Altruism	2.10**	2.69***
	(0.84)	(0.58)
	[0.09]	[0.06]
Negative reciprocity	0.08	-0.47
	(1.29)	(2.44)
	[0.95]	[0.85]
Positive reciprocity	0.81	-0.88
	(0.52)	(0.99)
	[0.34]	[0.62]
Risk-taking	-1.72**	-2.55**
	(0.82)	(1.04)
	[0.12]	[0.09]
Self-assessment of math ability	0.65	0.58
	(0.78)	(1.47)
	[0.55]	[0.54]
Procrastination	-0.87	-0.60
	(1.22)	(2.31)
	[0.55]	[0.54]
Teacher controls	Yes	Yes
Subject fixed effects	Yes	Yes
Teacher FE in Equation (4.1)	No	Yes
Observations	136	136
Adjusted R-squared	0.18	0.16

Notes: All coefficients and standard errors are 1000 times as the raw estimated value to make them easier to read. ***significant at the 1% level, **5% level, *10% level. Values in the square brackets are controlling the false discovery rate adjusted p-values according to Benjamini and Hochberg (1995).

From view of the correlation between teacher preferences and teacher value-added, it shows that altruism and risk taking are significantly correlated with teacher value-added. Altruism is benefit for being a good teacher, while risk-taking preclude one from being a good teacher.[32][33] Furthermore, in order to reduce the likelihood of these false rejections, we apply multiple hypothesis testing. Specifically, we control the False Discovery Rate (FDR) and compute adjusted p-values according to Benjamini and Hochberg (1995). The result shows that altruism remains statistically significant at level 0.1 for both methods. Furthermore, risk-taking is also robust at significance level 0.1 in the estimaton where teacher fixed effects is controlled in Equation (4.1), but no more significant at level 0.1 in our base estimation.

Next, we regress teacher behaviors on teacher preferences, respectively, to investigate whether teacher preferences can be good predictors to teacher behaviors. The results of Equation (4.6) are shown in Table 4.7.

$$m_{zj}^{k} = \boldsymbol{pref_{zj}\eta^{k}} + Tea_{zj} + Sub_{z} + \varepsilon_{zj}^{k},\ k = 1,2,3,4 \ (4.6)$$

The results show that no teacher preferences can be good predictors in terms of teacher questioning in class. Moreover, we find that patience and altruism are positively associated with teacher praises in class. Whereas, it seems to be counter-intuitive that altruism and positive reciprocity are positively associated with teacher criticisms in class, while negative reciprocity are negatively associated with that. As for communication with students or their parents out of class, more altruistic and positive reciprocal teachers are likely to communicate.

[32] For the correlation between risk taking and cognitive ability, Andersson et al. (2016) show that this relationship may be spurious. In their study, they show that by changing the way how risk elicitation tasks are presented, they are able to generate both negative and positive correlations between risk aversion and cognitive ability. They argue that cognitive ability is related to behavior error rather than to risk preferences.

[33] Nevertheless, sometimes there is actually a significant relationship between independent and dependent variables but because of small sample size, or other extraneous factors, there could not be enough power to predict the effect that actually exists (Shrout & Bolger,2002). Furthermore, it is possible for one variable (M1) to act as a mediator and for a second (M2) to act as a suppressor. Overall effect will be cancel out by those two channels (MacKinnon et al., 2000). Therefore, we can still get into the next step even there is no significant result in the first step.

Table 4.7. Regression of Teacher Behaviors on Teacher Preferences

	Dependent variables: Teacher Behaviors			
	Questioning	Praises	Criticisms	Communication
Trust	0.138 (0.177)	0.082 (0.160)	-0.140 (0.162)	-0.013 (0.128)
Patience	0.198 (0.143)	0.411** (0.130)	-0.042 (0.131)	0.117 (0.103)
Altruism	0.214 (0.155)	0.389** (0.140)	0.231* (0.100)	0.519*** (0.111)
Negative reciprocity	-0.140 (0.239)	-0.145 (0.216)	-0.915*** (0.218)	-0.128 (0.172)
Positive reciprocity	0.111 (0.097)	-0.041 (0.088)	0.340*** (0.089)	0.236** (0.070)
Risk taking	-0.111 (0.151)	-0.210 (0.137)	0.271 (0.138)	-0.072 (0.109)
Self-assessment of math ability	-0.161 (0.144)	-0.196 (0.130)	-0.020 (0.132)	-0.037 (0.104)
Procrastination	-0.275 (0.226)	-0.161 (0.205)	0.729*** (0.207)	-0.089 (0.163)
Teacher controls	YES	YES	YES	YES
Subject fixed effect	YES	YES	YES	YES
Observations	136	136	136	136
Adjusted R-squared	0.152	0.277	0.202	0.381

Notes: All teacher behaviors are the standardized mean of evaluation by their students such that each teacher behavior has a mean of zero and standard deviation of one. Therefore, the regression is implemented at teacher level which is consistent with the level in the regression of overall effect. ***significant at the 1% level, **5% level, *10% level.

Then, we regress teacher value-added both on teacher preferences and teacher behaviors with Equation (4.7).

$$\hat{\mu}_{zj} = \boldsymbol{Prf_{zj}\beta'} + \sum_{k=1}^{4} m_{zj}^{k}\kappa^{k} + Tea_{zj} + Sub_{z} + \varepsilon_{zj} \quad (4.7)$$

The result is presented in Table 4.8, we can see that the coefficient of altruism greatly reduces and is not significant anymore, which means the four teacher behaviors indeed explain part of the correlation between altruism and teacher value-added. Nevertheless, the coefficient of risk taking remain unchanged and is still significant, which suggests that none of these behaviors can be the channels that how risk taking decreases teacher value-added on test score. As for teacher behaviors, criticisms and communication are two efficient ways to improve teacher value-added on test score. Praises in class seems to have adverse influence in teacher value-added on test score although it is not significant.

Table 4.8. Regression of Teacher Value-Added Both on Teacher Preferences and Teacher Behaviors (Full Estimation)

	Outcome variable: teacher value-added	
Trust	-0.66	-0.51
	(0.96)	(0.88)
Patience	0.96	1.47
	(0.82)	(1.61)
Altruism	1.21	1.88
	(0.88)	(1.70)
Negative reciprocity	0.71	-1.39
	(1.46)	(2.85)
Positive reciprocity	0.12	-0.39
	(0.48)	(1.18)
Risk-taking	-1.84*	-2.86
	(0.80)	(1.66)
Self-assessment of math ability	0.63	0.48
	(0.78)	(1.52)
Procrastination	-1.12	-0.63
	(1.39)	(2.37)
Questioning	0.31	0.39
	(1.26)	(2.38)
Praises	-0.79	-1.37
	(0.91)	(1.77)
Criticisms	0.49**	0.38***
	(0.16)	(0.14)
Communication	1.97*	2.44**
	(0.85)	(0.99)
Teacher controls	Yes	Yes
Subject fixed effect	Yes	Yes
Teacher FE in Equation (4.1)	No	Yes
Observations	136	136
Adjusted R-squared	0.21	0.29

Notes: All coefficients and standard errors are 1000 times as the raw value. All teacher behaviors are the standardized mean of evaluation by their students such that each teacher behavior has a mean of zero and standard deviation of one. Therefore, the regression is implemented at teacher level which is consistent with the level in the regression of overall effect. ***significant at the 1% level, **5% level, *10% level.

