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Parents' Biased Beliefs and Competitive Investments in Education: A Field Experiment

Yixi Jiang Fei Yuan*

Abstract

Using a field experiment in China, we demonstrate that parental investment decisions are affected by their beliefs about their peers' investment levels, and that they often hold biased beliefs about these levels. When provided information about the true distribution of tutoring hours invested among their reference groups, parents in the treated group significantly adjust their investments (by over 30%) accordingly. When parents receive the common-knowledge message that the information is also available to their peers, they are 8.6% more likely to believe other parents would increase their investments. One month after the treatment, participants had increased their *actual* investment hours by 1.14 hours per week, a 51% increase relative to the average level. The effect is mostly driven by those with *low baseline* investment levels. Our findings suggest that one driver of investment in private tutoring is the fear of falling behind.

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1 Introduction

Family investment in education is a well-established contributor to human development and social mobility (Heckman and Mosso, 2014). An emerging strand of literature indicates that parents plan and adjust investments in their children's education based on their perceptions of the children's ability, academic performance, and learning trajectories (Dizon-Ross, 2019; Barrera-Osorio et al., 2020). At the same time, parents often have biased perceptions due to information frictions, such as limited information and inaccurate understanding of available information, especially in low- and middle-income settings. As a consequence, they may not make optimal educational investments.

One form of educational investment is tutoring including hiring tutors or participating in tutoring classes. In developing countries, a significant proportion of students receive tutoring after school (Jayachandran, 2014). Specifically in China, about one-third of K-12 students regularly participate in private tutoring and extracurricular activities, with a much higher proportion (80%) in economically developed areas (Wei and Lu, 2021). A primary motivation for parents to invest in these extracurricular services is to prepare their children for the increased competition for high-quality education resources (such as admission to exam-based high schools and elite colleges), since the returns are disproportionately high (Li et al., 2012; Jia and Li, 2021). In such highly competitive settings where quality education is seen as a competitive good, it is likely that when parents make decisions about educational investments, they consider other parents' investment behavior to ensure their children's relative competitiveness or to follow social norms. However, information on how much other parents invest is often not easy to obtain, so parents may have biased beliefs about others' investment behaviors. These information frictions may lead to a series of negative consequences, including inadequate investment levels, excessive anxiety for both parents and children, and increased inequality.

In this paper, we explore two research questions. First, do parents have biased beliefs about others' education investment levels? While biased beliefs have been proven to affect

people's behavior in various settings (Bursztyn and Yang, 2022), little is known about how parents think about their relative levels of educational investments. Second, are parents' decisions about educational investments affected when their biased beliefs are corrected through an information intervention experiment, which causally establishes the impact of parents' beliefs about their peers on their own educational investments?

We study these two questions in the context of parents' investments in tutoring in China, with a focus on parents with children in Grades 5 and 6 [1]. Our research consists of two phases: The first phase was a parent survey about their investment levels in tutoring and the second phase included an information intervention.

In the first phase, we examined parents' beliefs about their relative investment levels in tutoring and collected their own investment levels in tutoring. We surveyed parents of children in three cohorts (i.e. Grades 5, 6, and 7). Grade 7 is the first year of middle school and serves as a comparison group for Grade 5 and Grade 6, in terms of investment levels in tutoring. In the survey, we asked parents about how much weekly time their children spent on private tutoring in each academic subject when they were in **Grade 6**, their children's current academic performance in Grade 7, and how they (the parents) ranked their own spending relative to others' spending in the same cohort.

Next, we conducted an information intervention to test whether parents' investment behaviors would be affected by their beliefs about peers' investment levels. We delivered information about the actual distribution of the tutoring investment levels of a previous cohort (i.e., Grade 7) when they were in Grade 6 to a randomly selected group of parents (the Treatment Group) in the Grade 5 and Grade 6 cohorts. Parents in the treatment group were given the option to learn one piece of information about the group they cared about the most (i.e., either information from the top 20% students or information from the cohort average), which ensured that they received the most relevant information. Parents in the

[1] When Chinese students transition from elementary school to middle school at the end of Grade 6, they usually face increased academic pressure. As a result, parents at this stage often become more mindful about their investments in tutoring services.

control group received no information.

To measure the treatment effect of this information intervention, we collected outcomes on: 1) parents' beliefs about their peers' investment levels in private tutoring (both before and after the treatment), 2) their *planned* investment in private tutoring, and 3) their *actual* investment behavior one month after the intervention. To add more insight into the impact of parents' beliefs about their peers' investment levels, we included an additional "Common Knowledge (CK)" treatment arm within the treatment group. Parents in the Treatment - CK group received the same set of information as parents in the Treat - NoCK group, except for an additional message confirming common knowledge. Specifically, parents in the Treatment - CK group were told that the information was shared with all parents in the same cohort. We expected this message to nudge them to think about how parents in the same cohort would react to this information, which might further affect their own investment behavior.

Using baseline belief data from both phases, we find that parents have inaccurate beliefs about their peers' investment levels. They hold biased beliefs about the weekly hours their children spend on tutoring in math and English, relative to other children in the same cohort. This is consistent across all three cohorts that we collect data on. Parents in the younger two cohorts (i.e. the sample of the experiment) tend to underestimate the relative time other students in their reference group spent on tutoring by 0.29 hours (or 0.22 standard deviations) in math and 0.20 hours (or 0.14 standard deviations) in English. They mistakenly believed they had relatively higher investment levels than the group average. [2] By contrast, parents in the oldest cohort (Grade 7) overestimated the average tutoring hours of other students. In addition, their anxiety levels about their children's education are also strongly

[2] Our study was conducted at almost the same time a national education policy - "Double Reduction" - took effect in China. This policy curbed the supply of tutoring services by shutting down more than 90% of service providers and banned tutoring on weekends and holidays. The policy environment may affect parents' baseline beliefs about their peers' investments downward, that is, parents are more likely to believe that other parents had reduced tutoring hours because of the policy.

correlated with those beliefs.