Finally, we compute an explanatory power of each teacher behavior in these teacher preferences by Equation (4.9) using estimates in the baseline estimation. According to the four steps involved in Baron and Kenny (1986) approach to establishing mediation, we just consider the significant teacher preferences (i.e., altruism and risk taking) and teacher behaviors (i.e., criticisms and communication). For altruism, the result is shown in Figure 4.1, criticisms in class can explain 5.38% of the correlation, communication out of class accounts for 48.76% of the correlation and the rest 45.95% is the unexplained part by these four behaviors (questioning and praises are regarded as unexplained part because of statistics insignificance).

The logic behind the relationship between criticism and teacher value-added is following. We find that altruistic teachers are more likely to increase their students' academic outcomes by criticizing students although criticism in class just accounts for 5%. Rolling (2013) find that a positive relationship between altruism and criticism in education. Further, Criticism functions to cultivate students' ability to question, deconstruct, and then reconstruct knowledge in the interest of emancipation (Leonardo, 2004). This relationship is also in line with the stereotype of teachers in China and other Asian countries, such as Japan and Korea. The tradition of education in China is criticisms-oriented, teachers always tend to criticize students when they really care about students. This is totally different from the norms in US or other western countries where implement praise-oriented education (Li, 2016; Wang, 2012).

The result also shows that communication out of class explains almost one-half of the correlation between teacher value-added and altruism. More altruistic teachers tend to communicate more with their students or students' parents, which leading to the improvement of students' test scores.

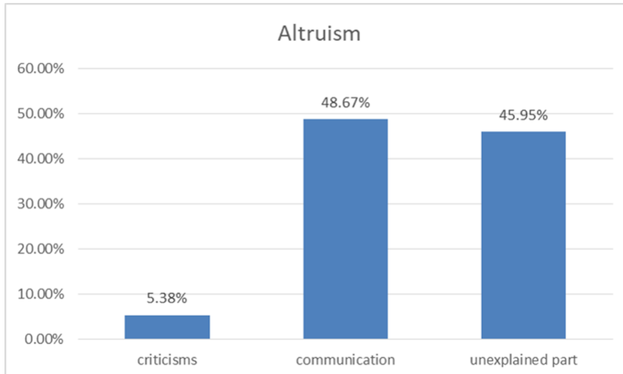
Altruism increase communication and cooperation (Daily and Dollinger, 1992; Eshel et al., 1998; Simon,1993, Schulze et al., 2002, Sirvani, 2007). In addition, neuroimaging studies, furthermore, provide support for the link between communication and altruistic behaviors. The evidence indicates that the human brain is wired so that the decision processes underlying altruistic behavior and socialization are strongly linked (Harbaugh et al., 2007, Moll et al., 2006, Hare et al., 2001)

Communication plays an important role on driving altruistic teachers to improve their students' test scores. First, communication is crucial for a teacher in delivery of education to students (McCarthy and Carter, 2001). Communication is a dynamic process which need of mind and courage to face the other and convey his/her massage in effective way. Communication process is successful when we deliver the massage in clear and understandable way. Effective communication need to convey and accept his/her massage in all kind of situation and circumstances. Good communication is considered a strong tool for effectiveness in the teaching profession.

Second, communication is also important for a student in understanding what his/her teacher saying. Student need to understand that what is right, and what is wrong while it totally depend upon the communication of teachers which he adopt in classroom (Morreale et al., 2000). Good communications minimize the potential of unkind feeling during the process of teaching. For learning the learner must be attentive toward their teacher during the lecture.

However, based on the data of teacher behaviors currently available, it seems that none of them is the channel that can explain why risk taking negatively correlated with teacher value-added. One may consider that the negative correlation between risk and teacher value-added is that elder teachers do not like to take risk but have higher teacher value-added. However, it may not true because we already controlled teacher age in Equation (4.5). One possible explanation is that there exists positive correlation between risk aversion and inequality aversion, which means that if one is more risk-averse then she is likely to have a stronger sense of fairness (Kroll and Davidovitz, 2003; Carlsson et al., 2005; Ferrer-i-Carbonell and Ramos, 2010; Bolton and Ockenfels, 2008; Ddavidovich, 2008). As a result, risk-averse teachers are tend to treat every student equally, which increases the students' academic outcomes.

Figure 4.1: Decomposing Altruism by Teacher Behaviors



Notes: The figure presents the estimated decomposition of positive correlation between altruism of teacher and teacher value-added. All percentages of each teacher behavior are computed by Equation (4.9). Questioning and praises are regarded as unexplained part because of insignificance.

4.5 Conclusion

This paper sheds light on the relationship between teacher preferences and teacher value-added, which helps us to understand the determinants of teacher effectiveness.

Our results show that teachers have impacts on students' academic outcomes. Having an English teacher at the 85th versus 50th percentile of value-added on the English test score for one semester (half year) would increase the English score by 0.093 standard deviation. Math teacher effect on math test score is 0.025, meaning that having a math teacher with value-added at the 85th versus 50th percentile on math test scores for one semester would increase math scores by roughly 0.025 standard deviation. Teacher value-added on Chinese test score is the smallest and insignificant, which is just 0.019 standard deviation.

Moreover, we find that more altruistic teachers have a higher teacher value-added, while teachers who like to take risks have a lower teacher value-added. The results provide a new dimension of identifying good teachers not only through their education or experience but also through their preferences on the process of teacher recruitment. The purpose of identifying good teachers is that we can take advantage of imformation about quality of teachers on the process of recruitment, assignment, compensation, evaluation, promotion, and retention. For instance, we expect that high-quality teachers would have higher wage than low-quality teachers. We also expect that high-quality teachers have more opportunities to get a promotion than low-quality teachers.

Furthermore, we uncover teacher behaviors to explain how altruism is associated with the teacher value-added. The results show that criticisms and communication explain 5% and 49% of the total correlation for altruism, respectively. However, based on the data of teacher behaviors currently available, we do not find how risk taking comes into play.

Chapter 5

Do Teachers' Preferences Matter for Students' Preferences?

5.1 Introduction

Individual preference endowments are treated exogenously in usual practice of economics. Recent theoretical contributions endogenize these endowments by assuming that individuals' preferences are influenced by the preferences of their parents inside the family or other role models (i.e., teachers, peers, etc.) outside the family. Bisin and Verdier (2000) developed a cultural transmission theory model which presents two types of socialization. One is the direct socialization of children inside the family. Another is children's cultural adaptation and imitation from society outside the family.

Socialization inside the family is called "direct vertical" socialization, which drawing attention to the role of the family in shaping children's preferences and attitudes. Empirically, Dohmen et al. (2012) show that the positive transmission of willingness to take risks and willingness to trust others from parents to children. Alan et al. (2017) find that risk preferences are correlated between mothers and their daughters when the daughters are just 7-8 years old.