Furthermore, using data from the information intervention, we find that the treated parents are significantly more likely to believe that other parents in the same cohort would increase their investments in private tutoring. Compared to the control group, parents in the Treat - NoCK group are 6.4% more likely ($p < 0.1$) to believe that other parents would increase the tutoring hours for their children, while those in the Treat - CK group are 8.5% more likely ($p < 0.05$) to believe so. In terms of the investment plans, parents in the Treat - CK group are 9.3% more likely ($p < 0.05$) to claim that they plan to increase private tutoring hours for their children. A positive but insignificant impact was found on parents in the Treat - NoCK group. However, the difference in *planned* investment hours between the two treatment groups is significant ($p = 0.04$), which indicates that Common Knowledge plays a crucial role in affecting parents' beliefs.

These findings are consistent with *actual* investment changes reported one month after the information treatment. The Treat - CK group significantly increased weekly Math tutoring hours by 0.46 hours or 0.20 standard deviations ($p < 0.05$), while the Treat - NoCK group increased Math tutoring by 0.26 hours or 0.14 standard deviations ($p < 0.1$). Although not statistically significant, we also observed an increase in weekly English tutoring hours for both treatment groups. Heterogeneity analysis shows that these effects are mostly driven by parents with baseline investment levels *below* the average investment levels who sought to catch up. Compared to the prospect of exceeding other children in tutoring hours, parents seem to be more responsive to the fear of falling behind.

Our study contributes to the understanding of how peer effects affect parents' educational investments. A large literature studies the effects of students' peers in terms of ability, academic performance, and social image (Sacerdote, 2014; Yeung and Nguyen-Hoang, 2016; Bursztyn and Jensen, 2015), but few studies examine how parents respond to peer effects in educational investments. There are some existing papers that provide evidence on how peers in social networks such as neighborhoods (Bobonis and Finan, 2009), family networks

(Angelucci et al., 2010), and local leadership (Macours and Vakis, 2014) influence schooling decisions. In education settings, Guo and Qu (2022) and Pan, Lien, and Wang (2022) study student peer effects on households' investments in shadow education. Our findings are consistent with theirs. However, to the best of our knowledge, our study is the first to examine how parents adjust their investment behaviors in response to the behaviors of their peers, using a clean identification strategy.

Furthermore, our study provides evidence on how perceptions of peers' investments affect one's own investment decisions. A growing literature has established that misperceptions about others influence one's own beliefs and behavior (Bursztyn and Yang, 2022). In the field of education, parents often hold misperceptions about their children's ability Ashraf et al. (2020), academic performance Dizon-Ross (2019); Kinsler and Pavan (2021), and school attendance Rogers and Feller (2018); Robinson et al. (2018), which undermines the quality of their related educational decisions. Our paper contributes to this literature by demonstrating that parents also have biased beliefs about their peers' educational investment levels - an important determinant of their own investment decisions - that might lead them to make suboptimal investment decisions.

The rest of the paper proceeds as follows. Section 2 outlines the empirical framework. Section 3 discusses the background and policy context. Section 4 describes the experimental design and data. Section 5 presents the empirical results. Finally, Section 6 concludes.

2 Empirical Framework

In this section, we first present a simple model that captures how parents make investment decisions based on their beliefs about others' investments. We then discuss empirical predictions derived from the model.

2.1 Model Setup

The Problem Consider a parent i who wants to invest in private tutoring for her child. She needs to choose the amount of time (t_i) spent on each subject to maximize total utility $U(t_i)$, where

$$U(t_i) = \underbrace{-t_i}_{\text{Investment Cost}} + \underbrace{\sqrt{t_i + [t_i - E_i(t|g)]}}_{\text{Investment Gain}} \tag{1}$$

Investment is costly, with $C(t_i) = t_i$ representing the opportunity cost of taking private tutoring. The utility gains $t_i + [t_i - E_i(t|g)]$ are from two channels. First, they come from the absolute level of investment (t_i), which directly contributes to the accumulation of human capital (Becker, 1964). For our analysis, we assume the effectiveness of private tutoring is the same across providers and for every student. Time is the only determinant of the utility gain, but we assume there is a diminishing marginal return. Secondly, utility gains can arise from the relative investment level compared to others in a reference group (here, other parents) because of the competition effect. A key assumption in our model is that parents consider investment in private tutoring a competitive good, which will be tested in the data later. Thus, the relative investment level $[t_i - E_i(t|g)]$ also enters the utility function, where $E_i(t|g)$ denotes the average investment level t of other parents in the parent (i)'s reference group g. [3]

A parent chooses t_i to maximize utility:

$$t^* = \underset{t}{\operatorname{argmax}}\, U(t_i) \tag{2}$$

[3] Parents may use different reference groups when they make investment decisions, depending on factors like their perceived competitors or aspiration level. Our early exploratory work suggests that parents' reference groups include high-performing students in the same school, average students in the same school, average students in the same city, etc. Later in the experiment, we provide parents with details about their reference groups, to ensure that they obtain the most relevant information.

After taking the derivative, we get:

$$t_i^* = \frac{1}{2}E_i(t|g) + \frac{1}{2} \tag{3}$$

Assume that in period 0, a parent does not know the true value of the average investment level $E_i(t|g)$ in her reference group g. She has some beliefs about $E_i(t|g)$ based on private information, here obtained from interactions with other parents, but she could not get that information from every parent in the group. Therefore, she chooses t_{i0}^* based on $(t|g)^{b_{i0}}$.

In period 1, when accurate information about $E_i(t|g)$ is provided, she forms a new expectation $(t|g)^{b_{i1}}$, and chooses a new investment level t_{i1}^*. $(t|g)^{b_{i1}}$ might also be affected by her beliefs about others' investment behaviors, which we discuss below.

Change in Investment We are interested in how parents change their investment behaviors based on their updated beliefs, which is the difference between t_{i1}^* and t_{i0}^*. Using equation (3), we get

$$t_{i1}^* - t_{i0}^* = \frac{1}{2}[(t|g)^{b_{i1}} - (t|g)^{b_{i0}}] \tag{4}$$

Common Knowledge (CK) To explore the competitive nature of tutoring investment, we discuss a Common Knowledge (CK) scenario in our model. In the CK treatment arm, in addition to providing information on the true distribution of investment levels of the selected reference group, we emphasize the public nature of the information. Although we did not encourage parents to think about how other parents would behave after receiving the information and the potential equilibrium effects, some parents might consider those impacts and adjust their behavior accordingly. [4]

The direction of treatment effects from the CK arm is unclear ex ante. Depending on the same utility function, even if a parent had the true belief in period 0, she might still increase her investment level if she believes the new equilibrium investment level would be higher as other parents might increase their investment after receiving the information. Our

[4] To be specific, we randomly tell a subset of parents that the information has been shared with other parents as well.

model provides one possible approach to Common Knowledge.

When a parent forms new expectations about $E_i(t|g)$, she takes both previous information and new information into consideration. In particular, $(t|g)^{b_{i1}}$ is a weighted average of the private information about $E_i(t|g)^{b_{i0}}$ in period 0 and the new information about $E_i(t|g)$ received in period 1:

$$(t|g)^{b_{i1}} = wE_i(t|g) + (1-w)(t|g)^{b_{i0}} \tag{5}$$

For simplicity, we assume w only takes two values, with $0 < w^{NoCK} < w^{CK} < 1$. That is, when there is no common knowledge, parents think that only a subset of their peers will invest at $E_i(t|g)$, considering the information as private knowledge. However, with common knowledge, parents believe more parents will invest at $E_i(t|g)$, so they put more weight on $E_i(t|g)$.

Using our experimental data, we can detect whether parents have accurate beliefs about $E_i(t|g)$ and how changes in $(t|g)^b$ affect their investment behaviors.

2.2 Model Predictions

1. For parents with a *low baseline* investment level due to low $(t|g)^{b_{i0}}$, that is, those with $(t|g)^{b_{i0}} < E_i(t|g)$, we always have $(t|g)^{b_{i1}} > (t|g)^{b_{i0}}$. Hence, we should expect to see:

   - $t^*_{i1} > t^*_{i0}$: those parents will increase their investment levels.
   - t^*_{i1} **increases under CK**: CK will make those parents invest even more, because of a higher $(t|g)^{b_{i1}}$

   Intuitively, for parents with a *low baseline* investment level, partly because of the fear of falling behind, their marginal return from increasing investments exceeds their marginal cost. Moreover, CK exacerbates the left-behind feeling. Hence, they will react by increasing their investment levels.

2. For parents with a *high baseline* investment level due to high $(t|g)^{b_{i0}}$, that is, those

with $(t|g)^{b_{i0}} > E_i(t|g)$, we always have $(t|g)^{b_{i1}} < (t|g)^{b_{i0}}$. Hence, we should expect to see:

- $t^*_{i1} < t^H$: those parents will decrease their investment levels.
- t^*_{i1} **decreases under CK**: CK will make those parents invest less.

Intuitively, for parents with a *high baseline* investment level, their marginal cost from increasing investments exceeds their marginal return. Therefore, they would cut back on investments until $MC = MR$. In addition, from the model setup, $(t|g)^{b_{i1}}$ **decreases** under CK for parents with a *high baseline* investment level. That is, CK drives down their reference points. Therefore, for the same investment level t, their marginal return will decrease when there is CK, which should reduce their investment level.

3 Background and Policy Context

3.1 Background

The Chinese education system consists of five levels: pre-primary, primary, lower secondary, upper secondary, and post-secondary education. The compulsory education cycle includes nine years of elementary (pre-primary and primary) and lower secondary education. Progression to upper secondary education involves a competitive selection exam, which determines whether students go to regular high schools with an academic focus or attend vocational high schools instead. It is also considered the first screening for access to selective colleges, as only the regular high schools cover the subjects on the nationwide college entrance exam. Students from vocational high schools can also take this exam, but their relatively weak academic preparation puts them at a disadvantage in accessing selective colleges.

Thus, the upper secondary school entrance exam ("Zhongkao" in Chinese) is the first trajectory-changing exam in Chinese students' educational experience. The exam is held at the city level and each city determines the proportion of students going to regular or

vocational high schools. Many families start preparing for the Zhongkao in elementary school by sending their children to good elementary and middle schools and by investing in private tutoring services to improve the children's academic competitiveness.

We conducted our study in an eastern coastal city in China with a per capita GDP of approximately $22,000 in 2021 (Bureau of Statistics of China, 2022). The city has one of the most selective Zhongkao exam rates, with only 45% students admitted to regular high schools in 2022. Partially because of the low admission rate, parents in the region commonly invest heavily in private tutoring services. In our early exploratory work, 80% of parents suggested that their children had participated in private tutoring and that expenditures on those services reached 20% of total household income. Two-thirds of parents also reported experiencing anxiety about their children's education.

3.2 Policy Context

In the summer of 2021, the State Council of China published a number of regulations, known as the "Double Reduction" (Shuangjian) policy, to curb the rapid growth of private tutoring services and reduce the academic burden on families. The regulations require local governments to scrutinize the qualifications of private tutoring entities and immediately close tutoring businesses without appropriate qualifications. By the end of 2021, about 90% of private tutoring services, both online and in-person, were shut down nationwide. At the same time, the policy also requested private tutors not to work on weekends or holidays, instead encouraging schools to provide after-school services. It also established a price ceiling for private tutoring services. For example, in our study site, the average hourly rate for private tutoring services was $20-25. After the policy took effect, the ceiling price dropped to $7-8.

The policy has two direct impacts on our study. First, the policy cut the supply of private tutoring services significantly, likely influencing consumer behavior— in this case, families' consumption of private tutoring services. Second, it also shifts parents' beliefs about others' investment levels. With the curbed supply and the promotion of "Double

Reduction" through public media and schools, parents are likely to believe that most families have stopped investing in private tutoring or that they should not participate in private tutoring services. We discuss these impacts in detail in the results section.

4 Experimental Design and Data

Our experiment provides parents with information on the private tutoring investments of other parents and measures the effects on their investment behavior. To deliver that information, we first need to construct a distribution of investment levels from the previous cohort of parents using a representative sample, and then provide the relevant information to parents in the current cohort.