Socialization by society is called "oblique" socialization, such as, imitation and learning from particular role models like teachers and peers. This type of socialization needs more empirical evidence as well given that we spend much time in school before 18 years old. More importantly, investigating socialization in schools helps us fully understand the mechanism of teacher effectiveness through the role of teachers in shaping students' preferences and attitudes. In addition, the existing research show that individuals' preferences are associated with their human capital. For example, Dohmen et al. (2010) show that individuals with higher cognitive ability are significantly more willing to take risks in the lottery experiments. Belzil and Leonardi (2007) find that more risk-averse individuals are more likely to terminate school. Beck et al. (2000) and Michinov et al. (2011) both find that a negative relationship between procrastination and academic performance.

This chapter studies the transmission of teachers' preferences to students' preferences using the data of random assignment of students and teachers to classes in middle schools of China. To achieve the purpose, first, we examine the correlation between teachers' preferences and their students' preferences. Second, we verify the correlation we found above is a direct relationship between teachers' preferences and students' preferences rather than driven by other confounders such as: sex and age of teachers and students.

What we find are the followings. First, we find a strong and significant relationship in procrastination and risk attitudes between classroom teachers and their students. Students are more likely to postpone task when they are taught by the classroom teachers who have tendency to postpone. Similarly, students are more willing to take risks when they are assigned classroom teachers who are prone to take risks.

Second, we verify the correlation we found above is a direct relationship between classroom teachers' preferences and students' preferences. First, we find that the correlations are essentially unchanged when demographic similarities in personal characteristics between teachers' and students' are included, which eliminates the influence of personal characteristics of teacher and student on the preference transmission. Then, we find that the correlations remain stable when we added a set of additional controls including parental education years. This result suggests that school choice by parents should not account for the correlation given that parental education can be a proxy for their procrastination and risk attitudes. Next, the correlations are robust to include both attitudes of teachers and students simultaneously, which indicating that correlations in procrastination and risk attitudes represent two distinct forms of attitude transmission. Last, we do not find any evidence of a significant correlation in preferences between subject teachers and their students. This result indicates that there is no preference sorting at school or region level and that, more importantly, the transmission may occur beyond teaching or giving lectures inside the class.

Furthermore, we conduct additional robustness checks. First, we check that the correlation should not be driven by the collaboration of teachers and students on survey responses. Second, we use different measures of risk attitudes to estimate the correlation. We still observe a strong correlation in risk attitudes across various survey measures with different scales. In particular, we find that risk attitude transmission appears to be a robust process, and students end up like the teachers even in very detailed contexts of measuring risk-taking attitude.

Finally, we investigate how the correlations between preferences of teachers and students vary across teacher characteristics, student characteristics, and class size. We find that male teachers have a stronger tendency to transmit their preferences than female teachers. We also find that boys are more sensitive to be influenced by their teachers than girls. Importantly, there are significant correlations for 8-graders and their classroom teachers but not for 7th-graders and their classroom teachers. This finding, again, indicates that there is no evidence showing the preference sorting in school or region level. Moreover, the results also suggest that the quantity of interaction between classroom teachers and students should be the key factor for the transmission. In addition, we find that students in small classes are likely to be affected by their teachers. In addition to the heterogeneous correlations above, we investigate the effect of similarity in personal characteristics on preference transmission. We find that the more similarities in both age and gender between classroom teachers and their students there is, the larger magnitude of transmission is.

This study builds on the previous literature in a number of ways. First, we expand the preference transmission environment from inside the family to society outside the family where children are randomly assigned to teachers and investigate whether there is a postnatal relationship in preference transmission. Former studies focus on the role of the family in shaping children's preferences and attitudes (Alan et al., 2017, Lindquist et al., 2015, Dohmen et al., 2012). However, there is one big concern in studying the intergenerational preference transmission inside the family. That is we cannot rule out the probability of transmission from genes. In other words, we cannot distinct the congenital transmission from postnatal transmission. We know that children also spend much time outside the family. They take a long time in school with teachers besides their families. Thus, we change into the context of the transmission outside the family.

Second, we extend the channels of role model effect. We show that preferences can serve a channel of the role model. As far as we know, many role model research pay much attention on sex. For instance, Bettinger and Long (2005), Betz and Sekaquaptewa (2012), and Eble and Hu (2017) all show that having a female teacher will improve academic outcomes of girls relative to boys. Put differently, girls will imitate their female teachers to try their best at the subjects through the identity of same-sex. In addition to sex, we show that preference can be a signal of role model as well. Specifically, students have tendency to mimic their classroom teachers in terms of specific preferences or attitudes.

Third, we present a new mechanism for teacher effects. The existing studies endeavor to find teacher characteristics in order to explain the variation of teacher quality. We find the transmission of teachers' preferences to students' preferences, which providing a new dimension to understand the mechanism behind teacher effects given that students' preferences are associated with their various outcomes.

The rest of this chapter is organized as follows. Section 5.2 explains our empirical strategy of this study. Section 5.3 presents the data and summary statistics. Section 5.4 reports the main results. Section 5.5 conducts robustness checks. Section 5.6 shows heterogeneous correlations. Section 5.7 concludes.

5.2 Empirical Strategy

Our research question concerns the preference transmission from classroom teacher to student. Understanding how students are matched to teachers and classrooms is therefore critical to our estimation and analysis. As mentioned in Chapter 2, an increasingly large number of schools have begun to employ random assignment to place students. Thus, we first to verify the rendomness of classroom assignments and then we estimate the magnitude of the transmission.

First, to verify the randomization, we conduct a balancing test. We regress teacher preferneces on students' baseline characteristics. We assume that teacher preferences are stable according to Cobb-Clark and Schurer (2012) which demonstrates that personality traits are stable for working-age adults. [34]Table 5.1 re-

[34]Regressing teachers' preferences on students' preferences measured at the beginning of class formation is the most ideal situation. But since we only have one wave preference data at the time after teacher-student interaction for one-year (for 7th graders) or two-year (for 8th graders), we assume that the preferences of teachers are stable. In addition, we also conduct a regression of teacher gender and age on the pre-determined variables of students, respectively, and find that the the class assignment is random in terms of characteristic variables of teachers and students.

ports regression results. We observe that none of the 8 baseline characteristics is statistically and economically significant. F-statistic shows that they are also jointly insignificant. These results suggest that the student characteristics in our sample are well balanced across classes.