Thus, the experiment consists of two stages. In the first phase (Parent Survey), we survey parents in cohort$_t$ about their investments in private tutoring, establishing Cohort$_t$ as a comparison group for later cohorts. In the second phase (Information Intervention), we randomly provide the information obtained from the first phase to a subset of parents in Cohort$_{t+1}$ and Cohort$_{t+2}$, and measure the effects on their planned investment behavior. Finally, one month after the information intervention, in a follow-up endline survey, we survey parents in Cohort$_{t+1}$ and Cohort$_{t+2}$ again, to measure changes in their actual investment behavior.

4.1 Study Sample

We collaborate with a local private education group to implement our experiment. The group has five K-9 school campuses and four of them are included in our study. Their middle school classes (Grades 7-9) are highly sought after by parents because of the outstanding student performance on the "Zhongkao" exam. The annual tuition fee is between $4,000-6,000 depending on the class and campus, and the majority of students come from middle-class families.

Our study sample is drawn from parents of children in Grades 5 - 7. We focus on this population because students usually make the transition from elementary school to middle school at the end of grade 6. In elementary school, students are not evaluated by standardized tests. However, starting in Grade 7, the upcoming Zhongkao exam drives more emphasis on academic performance and competition. Parents tend to reevaluate and adjust their educational investments around this time, which creates an opportunity for our intervention.

4.2 First Phase: Parent Survey

In January 2022, we invited all parents of Grade 7 students (i.e., Cohort_{2023}) to fill out an online survey about their investments in private tutoring services.[5]. The survey had two main goals. First, we wanted to learn about parents' beliefs about the educational investments of other parents. In particular, we are interested in whether they had biased beliefs about other parents' investment levels. Second, we wanted to collect data on actual educational investments from a representative sample so we could provide this information to parents in later cohorts (i.e., Cohort_{2024} and Cohort_{2025}) in our study sample.

The survey was anonymous and was conducted entirely online. It consisted of three parts. In the first part, demographic information like age, gender, occupation, and family income was gathered. We also asked for participants' educational investment (in terms of both hours spent and money spent) in private tutoring [6] during: 1) Grade 6 and 2) the summer before Grade 7.

In the second part, we asked participants to estimate their educational investments relative to other parents. They were first asked to rank their educational investments compared

[5] For credibility reasons and to improve the parents' response rate, the survey was distributed directly through the school's administrative system. When parents logged into the system, a reminder to complete the survey was displayed. Completion of the survey was completely voluntary. The survey collection lasted two weeks. [6] We split the spending on private tutoring into four categories: Math, English, Chinese, and Non-academic (sports, arts, etc.).

to other parents: more than others, about the same, or less than others [7]. In addition, they were asked to guess what other parents spent on tutoring in terms of hours and money. After that, we asked participants whether their education choices were influenced by their peers' decisions [8].

Finally, since the survey was conducted after the end of the first midterm exams in Grade 7, we asked about their child's performance (i.e., ranking) on the midterm exam. We also asked them to rate their anxiety level related to their children's education during the past month.

4.3 Second Phase: Information Intervention

In May 2022, parents of children in Grades 5 and Grade 6 (i.e., Cohort_{2025} and Cohort_{2024}) were invited to participate in the Information Intervention experiment. The experiment took the form of an online survey that was distributed through the school's administrative system, the same platform as the Parent Survey.

4.3.1 Randomization and Treatment

The survey platform that we used randomly assigned parents into one of three treatment groups: Information treatment with common Knowledge (Treat - CK), Information treatment without common Knowledge (Treat - NoCK) and Control (No Info, No CK). [9]

Parents in both treatment groups received information about the investment levels in private tutoring for Cohort_{2023}, while parents in the Control group received no information. To ensure parents receive the most relevant information, they were first asked to choose

[7] We used two reference groups here: previous peers in Grade 6 as well as current peers in Grade 7. [8] Two questions were included here: 1) When you are choosing among various private tutoring classes, would you take other parents' choices into consideration? 2) Have you ever signed your child up for private tutoring classes simply to compete with other students? [9] We used Wenjuanxing, a Chinese online survey platform, for the experiment. It has a built-in option to randomly assign survey respondents into different groups.

which piece of information they cared the most about: 1) the average time that **the top 20% students** in Cohort_{2023} spend weekly on Math and English tutoring, or 2) the average time that **all students** in Cohort_{2023} spend weekly on Math and English tutoring.

In addition, to implement common knowledge, parents in the Treat - CK group were told that "This piece of information will be communicated to all parents of children in Grade 5 and Grade 6" [10].

4.3.2 Survey flow

Parents were first asked about their children's average time spent per week on private tutoring (i.e. Baseline Spending) [11] throughout the spring semester, as well as their estimation of relative time spent compared to peers in the same grade. After that, depending on their treatment status, parents in the two treatment groups received one set of information corresponding to their choice, while parents in the control group received no information.

After the information treatment, we collected intermediate outcomes on participants' *planned* education spending, by asking about their *planned* time allocation for private tutoring in the coming month, as well as their estimates on how much time their same-grade peers allocated. In addition, to measure participants' competitiveness level, we also collected data on their aspirations for their children's achievements and their reference groups when making education-related decisions.

One month after the information treatment, we collected endline outcomes on *actual* time allocation in private tutoring during the previous month (i.e., June 2022).

[10] To avoid deception without affecting the follow-up round, we revealed this information at the end of the follow-up survey to all parents. [11] We separately asked about spending in two categories, Math and English, since according to the first-phase survey, parents mainly invest in these two subjects.

4.3.3 Hypotheses

We are primarily interested in whether changes in beliefs about other parents' education investments affect participants' own investments in private tutoring. The policy shock in 2021 created a natural shift in parents' beliefs about their peers' investments, prompting them to invest less in the baseline. This corresponds to the *low baseline* investment case in our model.

Based on our model predictions, the information treatment should first *increase* parents' beliefs about how much time their peers invest in private tutoring, which translates to an *increase* in their planned and actual education investments. Additionally, the **Common Knowledge** treatment arm should strengthen this treatment effect. We test these hypotheses using the experiment data.

4.3.4 Outcomes

Following our hypotheses, we measure two sets of outcomes: 1) parents' own investment decisions in private tutoring, and 2) their beliefs about the time their same-grade peers invest in private tutoring. For the first set of outcomes, we collect data on *planned* investment decisions in the Information Intervention survey round, as well as data on *actual* investment decisions in the follow-up survey round.

Parents in all groups answer the same questions, with responses from the Control group serving as benchmarks that capture natural variations. If there are any differences in cross-group comparisons, they should be attributed to the information treatment.

4.4 Data

The data used in this study are from three surveys: the first-phase Parent Survey, the second-phase Information Intervention Survey, and a follow-up survey of the second-phase participants.

In January 2022, parents of 403 students in Grade 7 (i.e., Cohort_{2023}) were invited to fill

out the first-phase Parent Survey. Although the survey was entirely voluntary to complete, we received 287 responses (i.e. response rate = 73%). This gave us a representative sample of the cohort, which allowed us to construct summary statistics (e.g., mean and median) of actual time spent on private tutoring.

In May 2022, over 98% of parents of children in Grade 5 (i.e., Cohort_{2025}) and Grade 6 (i.e., Cohort_{2024}) participated in the Information Intervention survey round. The survey period coincided with a school closure due to a rise in COVID-19 cases in the city.[12] Hence, parents were following school announcements more closely and tended to be more active in school activities, which yielded a high participation rate in our study. One month later, we were able to track down 73% of them for the follow-up survey. [13]

5 Empirical Results

5.1 Parents' Beliefs

5.1.1 Beliefs about Peer Parents' Investment Levels

We collected data on parents' beliefs about other parents' investment levels from two groups of parents: Grade 7 and Grades 5& 6. As noted earlier, Grade 7 parents serve as a comparison group in terms of tutoring hours for the later two cohorts who were in Grades 5 and 6 when surveyed. We find that parents in both groups tend to have biased beliefs about others' investment levels. However, the direction of their beliefs relative to the actual levels is

[12] The schools in my study were closed and adopted online instruction when the survey was conducted. However, the impacts of COVID on the treatment effects are not clear. On the one hand, parents might believe online learning is less effective and would increase tutoring to make up that. On the other hand, it is hard to engaged in online tutoring as well. [13] The schools in my study were closed and adopted online instruction when the survey. Parents could invest either more or less in tutoring during online learning. On the one hand, parents might believe online learning is less effective and would increase tutoring to make up for that. On the other hand, it is harder to engage in online tutoring as well. Thus, the actual effects of COVID-19 on the treatment effects are not clear.

different.

First, we find that around 70% of students currently in Grade 7 (i.e. Cohort_{2023}) attended private tutoring for academic subjects (i.e. English, Math, or Chinese language) when they were in Grade 6, with the majority of private-tutoring hours spent on Math and English. Table 1 shows that on average, the time spent on Math each week was 1.3 hours, with a standard deviation of 1.6 hours; the average time spent on English was also 1.3 hours, with a standard deviation of 1.5 hours. The total tutoring time was 3 hours per week. By comparison, the top 20% students in terms of academic performance spent an average of 1.2 hours on Math and English each, with a standard deviation of 1.2 hours.

In addition, survey results also indicate that parents hold incorrect beliefs about other parents' education investment levels: they either explicitly say that they have no idea how much time others spend on private tutoring, or they provide guesses that are far off from the true average spending. On average, parents overestimated the investment level of other parents: they believed that the average time other students spent on tutoring per week was 3.6 hours while the actual mean was 3.1 hours.

Table 1: Tutoring hours and parents' beliefs of Grade 7 Students

		Tutoring hours per week		
	Participated	Math	English	Academic total
Cohort average	70.4%	1.26	1.32	3.07
		(1.57)	(1.54)	(3.52)
Top 20% best-performing students	67.7%	1.22	1.23	2.82
		(1.21)	(1.17)	(2.57)
Parents' beliefs about cohort average				3.58
				(3.35)

Notes: Top 20% best-performing studenst were sampled based on the test scores of the first mid-term exams in Grade 7. Standard deviations are in parentheses.

In the baseline survey administered to the parents in Grades 5& 6, we asked a similar set of questions about investments in tutoring with more details. Table 2 presents the baseline results by treatment group. On average, they invested around 1.3 hours in after-school tutoring for both Math and English. Parents believed that their own investment levels were

higher than the actual average in both subjects by approximately 0.3 hours in each subject. A similar trend is also observed in the difference between the believed and true differences in relative hours, which measures the accuracy of parents' beliefs. However, those beliefs were not accurate. The average gaps between parents' beliefs about their relative investment levels to the cohort average and the actual difference are 0.29 hours for math and 0.20 hours for English, which corresponds to 0.22 standard deviations and 0.14 standard deviations of the actual distribution of investments in tutoring.

It is worth noting that the actual average tutoring hours are almost identical between these cohorts, around 1.3 hours per week for each subject. However, parents' beliefs about their peers' investment levels are in the opposite direction. One possible explanation is related to the "Double Reductions" policy (discussed in section 3.2) which curbed the supply of tutoring services and encouraged parents not to utilize any of those services. Against this policy backdrop, many parents may believe that others have stopped investing in tutoring and that their investment levels were thus higher than others.

Nevertheless, these two sets of results suggest that parents have biased beliefs about other parents' education spending, which might affect their own education investments. Thus, as our model predicts, correcting parents' beliefs about others' education investments might lead to changes in their behavior.