Table 5.1. Balancing Test

Dependent Variable: Teachers' preferences	CTs' Risk-taking	CT's prorastination	STs' Risk-taking	STs' Procrastination
Math baseline score	-0.002	-0.006	0.005	-0.004
	(0.019)	(0.022)	(0.017)	(0.018)
Chinese baseline score	0.007	-0.004	0.002	0.009
	(0.019)	(0.022)	(0.018)	(0.018)
English baseline score	-0.007	0.002	-0.001	-0.009
	(0.023)	(0.024)	(0.018)	(0.021)
Student age	-0.023	-0.012	0.001	0.011
	(0.018)	(0.016)	(0.013)	(0.014)
Only child in family	0.064	0.011	-0.009	-0.062
	(0.043)	(0.049)	(0.038)	(0.040)
Male student	0.022	-0.009	0.005	-0.021
	(0.032)	(0.036)	(0.029)	(0.030)
Father's schooling years	0.005	-0.003	-0.001	-0.001
	(0.006)	(0.006)	(0.005)	(0.006)
Mother's schooling years	0.008	0.004	0.004	-0.003
	(0.006)	(0.007)	(0.005)	(0.006)
Test for joint significance				
F-statistics	1.205	1.082	0.836	0.808
p-value	0.292	0.373	0.570	0.595
School-by-grade fixed effects	YES	YES	YES	YES
Observations	1167	1319	3086	3423
Adjusted R-squared	0.025	0.015	0.006	0.014

Notes: Each cell presents the coefficient and standard error (in parentheses) for the listed student and the pre-determined variables from the regressions in which the dependent variables are risk-taking and procrastination attitude of the classroom teacher and subject teacher, respectively. The independent variables are all the student baseline characteristics. All baseline scores are normalized by subject, grade in the whole county. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

Next, we investigate the impact of classroom teachers' preferences on their students' preferences . We use the following equation as our base estimation:

$$stupref_{ijk} = \beta teachpref_{ijk} + S_{ij}\gamma + X_{ij}\delta + \tau_{sg} + \varepsilon_{ijk} \tag{5.1}$$

where $stupref_{ijk}$ is the measure of preference k of student i after one year (7th grade) or two years (8th grade) schooling under classroom teacher j,[35] $teachpref_{ijk}$ is the measure of preference k of classroom teacher j after teaching student i one or two school years, S_{ij} is a set of personal characteristics which related to similarity of teacher and student (i.e., gender and age of both student i and teacher j). X_{ij} is a set of additional student and teacher controls which are listed in Table 5.3 (i.e., a dummy variable whether student i is the only child in family, parental education years of student i, a dummy for student grade, and teacher's publication level). Based on the virtue of random class assignment within each school, β is the coefficient we interested in, capturing the correlation between teacher preference and student preference.

In order to get a direct relationship between classroom teachers' preference and students' preference. First, we add personal characteristics related to similarity of teacher and student, S_{ij}, in Equation (5.1) – gender and age – which were found previously to affect risk attitudes. This allows us to investigate whether teacher and student preferences are still related, once we control for similarity in personal characteristics. On one hand, including similarity in personal characteristics eliminates the influence of personal characteristics of teacher and student on the preference transmission. On the other hand, for example, if male teachers tend to teach male students, then male teacher dummy could potentially explain a similarity in risk attitudes. Alternatively, if personal characteristics do not explain the correlations of preference transmission between teachers and students, this strengthens the success of randomization of class assignment and, more importantly, suggests a more direct relationship between attitudes of teachers and their students, consistent with the transmisstion process assumed in models of preference transmission.

Second, we includ a varitey of additional controls, X_{ij}, for individual characteristics that could affect student preferences as well. These include a dummy variable whether student i is the only child in family, parental education years of student i, student grade, and teacher's publication level.

[35] We focus on two preferences, procrastination and risk-taking for the main analysis, so $k = 1, 2$

One may concern that it is inappropriate to omit the parental preferences variables for two reasons basically. First, we omit the important variables due to Dohmen et al. (2012) found that there is a strong and significant intergenerational transimission. More importantly, parents are more incentive to assign their children to the teachers who have a similar preference with their own.[36] If this is the case, parental preferences will explain much of correlations between teachers and students. We control the parents' education years instead of parents' procrastination and risk attitudes due to the data limitation, which mitigating the concern. It is found that there exists strong and significant correlation between attitudes of risk and procrastination and education years (Dohmen et al., 2010, Belzil and Leonardi, 2007, Beck et al., 2000, Michinov et al., 2011). Therefore, education years of parents are good proxy for their procrastination and risk attitudes.

Furthermore, we controlled both preferences (i.e., procrastination and risk-taking) of teachers and students in the regressions of each preference. We have assumed so far that procrastination and risk-taking are distinct attitudes. One may argue that postponing tasks is a risk aversion decision and thus that tendency to postpone could partly relect risk preference. On the other hand, individuals who want to take risk because they just do not want to postpone something. To address this question, we regress students' procrastination and risk attitudes on both attitudes of teachers and students.

Finally, as randomization is conducted within each grade of each school, we include school-by-grade fixed effects in the regressions to control for all school-by-grade level factors in our cross-sectional data. However, the random class assignment within each school still cannot provide a reasonable explanation for a direct relationship between teacher and student preferences because the correlation may be the consequence of preference sorting at school or region level. While this is potentially a very serious concern, we investigate the correlation of preference between subject teacher and student. In addition, we examine the correlation of preference between classroom teachers and 7th grade students who

[36] Although the enrollment from primary school to middle school in China is based on the nearby enrollment policy that is student who lives in one specific living area will be randomly assigned to the nearby middle schools as mentioned above in Section 2.1, there may still be parents with excellent social backgrounds send their children to the satisfied middle schools by their interpersonal relationships or parents move their house to the fancy middle schools nearby. If there are too many such parents who choose schools according to the teachers' preferences under the assumption they can observe teachers' preferences, then it will inevitably lead to the fact that no matter how randomly assign students to teachers, the correlation of preferences between teachers and students will be large due to this preference sorting at school level.

just enter middle school for the first year. If there is no significant correlation between these two cases, we can infer that correlation of preferences between teachers and students is not explained simply by the pattern of preference sorting at school or region level.

We also provide additional robustness checks to check whether the correlation is explained by collaboration on survey answers and single scale use. We show the details in Section 5.6 Robustness checks.

5.3 Data

Our data consists of two parts. First part is the information of students and teachers which are obtained from ministry of education of Qiyang county in Hunan province, China. Second part is the preference information of students and teachers. Matching these two datasets by student ID, we get final dataset used in this chapter.

We get the basic characteristics of students and teachers from a survey conducted by the ministry of education in Qiyang county at the end of 2017-18 school year on July 2018. Characteristics of students include sex, age, only child in family or not, and parental education year. Teachers' demographics comprise of sex, age, and the highest level of publication of each teacher.

As for preferences data, we measure and collect preferences of both students and teachers by Chinese version of global preferences surveydesigned by Falk et al.(2016).[37] The questionnaire aims at measuring eight preferences: risk-taking, time discounting, trust, altruism, positive reciprocity, negative reciprocity, self-assessment of math ability, and procrastination. The components of each preference are shown in Table 5.2 below.

Finally, we match this preference dataset with characteristic dataset by student ID, and get a student-teacher matched data used in this chapter. Our sample includes 1903 students and 136 teachers in 7th and 8th grades, across 38 distinct classrooms and 2 schools after matching.

The summary statistics is shown as Table 5.3. As for teachers, about 57% of teachers are female. The average age of teachers is about 41 years old. The publications of teacher reach county level on average. Teachers typically have 16 years of education. From the student control variable, it is clear that the proportion of children with no siblings is just 14%. This is mainly due to the

[37] Questionnaires of various languages can be downloaded at https://www.briq-institute.org/global-preferences/downloads.

deregulation of the one-child policy in remote areas and the dismantlement of the one-child policy in recent years. The proportion of female students is 43%. This is due to gender discrimination and the strong preference for sons in the rural and remote areas of China (Li et al., 2004). The average of parental education is just above the nine years of compulsory education year.

Table 5.2. Components of Each Preference

Preference	Module Items
Risk Taking	1. Please tell me, in general, how willing or unwilling you are to take risks. 2. Staircase measure (five interdependent choices between a lottery and a safe option)
Time Discounting	1. How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future? 2. Staircase measure (five interdependent choices between an early and a delayed amount of money)
Trust	1. I assume that people have only the best intentions.
Altruism	1. How willing are you to give to good causes without expecting anything in return? 2. Hypothetical donation.
Positive Reciprocity	1. When someone does me a favor I am willing to return it. 2. Hypothetical choice: size of a "thank-you"-gift.
Negative Reciprocity	1. If I am treated very unjustly, I will take revenge at the first occasion, even if there is a cost to do so 2. How willing are you to punish someone who treats you unfairly, even if there may be costs for you? 3. How willing are you to punish someone who treats others unfairly, even if there may be costs for you?
Self-assessment of math ability	1. I am good at math.
Procrastination	1. I tend to postpone tasks even if I know it would be better to do them right away.

Notes: Most preferences are measured with one qualitative and one quantitative item. Each preferene begin with a qualitative measure, respondents are asked to self-assess their preference "in general" on an 11-point (0-10)scale for the qualitative items. Respondents are also required to answer quantitative items which typically included a hypothetical version of the incentivized choice experiment. For details of these experiments, you can check the questionnare of global preference survey at https://www.briq-institute.org/global-preferences/downloads.

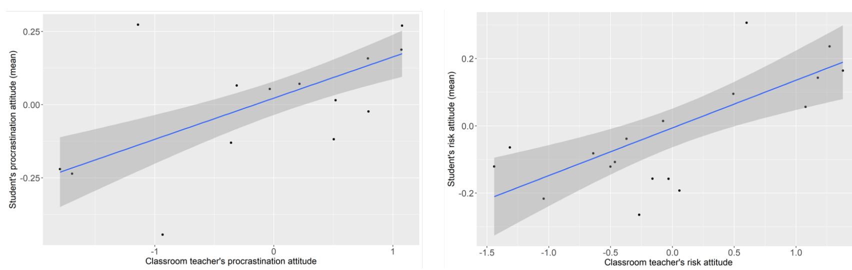
Table 5.3. Summary Statistics

	Mean	Standard Deviation	Observation
Teacher controls			
Female Teacher	0.57	0.49	136
Age	40.96	8.26	136
Published journal level	2.27	1.02	136
Student controls			
Male student	0.57	0.49	1859
Age	13.3	0.75	1854
Only child	0.14	0.35	1850
Father education	10.65	3.11	1732
Mother education	10.15	3.15	1738

5.4 Main Results

Figure 5.1 provides a first look at the relationship in procrastination (left diagram) and general risk (right diagram) attitudes between classroom teachers and their students, as it appears in the raw data.[38] The figure shows students' average tendency of postponing tasks and willingness to take risks, for given the procrastination and risk trait of their classroom teachers. Students' tendency of postponing tasks and willingness to take risks are clearly positively associated with classroom teachers' corresponding preference traits. This is illustrated by the positively sloped regression lines in the diagrams, which are based on a simple OLS regression of students' preference traits on the respective classroom teachers' traits.

Figure 5.1. Simple Correlation Between Classroom Teachers' and Students' Preferences



Notes: Student's attitudes towards procrastination and risk as a function of classroom teachers'. The left diagram shows students' average self-reported tendency to postpone tasks for a given tendency to postpone tasks of their classroom teachers. The right diagram shows students' average general risk attitude for a given general risk attitude of their classroom teachers.

Column (1) and (5) in Table 5.4 present simple correlations between classroom teachers and students in terms of procrastination and risk, respectively, as shown in Figure 5.1. Coefficients for procrastination and risk are both highly

[38]General risk attitude is a risk measure of weighted average of the risk qualitative measure and risk quantitative masure. Specifically, we first to get risk attitudes in the context of a 11-point scale self-assessment (qualitative item) from 0 (completely unwilling to take risks) to 10 (completely willing to take risks) and a staircase hypothetical lottery (quantitative item) in which respondents are asked to answer five interdependent choices between a lottery and a safe option. According to the five choices, Falk et al. (2016) gives a quantitative value to measure his/her willingness to take risks in this hypothetical lottery. Then, both qualitative and quantitative items are nomalized to have a mean 0 and standard deviation 1. Next, multipying both standardized items by the corresponding weight which are obtained from a multivariate regression of the standardized experimental preference measure on standardized measures of the two survey items. Finally, normalize the weighted risk measurement again, we will get the final general risk measurement used in this paper.

significant, indicating that student preferences are strongly related to the preferences of classroom teachers.

In Column (2) and (6), we add exogenous controls – gender and age of both students and their teacher. We find that there is no evidence male students are likely to postpone tasks compared with female students while boys are willing to take risks relative to girls. Importantly, the positive relationship of preferences between students' and teachers' remains virtually the same as in Column (1) and (5), respectively and is similarly significant after controlling for personal characteristics of teacher and the student. This result suggests a more direct relationship between preferences of teachers and their students rather than the sorting of similarity in personal characteristics between teachers and students.

In Column (3) and (7), we include a varitey of additional controls for individual characteristics that could affect student preferences. These include a dummy variable whether student i is the only child in family, parental education years of student i, student grade, other two core subject teachers' preferences, and teacher's publication level. We find that the coefficients of teacher's preference remain essentially unchanged relative to previous columns when we add additional controls, especially parents' education years. Thus, this result suggests that the relationship between preferences of teachers and their students should not be account for the school choice by parents even though parental education years are just proxies for their procrasination and risk attitudes.

In Column (4) and (8), we controlled both procrastination and risk attitudes of teachers and students in regressions of each preference.The coefficients on classroom teacher's procrastination and risk attitudes are positive and significant and similar in size to those in Column (3) and (7), respectively. This shows that the disposition towards procrastination and risk does not explain risk attitude and procrastionation attitude. This implies that correlations in procrastination and risk attitudes represent two distinct forms of attitude transmission.[39]

[39] In fact, we also examine covariance between all preferences included in Falk et al. (2016). These preferences consist of trust, patience, altruism, negative reciprocity, positive reciprocity, risk-taking, self-assessment of math ability and procrastination. We find that the covariance between these preferences are low for both teachers and students, meaning that we can regard each preference as an independent attitude. Results of covariance between all preferences of teachers and students are available upon request.