5.1.2 Motivation for investing in private tutoring

In the survey of Grade 7 parents, we find additional evidence that parents take into account their peers' behavior when making educational investment decisions. When asked about whether their decisions on education spending would be affected by other parents' behavior, over two-thirds of parents claimed that their education investment decisions are mostly determined by their children's actual needs, denying that other parents' behaviors played a role. For instance, some parents mentioned that their children were lagging behind and needed extra help. However, their revealed preferences tell another story: parents' anxiety

Table 2: Tutoring hours and parents' beliefs of Grades 5&6 Students

	(1) Control Mean/SE	(2) Treat CK Mean/SE	(3) Treat No CK Mean/SE	T-test Difference (1)-(2)	(1)-(3)	(2)-(3)
Hours in Math	1.241	1.362	1.220	-0.120	0.021	0.141
	(0.078)	(0.080)	(0.080)			
Hours in English	1.480	1.446	1.311	0.034	0.170	0.135
	(0.085)	(0.081)	(0.080)			
Beliefs about relative hours in Math	0.220	0.353	0.208	-0.133	0.011	0.144
	(0.083)	(0.083)	(0.083)			
Beliefs about relative hours in English	0.328	0.432	0.178	-0.104	0.150	0.254**
	(0.079)	(0.077)	(0.079)			
Believed - true difference in relative hours in math	0.279	0.291	0.288	-0.012	-0.010	0.003
	(0.089)	(0.084)	(0.081)			
Believed - true difference in relative hours in English	0.148	0.286	0.167	-0.138	-0.019	0.119
	(0.090)	(0.087)	(0.083)			
Attrition at follow-up	0.312	0.288	0.266	0.024	0.046	0.021
	(0.028)	(0.027)	(0.028)			
N	282	278	259			

Notes: For columns 1-3, each row reports the coefficients of a covariate regressed on a series of indicator variables for each of the treatment conditions, with grade and school fixed effects. The values displayed for t-tests are the differences in the means across the groups. Standard errors are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

levels have a strong, positive relationship with their guesses about others' investments.

As Table 3 shows, when we regress both parents' own investment levels and their estimates of others' investments on their anxiety levels, only the coefficient before *Investment (Guess)* is significant, which means it has more explanatory power for the variability in anxiety levels. This suggests that parents care about other parents' education investment decisions, and that their behavior is likely to be affected by others' spending.

5.2 Information Intervention Results

5.2.1 Empirical Strategy

Our main estimating equation for the treatment effects takes the form:

$$I_{igc} = \beta_0 + \beta_1 * CK_{igc} + \beta_2 * NoCK_{igc} + \beta_{G_i} * G_i + \beta_{S_i} * S_i + \beta_{X_i} * X_i + \epsilon_{igc} \quad (6)$$

where I_{igc} represents investment related outcomes for parent i in grade g in school campus c. CK_{igc} and $NoCK_{igc}$ are indicators for treatment conditions. Grade G_i and school campus

Table 3: Association between Parents' Own Investment and Estimates of Others' Investment on Their Anxiety Levels

	(1) Anxiety Level	(2) Anxiety Level
Investment (Own)	0.107***	0.007
	(0.028)	(0.037)
Investment (Guess)		0.209***
		(0.036)
Controls	Yes	Yes
Mean	2.990	2.990
SD	1.355	1.355
IDs	287	287

Notes: Each column reports the coefficients of an ordinary least square regression of parent anxiety level about their children's education (on a scale of 1 to 5; 1 is not anxious at all and 5 is extremely anxious) on their own tutoring hours and guessed tutoring hours of others. Covariates of parental education and family income are included in the regressions. Standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

fixed effects S_i are included. Individual covariates X_i include baseline tutoring hours for math and English. We estimate β_1 and β_2 both with and without individual covariates at baseline.

Baseline variables are presented in Table 2. All the variables are balanced across treatment and control groups, with one exception: parents in the Treat - NoCK group made significantly lower estimates of others' investment hours in English, compared to parents in the Treat - CK group. To ensure this imbalance does not affect the empirical results, we run separate regressions controlling for parents' baseline beliefs and present them in the next subsections, although the results are robust to omitting this control variable.

In the follow-up survey administered one month after the information treatment, we were able to track a majority of our original samples. The overall attrition rate is about 27%, with no significant difference across the three groups.

5.2.2 Beliefs about Others' Future Investments & Own Planned Hours

The first set of outcomes of interest include (1) parents' beliefs about their peers' future investment behaviors, and (2) parents' own *planned* hours spent on private tutoring in the

coming month.

Table 4 shows the treatment effect on beliefs about others' investments and planned hours. After the information intervention, parents in both treatment groups are more likely to believe their peers will increase hours spent on private tutoring, and they are also more likely to increase their *planned* hours in private tutoring in the coming month. In particular, we observe stronger treatment effects for parents in the Treat - CK group, who are 8.6% more likely ($p < 0.05$) to believe that their peers will invest more in private tutoring. They are also 9.4% more likely ($p < 0.05$) to state that they themselves plan to increase hours spent on private tutoring in the coming month, which corresponds to a 32.5% increase relative to the average percentage of planned increases (28.8%). These effects on the own planned hours are consistent with our model predictions in section 2.2 that parents with baseline beliefs lower than the actual investment levels would update their beliefs about the actual distribution and make investment plans accordingly. In our case, parents on average underestimated the actual average investment levels at baseline. When given accurate information, they were more likely to plan to increase their investment levels.

5.2.3 Actual Investment in Tutoring Hours

To measure changes in real-life outcomes, one month after the information intervention experiment, we collected *actual* hours spent on private tutoring through a follow-up survey.