Table 5.4. The Relationship Between Students' Preference and Classroom Teachers' Preference

Dependent Variable: Student's preference	Procrastination				Risk			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Classroom teacher's procrastination	0.169***	0.149***	0.141***	0.124**				-0.013
	(0.028)	(0.034)	(0.042)	(0.056)				(0.044)
Classroom teacher's risk				-0.013	0.142***	0.128***	0.120***	0.117**
				(0.057)	(0.035)	(0.042)	(0.043)	(0.050)
Student's risk				0.018				
				(0.036)				
Student's procrastination								-0.004
								(0.033)
1 if male		0.065	0.034	-0.009		0.129***	0.144**	0.153**
		(0.058)	(0.061)	(0.070)		(0.047)	(0.064)	(0.066)
Age of student		-0.003	-0.025	0.019		-0.103*	-0.086	-0.010
		(0.042)	(0.043)	(0.051)		(0.045)	(0.047)	(0.049)
1 if male teacher		0.228**	0.272***	0.272**		-0.122	-0.101	-0.109
		(0.069)	(0.081)	(0.092)		(0.077)	(0.082)	(0.084)
Age of teacher		-0.016**	-0.021***	-0.024***		-0.005	-0.056	-0.005
		(0.005)	(0.005)	(0.007)		(0.006)	(0.007)	(0.009)
Additional controls	NO	NO	YES	YES	NO	NO	YES	YES
Observations	1268	1171	1073	826	1153	1074	1017	954
R-squared	0.019	0.026	0.028	0.030	0.013	0.014	0.020	0.023

Notes: The dependent variable in Columns (1) - (4) measures the tendency of postpone tasks on a 11-point scale from 0 (Do not like to postpone at all) to 10 (Very like to postpone). The dependent variable in Columns (5) - (8) measures general willingness to take risks on a linear combination of a 11-point scale self-assessment from 0 (completely unwilling to take risks) to 10 (completely willing to take risks) and a staircase hypothetical lottery. All preferences are obtained by the instruction of Falk et al.(2016), so each preference of both teachers and students has a mean of zero and standard deviation of one. Subject and school-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level. Additional controls include a dummy variable whether student i is the only child in family, parental education years of student i, student grade, other two core subject teachers' preferences, and teacher's publication level.

In summary, the results show that the procrastination and risk-taking attitudes of classroom teachers are reflected in the tendency to postpone tasks and willingness to take risks of their students and thus provide supportive evidence for a process of oblique preference transmission outside family.

To further prove the relationship between classroom teachers and their students are not driven by preference sorting at school or region level. We examine the correlation of procrastination and risk-taking attitudes between subject teachers and their students. As shown in Table 5.5, we do not find any evidence that there exists significant transmission of procrastination or risk-taking between subject teachers and their students. This result indicates that preference sorting at school or region level does not hold and that transmission may occur beyond teaching or giving lectures inside the class.

Table 5.5. The Relationship Between Students' Preference and Subject Teachers' Preference

Dependent Variable: Student's preference	Procrastination	Risk
Subject teacher's preference	-0.016 (0.029)	-0.046 (0.033)
Additional controls	YES	YES
Observations	3066	3396
R-squared	0.009	0.040

Notes: All preferences are obtained by the instruction of Falk et al.(2016), so each preference of both teachers and students has a mean of zero and standard deviation of one. The set of explanatory variables in both columns is indentical to that in Column (3) of Table 5.4. Subject and School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

The strength of attitude transmission from teachers to students is substantial in magnitude. The strength is comparable with intergenerational correlation in risk-taking and trust attitude. Dohmen et al. (2012) estimates that intergenerational transmission in risk-taking is around 0.149 and 0.153 standard deviation for mother and father, respectively, and similar for trust attitude, 0.200 and 0.140 for mother and father separately. Our estimates indicate that increasing classroom teachers' procrastination and risk-taking attitudes by 1 standard deviation increases the students' corresponding attitudes by 0.141 and 0.120, respectively, which is of the same order of magnitude as intergenerational transmission of preferences.

5.5 Robustness Checks

5.5.1 Collaboration on Survey Responses

A potential concern regarding the results shown in Table 5.4 is that the correlations could be driven by teachers and students somehow coordinating on how to answer different questions. We provide evidence that could eliminate the threat. First, students and teachers answer the questionnaire in different place. Students are required to finish the survey just after school in their classroom, while teachers are asked to answer the survey in their offices simultaneously. Second, the correlations between preferences of teachers and students for all preferences should be shown strongly and significantly if they collaborate. Actually, we did the same exercises for all preferences included in Falk et al. (2016). These preferences consist of trust, patience, altruism, negative reciprocity, positive reciprocity, risk-taking, self-assessment of math ability and procrastination. We find that there is no evidence that a strong and significant correlations are shown in all preferences between teachers and students except for procrastination and risk attitudes. [40] It is hard to believe that they just collaborate for certain questions (i.e., questions about procrastination and risk attitudes) and do not collaborate for others.

5.5.2 Scale Use

We use the general risk measurement in the analysis above. As a robustness check, we investigate the correlations between risk attitudes of teachers and students using different risk measures. Table 5.6 shows the correlation in alternative risk attitudes. The set of controls is the same as those in our full specification, Column (3) of Table 5.4. To facilitate comparison, in Column (1) we once again report the coefficients for the general risk question. Column (2) and (3) report coefficient estimates using each of the two questions about risk attitudes, which ask about a 11-point scale self-assessment, and a hypotheti-

[40] Results of correlations between other prferences of teachers and students are available upon request.

cal lottery, respectively. As is evident from Table 5.6, the correlation of risk attitudes is significant for both contexts.

Table 5.6. Robustness to Alternative Risk Measures

	Student's willingness to take risks in the context of		
	General	Self-assessment	Hypothetical lottery
Dependent variable	(1)	(2)	(3)
Classroom teacher's risk attitude (in respective context)	0.120** (0.042)	0.098** (0.036)	0.152*** (0.029)
Observations	1017	1156	1017
R-squared	0.020	0.022	0.019

Notes: The dependent variable in Column (1) measures general willingness to take risks on a linear combination of Column (2) and (3) which are a 11-point scale self-assessment from 0 (completely unwilling to take risks) to 10 (completely willing to take risks) and a staircase hypothetical lottery, respectively. All preferences are obtained by the instruction of Falk et al.(2016), so each preference of both teachers and students has a mean of zero and standard deviation of one. The set of explanatory variables in Columns (1)-(3) is indentical to that in Column (3) of Table 5.4. Subject and school-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

Table 5.7. Specificity of the Correlation in Risk Attitudes

	Student's willingness to take risks in the context of	
	Self-assessment	Hypothetical lottery
Dependent variable	(1)	(2)
Self-assessment: Classroom teacher	0.085***	0.051
	(0.025)	(0.045)
Hypothetical lottery : Classroom teacher	0.020	0.114***
	(0.030)	(0.031)
Additional controls	YES	YES
Observations	1017	1017
R-squared	0.075	0.092

Notes: The dependent variable in Column (1) measures a 11-point scale self-assessment of willingness to take risks from 0 (completely unwilling to take risks) to 10 (completely willing to take risks) and the dependent variable in Column (2) is a staircase hypothetical lottery. We omit the general risk measure due to the multicolinearity. All preferences are obtained by the instruction of Falk et al.(2016), so each preference of both teachers and students has a mean of zero and standard deviation of one. The set of explanatory variables in Columns (1)-(2) is indentical to that in Column (3) of Table 5.4. Subject and school-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

In addition, we regress students' answers to a given risk question on teachers' responese to both risk questions simultaneously. Table 5.7 reveals that the respective estimated coefficients, which are found along the diagonal of the table, are both positive and highly sigificant. Thus, controlling for risk attitudes in all other contexts, students' in a given context are strongly and signifcantly associated with those of their teachers in that same context. Moreover, both other coeffcients off the diagonal are not signifcant; Thus, teachers' attitudes in a given context are the best predictor of a student's attitudes in that same context. It is noteworthy that students are not just similar to their teachers in terms of a general disposition towards risk-taking but are similar in an even more precise sense. Thus, attitude transmission appears to be a fine-tuned process, and students end up like the teachers even in a very detailed sense.

5.6 Heterogeneous Correlations

In the previous section, our main findings, which are reproted in Table 5.4, capture the average correlation between teacher preference on student preference. In this section, we examine whether the correlation varies accross teacher gender and age, student gender and grade and class size.

Panel A and Panel B in Table 5.8 present the results of heterogeneous correlations for procrastination and risk, respectively. Typically, we find three patterns.

First, Male teachers have a stronger tendency to transmit their preferences to their students compared with female teachers. There are two possible explanations for the differences between teacher gender. First of all, students are more likely to succumb to male teachers' authority due to the patriarchal society in China, especially in rural area of China. In addition, male teachers may play an important role of fatherhood in schools. Paquette (2004) found that men seem to encourage children to take risks, while at the same time ensuring the latter's safety and security, thus permitting children to learn to be braver in unfamiliar situations, as well as to stand up for themselves.

Second, boys are more sensitive to be influenced by their teachers. In particular, we find that boys are much more sensitive to risk attitudes than girls, which means that boys are more willing to take risk if others surrounding them are risk-lovers.

Furthermore, we do not find the evidence that there is a significant correlation between preferences of teachers and 7th graders both for procrastination and risk attitudes. The results suggest that students are randomly assigned to teachers even in terms of preferences. More importantly, the correlations are direct relationship between 8th-graders preferences and their classroom teacher preferences rather than the preference sorting in school or region level. The result also indicates that one-year interaction between classroom teachers and students may not enough to transmit the preferences from teachers to their students.

Finally, we find that students in small class are easily affected by their teachers. One possible reason is that teacher will have more interaction with students when the class size becomes smaller. The result is in line with the result in Dohmen et al. (2012), who found that intergenerational correlation decreases when the number of children increases. They argue that parents may devote less time to children when the number of children increases.

In addition to the heterogeneous correlations above, we investigate the correlations by similarity in personal characteristics. We find that younger teachers and samesex pair of classroom teachers and their students have a stronger transmission in terms of both procrastination and risk-taking.

For personal characteristics of age, one possible reason that younger teachers have a stronger transmission may be that younger teachers have smaller generation gap relative to students in middle schools. Furman and Buhrmester (1992) find that age difference may reflect adolescents' tendency to distance themselves from elders and invest more in peers who have a similar age with them. Hence, it is easier for younger teachers to transmit their preferences to students in such a close relationship.

We also examine the correlations under different gender pairs of classroom teacher and their students. As shown in Table 5.9, the transmission is stronger for same-sex pairs compared with different-sex pairs for both procrastination and risk-taking. Interaction between same-sex pairs is more frequent than that between opposite pairs. Previous studies show that female teachers tend to ask more questions, give more praise, and make fewer critical comments to girls (Gong et al., 2018). Similar results in Lim and Meer (2017) also argue that female students report that their female teachers are more likely to encourage them and to give them an equal opportunity to express themselves. Hence, these significant interaction between same sex of teachers and students leads to a stronger transmission strength in preferences.

Table 5.8. Heterogeneous Correlations Between Students' and Classroom Teachers' Preferences

	Panel A									
	Student's procrastination tendency									
	Teacher gender		Class size		Student gender		Student grade		Teacher age	
	Male	Female	>=43	<43	Male	Female	7th grader	8th grader	>=42	<42
Dependent variable Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Classroom teacher's procrastination	0.270***	0.140**	0.098	0.209***	0.176***	0.149*	0.009	0.190**	0.067	0.261***
	(0.081)	(0.050)	(0.068)	(0.061)	(0.057)	(0.062)	(0.097)	(0.073)	(0.051)	(0.055)
Observations	528	545	574	499	621	452	484	589	508	565
R-squared	0.064	0.033	0.021	0.079	0.031	0.084	0.027	0.103	0.018	0.067
	Panel B									
	Student's willingness to take risks									
	Teacher gender		Class size		Student gender		Student grade		Teacher age	
	Male	Female	>=43	<43	Male	Female	7th grader	8th grader	>=42	<42
Dependent variable Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Classroom teacher's risk	0.124**	0.106*	0.099*	0.194*	0.164*	0.080	0.081	0.218**	0.083*	0.156**
	(0.055)	(0.059)	(0.059)	(0.082)	(0.067)	(0.077)	(0.073)	(0.079)	(0.051)	(0.060)
Observations	428	589	554	463	558	459	483	534	496	521
R-squared	0.029	0.050	0.034	0.020	0.029	0.024	0.037	0.048	0.032	0.026

Notes: The dependent variable and the main explanatory variable in Panel A measure tendency to postpone tasks for student and classroom teacher, respenctively. All procrastination variables are standardized on the full sample. The dependent variable and the main explanatory variable in Panel B measure willingness to take risks for student and classroom teacher, respenctively (general risk measure). All risk variables are standardized on the full sample. The set of explanatory variables in Panels A and B is identical to that in Column (3) of Table 5.4. School-by-grade fixed effects are included in all regressions except in the regression of different grades. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

Table 5.9. Heterogeneous Correlations for Different Gender Pairs of Classroom Teacher and Students

	Panel A			
Dependent variable	Student's procrastination tendency			
Sample	Male Teacher Male Student	Male Teacher Female Student	Female Teacher Male Student	Female Teacher Female Student
	(1)	(2)	(3)	(4)
Classroom teacher's procrastination	0.308***	0.123*	0.020	0.195*
	(0.105)	(0.072)	(0.065)	(0.096)
Observations	325	407	448	432
R-squared	0.038	0.029	0.021	0.031
	Panel B			
Dependent variable	Student's willingness to take risks			
Sample	Male Teacher Male Student	Male Teacher Female Student	Female Teacher Male Student	Female Teacher Female Student
	(1)	(2)	(3)	(4)
Classroom teacher's risk	0.199*	0.065	0.100*	0.122*
	(0.060)	(0.052)	(0.058)	(0.063)
Observations	374	383	543	423
R-squared	0.035	0.025	0.028	0.030

Notes: The dependent variable and the main explanatory variable in Panel A measure tendency to postpone tasks for student and classroom teacher, respenctively. All procrastination variables are standardized on the full sample. The dependent variable and the main explanatory variable in Panel B measure willingness to take risks for student and classroom teacher, respectively (general risk measure). All risk variables are standardized on the full sample. The set of explanatory variables in Panels A and B is identical to that in Column (3) of Table 5.4. School-by-grade fixed effects are included in all regressions. Standard errors are clustered at the school-by-grade level. ***significant at the 1% level, **5% level, *10% level.