Table 5 reports the treatment effect on self-reported tutoring hours one month after the intervention. We again observe positive treatment effects for parents in both treatment groups, with a stronger treatment effect for parents in the Treat - CK group, especially for Math. Specifically, parents in the Treat - CK group increased time spent on Math tutoring by 0.46 hours ($p < 0.05$), which corresponds to an approximately 48% increase relative to the average hours spent on Math (0.96 hours). Though not statistically significant, we observe a similar positive treatment effect for hours spent on English tutoring. Finally, when we look at total tutoring hours (i.e. Math and English), parents in the Treat - CK group increased

Table 4: Effects of Information Treatment on Beliefs about Others' Investments (Increase) and Planned Hours (Increase)

	(1) Beliefs on Others	(2) Beliefs on Others	(3) Planned Hours	(4) Planned Hours
Treat CK	0.086**	0.085**	0.093**	0.088**
	(0.038)	(0.039)	(0.038)	(0.038)
Treat NoCK	0.061	0.064*	0.014	0.019
	(0.038)	(0.038)	(0.037)	(0.037)
Baseline Hours		0.002		-0.001
		(0.005)		(0.005)
CK = NoCK p-val	0.52	0.59	0.04	0.08
Controls	No	Yes	No	Yes
Mean	0.304	0.304	0.288	0.288
SD	0.460	0.460	0.453	0.453
IDs	819	819	819	819

Notes: Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (2) are binary variables indicating whether a parent believed other parents would increase the hours their children spent on private tutoring. Dependent variables in Columns (3) - (4) are binary variables indicating whether a parent planned to increase their own hours spent. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the total time spent on Math and English by 1.14 hours ($p < 0.05$), which corresponds to an approximately 51% increase relative to the average total hours spent on Math and English (2.23 hours).

Taken together, these findings show that the information treatment significantly changes parents' beliefs about their peers' investment behaviors, which then translates to changes in their own investment behaviors, as our model predicts.

5.2.4 Common Knowledge

Finally, comparing the Treat - CK group to the Treat - NoCK group gives us the treatment effect of Common Knowledge.

As both Table 4 and 5 show, we consistently see larger treatment effects for the Treat - CK group for all outcomes measured, especially for *Planned* Hours. Parents in the Treat - CK group are 7.9% more likely ($p = 0.04$) to increase their *planned* hours for private tutoring spending, compared to the Treat - NoCK group, which corresponds to an approximately 26%

Table 5: Effects of Information Treatment on Actual Tutoring Hours

	(1) Math Actual	(2) Math Actual	(3) English Actual	(4) English Actual	(5) Total Actual	(6) Total Actual
Treat CK	0.458**	0.378**	0.678	0.606	1.137**	1.031*
	(0.194)	(0.188)	(0.516)	(0.493)	(0.574)	(0.570)
Treat NoCK	0.285*	0.264*	0.120	0.128	0.405	0.314
	(0.152)	(0.158)	(0.344)	(0.329)	(0.399)	(0.391)
Belief on Others		0.199**		0.077		0.261
		(0.081)		(0.170)		(0.204)
CK = NoCK p-val	0.41	0.58	0.28	0.33	0.21	0.21
Controls	No	Yes	No	Yes	No	Yes
Mean	0.959	0.959	1.269	1.269	2.229	2.229
SD	1.876	1.876	4.670	4.670	5.273	5.273
IDs	594	594	594	594	594	594

Notes: Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (4) are actual self-reported tutoring hours spent on Math and English one month after receiving the information treatment. In Columns (5) - (6), the outcomes are the sum of actual hours spent on Math and English. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

increase relative to the average percentage of increases in planned hours in the Treat - NoCK group (30.3%). Although not statistically significant, the treatment effects of Common Knowledge for Beliefs on Others and Actual Hours are both positive. Therefore, we've seen suggestive evidence that Common Knowledge strengthens the treatment effects for all outcome variables, including Beliefs on Others and Parents' Own Investment Behaviors.

5.2.5 Heterogeneous treatment effects by baseline investment levels

Our model in Section 2 predicts different behaviors for parents with initial investment levels above and below the actual average of their reference group. That is, parents would increase the tutoring hours if they invested less than their peers because they underestimated others' investment levels, and vice versa. We test these predictions using a heterogeneous effect analysis by the baseline investment levels. We group parents into either "high baseline" or "low baseline" groups based on whether their children's initial tutoring hours are above or below the median of the whole sample. Tables 6 and 7 report the treatment effects on self-reported tutoring hours at endline for these two groups. The impacts on the beliefs about others and planned hours are presentedin Appendix Table A1 and A2.

Although the subgroup samples are underpowered, we find sizeable positive effects on

parents in the "low baseline" group, as predicted. Those parents significantly increased the tutoring hours for their children in math, English and the combined total. The impacts of the Treat CK group are 0.67 hours on math, 1.09 hours on English, and 1.82 hours on the two subjects combined, which leads to actual tutoring hours almost double the control means (Table 6). These results suggest that parents invested heavily to catch up.

We do not find any significant treatment effect on parents with high baseline investment levels (Table 7), although our model suggests that they would reduce their investment as a result of corrected beliefs. The null results could be driven by the relatively small sample size of this analysis. Alternatively, it could be harder for parents to pull out children from the tutoring services they already started within a short period of time (i.e., one month after the intervention) in practice. In that case, we might be able to observe the predicted negative effects in a longer time. Nevertheless, we do not observe an average increase in tutoring hours in this group either, which suggests that "high baseline" parents are not trying to keep an advantage in tutoring investments.

Table 6: Effects of Information Treatment on Actual Tutoring Hours, Low Baseline Hours

	(1)	(2)	(3)	(4)	(5)	(6)
	Math Actual	Math Actual	English Actual	English Actual	Total Actual	Total Actual
Treat CK	0.660**	0.564**	1.087*	0.906*	1.824**	1.589**
	(0.275)	(0.250)	(0.624)	(0.484)	(0.783)	(0.639)
Treat NoCK	0.267*	0.276	0.522	0.424	0.677*	0.601
	(0.149)	(0.169)	(0.328)	(0.338)	(0.378)	(0.380)
Belief on Others		0.191*		0.296		0.470
		(0.109)		(0.224)		(0.291)
CK = NoCK p-val	0.18	0.31	0.41	0.41	0.17	0.16
Controls	No	Yes	No	Yes	No	Yes
Mean	0.736	0.736	0.963	0.963	1.649	1.649
SD	1.901	1.901	4.315	4.315	4.888	4.888
IDs	367	367	325	325	310	310

Notes: Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (4) are actual self-reported tutoring hours spent on Math and English one month after receiving the information treatment. In Columns (5) - (6), the outcomes are the sum of actual hours spent on Math and English. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. The sample only includes parents with baseline investment levels below the median. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Effects of Information Treatment on Actual Tutoring Hours, High Baseline Hours