5.7 Conclusion

This paper provides empirical evidence on the preference transmission outside the family from teacher to student. We find a strong and significant correlation in procrasination and risk-taking between classroom teachers and their students using the random assignment of students to teachers in middle school classes in China. The correlations of preferences between teachers and students are robust to include the similarity in personal characteristics, additional controls including parental education years, and other preferences. We also eliminate the concerns that the correlations are driven by the collaboration on survey responses of teachers and students and scale use. All results suggest that the correlations we get are a direct relationship of preferences between teachers and students. The results provides an empirical underpinning for the attitude transmission approach and helps open the black box of where fundamental economic attitudes come from. More importantly, these results provide a new dimension to understand the mechanism behind teacher effects given that students' preferences are associated with their various outcomes.

Chapter 6

Conclusion

This dissertation shed light on teacher effects on students' outcomes. I considered pastoral and managerial role, preferences of teachers, and preferences of students, to investigate how teachers impact on various students' outcomes. I found that teachers have impacts not only on students' academic outcomes through behaviors and preferences of teachers but also on students' preference formation.

My study has a number of implications for educators and policy makers. First, our findings provide useful information for policy makers who seek to balance the comprehensive growth of students. There is a trade-off between the ex-ante and ex-post perspectives in equality based on the findings in chapter 3. Under the current regulations, ex-ante equality is guaranteed by the randomization class assignment. However, as an alternative policy to enhance the ex-post equality, schools could assign students who are weaker in one specific subject to the corresponding subject classroom teacher's class.

Second, our results provide insights for teachers regarding the differential impact of teacher behaviors. In the context of exam-oriented education in China, teachers may pay much attention to teaching behavior in the classroom, such as questioning, praising, and criticizing students, as well as caring for or managing a class. However, we find that teacher behaviors outside the classroom play a more important role than the behaviors inside the classroom in terms of improving the students' academic outcomes. In particular, beyond teaching or giving lectures, teachers can also communicate with students to get more information of students. Policy makers can provide some teaching trainning programs which are focus on the teachers' actions both inside and outside the class.

Third, teachers' preferences may serve as a predictor of teacher quality. In China, teachers' educational backgrounds are basically the same because the substantial increase in the level of education recently. Thus, it is difficult to identify good teachers in the process of recruitment. Based on my finding, teachers' preferences could serve as a predictor of teachers' performance. It is helpful to measure the teachers' preferences when they are being recruited.

There are two possible topics to research as furture studies. First, examining the teacher effects on students' non-cognitive ability is obvious candidate given that human capital is not captured by test scores alone. Second, investigating the teacher effects on students' long-term outcomes is also important based on the finding that teachers have impact on students' preference formation which is associated with long-term outcomes of students. Overall, studying these topics is necessary to understand a whole picture of teacher effects.

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Appendix

Table 1A. Student Survey

Dear all students, there is NO RIGHT OR WRONG for your filling answers and the answers will NOT be used as a basis for judging your academic performance. We solemnly promise that we do NOT leak your information or answers to anyone. Please fill your answers according to your real thought. Thank you for your cooperation.

1. Your school : ______ Grade :______ Class :______Student ID :_______

Gender :_______ Age :______ Only child or not :_____

Your parents' education year : Father_________Mother______

Which subject does your classroom teacher teach?

____

2. Do you agree the following statements of each subject?

	Always ask me question in class	Always praise me in class	Always criticize me in class
Math Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Srongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
Chinese Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
English Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
Physics Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
Histroy Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
Geography Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree
Biology Teacher	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree	□Strongly disagree □Disagree □Agree □Strongly agree

3. Do you agree the following statements of each subject?

	Strongly disagree	Disagree	Agree	Strongly agree
Math is useful for my future.	□	□	□	□
Chinese is useful for my future.	□	□	□	□
English is useful for my future.	□	□	□	□
Physics is useful for my future.	□	□	□	□
Histroy is useful for my future.	□	□	□	□
Geography is useful for my future.	□	□	□	□
Biology is useful for my future.	□	□	□	□

4. Do you agree the following statements of each subject?

	Strongly disagree	Disagree	Agree	Strongly agree
Math teacher cares my daily life and manages the class well.	☐	☐	☐	☐
Chinese teacher cares my daily life and manages the class well.	☐	☐	☐	☐
English teacher cares my daily life and manages the class well.	☐	☐	☐	☐
Physics teacher cares my daily life and manages the class well.	☐	☐	☐	☐
Histroy teacher cares my daily life and manages the class well.	☐	☐	☐	☐
Geography teacher cares my daily life and manages the class well.	☐	☐	☐	☐
Biology teacher cares my daily life and manages the class well.	☐	☐	☐	☐

5. Do you want to spend more time on each subject compared to other subjects?

	Strongly disagree	Disagree	Agree	Strongly agree
I am willing to spend more time on Math.	☐	☐	☐	☐
I am willing to spend more time on Chinese.	☐	☐	☐	☐
I am willing to spend more time on English.	☐	☐	☐	☐
I am willing to spend more time on Physics.	☐	☐	☐	☐
I am willing to spend more time on History.	☐	☐	☐	☐
I am willing to spend more time on Geography.	☐	☐	☐	☐
I am willing to spend more time on Biology.	☐	☐	☐	☐

6. Are you willing to obey each subject teacher compared to other subject teachers?

	Strongly disagree	Disagree	Agree	Strongly agree
I am willing to obey Math teacher's order.	☐	☐	☐	☐
I am willing to obey Chinese teacher's order.	☐	☐	☐	☐
I am willing to obey English teacher's order.	☐	☐	☐	☐
I am willing to obey Physics teacher's order.	☐	☐	☐	☐
I am willing to obey History teacher's order.	☐	☐	☐	☐
I am willing to obey Geography teacher's order.	☐	☐	☐	☐
I am willing to obey Biology teacher's order.	☐	☐	☐	☐

7. Do your teachers of each subject always communicate with you and your parents?

	Strongly disagree	Disagree	Agree	Strongly agree
Math teacher always communicates with me and my parents	☐	☐	☐	☐
Chinese teacher always communicates with me and my parents	☐	☐	☐	☐
English teacher always communicates with me or my parents	☐	☐	☐	☐
Physics teacher always communicates with me and my parents	☐	☐	☐	☐
History teacher always communicates with me and my parents	☐	☐	☐	☐
Geography teacher always communicates with me and my parents	☐	☐	☐	☐
Biology teacher always communicates with me and my parents	☐	☐	☐	☐

Table 2A. Teacher Survey

Dear all teachers, there is NO RIGHT OR WRONG for your filling answers and the answers will NOT be used as a basis for judging you and your school working. We solemnly promise that we do NOT leak your information or answers to anyone. Please fill your answers according to your real thought. Thank you for your cooperation.

1. School : _ _ _ _ _ _ _ _ _ _ _ _ _
Class(es) and Subject(s):_ _ _ _ _ _ _ _ _ _ _ _ _(Please fill all classes and subjects you teach)

2. Do you work as a classroom teacher?
□ Yes (If you choose "Yes", please tell us which class you teach as a classroom teacher_ _ _ _)
□ No

3. Gender
□Male □Female

4. Your education year:_ _ _ _ _ _ _ _

5. Your age:_ _ _ _ _ _ _

6. How many times did you take part in the open class?
□More than 5 times □4 times □3 times □2 times □ Once □None

7. Which is the highest level of your published paper?
□None□County level □Provinve level□National level