	(1) Math Actual	(2) Math Actual	(3) English Actual	(4) English Actual	(5) Total Actual	(6) Total Actual
Treat CK	0.072	0.085	0.265	0.078	0.365	0.189
	(0.272)	(0.268)	(0.834)	(0.746)	(0.850)	(0.714)
Treat NoCK	0.295	0.341	-0.274	0.003	0.231	0.427
	(0.311)	(0.308)	(0.621)	(0.550)	(0.716)	(0.642)
Belief on Others		0.106		-0.412		-0.067
		(0.119)		(0.353)		(0.318)
CK = NoCK p-val	0.45	0.39	0.49	0.90	0.87	0.74
Controls	No	Yes	No	Yes	No	Yes
Mean	1.320	1.320	1.639	1.639	2.861	2.861
SD	1.781	1.781	5.050	5.050	5.604	5.604
IDs	227	227	269	269	284	284

Notes: Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (4) are actual self-reported tutoring hours spent on Math and English one month after receiving the information treatment. In Columns (5) - (6), the outcomes are the sum of actual hours spent on Math and English. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. The sample only includes parents with baseline investment levels above the median. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6 Conclusion

This paper highlights an important channel that affects family decisions to invest in education: parents' beliefs about their peers' investment levels. The study consists of two phases. In the first phase (Parent Survey), using survey data from a representative sample of parents, we document the fact that Chinese parents have biased beliefs about their peers' education investments in private tutoring. Due to a policy shock ("Double Reduction" policy) in 2021, these parents are more likely to believe that most families stopped investing or greatly reduced their investments in private tutoring.

In the second phase (Information Intervention Experiment), relying on data collected from the first phase, we randomly provide the true distribution of private tutoring investment hours to a subset of parents, which corrects their beliefs about others' investment levels. Since the true summary statistics of private tutoring investment hours are higher than most parents' expectations, their beliefs about others' investment levels increase after the information intervention. As parents care more about their children's relative competitiveness, they react by increasing their investments in private tutoring. Moreover, Common Knowledge strengthens the treatment effects on Beliefs on Others and Own Investment Behaviors, due to parents' updated beliefs that more families are going to increase private tutoring spending.

Our study establishes a causal relationship between beliefs about others' education investments and one's own education investment decisions. Due to limited data availability, parents often have biased beliefs about their peers' spending on private tutoring. However, our experimental results show that once parents are provided with the true distribution of investment hours, those with *low baseline* investment levels significantly increase their private tutoring spending towards the average level. The effects are stronger when we nudge parents to think about their peers' investment decisions using a common-knowledge message, which reaffirms the importance of parents' beliefs.

In this study, we focus on correcting beliefs on investment *levels*. One area for a future extension would be to correct beliefs on investment *slopes* (i.e., returns on private-tutoring investment). In a similar information intervention round, this could be achieved by providing parents with summary statistics on education spending from both groups (average students and high-performing students). Parents could then calculate the perceived education investment returns and adjust their investment decisions.

This paper contributes to the ongoing policy discussions about how to regulate tutoring or shadow education across the globe. In many countries, especially Asian countries, demand for tutoring has driven a large private education industry that shadows public education (Heyneman, 2011). From a policy perspective, high levels of private investment in education are beneficial for human capital accumulation on one hand, but on the other hand, they increase financial burdens on households and generate inequality in the society. South Korea has made a number of attempts in the past few decades to crack down on the tutoring industry, but with minimum success due to the popular demand. China recently has adopted similar policies to cut the supply of tutoring. Our study suggests that parents' investments are partially driven by the fear of falling behind. More transparent information on the demand side could ease parents' misperceptions and anxiety, and more effectively reduce households' burdens for education.

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Appendices

Appendix A Heterogeneous Analysis

Table A1: Effects of Information Treatment on Beliefs on Others (Increase) and Planned hours (Increase), Low Baseline Hours

	(1) Belief on Others	(2) Belief on Others	(3) Planned Hours	(4) Planned Hours
Treat CK	0.182***	0.173***	0.196***	0.181***
	(0.052)	(0.053)	(0.052)	(0.053)
Treat NoCK	0.121**	0.124**	0.086*	0.088*
	(0.052)	(0.052)	(0.050)	(0.050)
Baseline Hours		-0.005		-0.009
		(0.007)		(0.006)
CK = NoCK p-val	0.30	0.42	0.05	0.10
Controls	No	Yes	No	Yes
Mean	0.304	0.304	0.290	0.290
SD	0.460	0.460	0.454	0.454
IDs	438	438	438	438

Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (2) are binary variables indicating whether a parent believed other parents would increase the hours their children spent on private tutoring. Dependent variables in Columns (3) - (4) are binary variables indicating whether a parent planned to increase their own hours spent. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. The sample only includes parents with baseline investment levels below the median. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Effects of Information Treatment on Beliefs on Others (Increase) and Planned hours (Increase), High Baseline Hours

	(1) Belief on Others	(2) Belief on Others	(3) Planned Hours	(4) Planned Hours
Treat CK	-0.021	-0.026	-0.021	-0.026
	(0.057)	(0.058)	(0.057)	(0.058)
Treat NoCK	-0.006	0.001	-0.066	-0.057
	(0.059)	(0.059)	(0.057)	(0.056)
Baseline Hours		0.025**		0.020*
		(0.010)		(0.010)
CK = NoCK p-val	0.85	0.71	0.39	0.53
Controls	No	Yes	No	Yes
Mean	0.304	0.304	0.286	0.286
SD	0.461	0.461	0.453	0.453
IDs	381	381	381	381

Each column reports the coefficients of an ordinary least squares regression. The dependent variables for Columns (1) - (2) are binary variables indicating whether a parent believed other parents would increase the hours their children spent on private tutoring. Dependent variables in Columns (3) - (4) are binary variables indicating whether a parent planned to increase their own hours spent. School and grade fixed effects are included. Controls include baseline tutoring hours in math and English. The sample only includes parents with baseline investment levels above the median. Standard errors are clustered at the individual level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.