With or without Siblings,

Sorting into Competition in Experimental Chinese Labor Market

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Abstract

We examine whether Chinese only child and child with siblings, having similar ability as well as similar risk and social preferences, differ in their selection into a competitive environment. Participants in a laboratory experiment solve a real task, first under a noncompetitive piece rate and then a competitive tournament incentive scheme. We find a significant differential sorting behavior into tournament between only child and child with siblings, even after controlling for gender, ability, risk attitude, social preference and other individual characteristics. Only child tends to underestimate her winning chances and is shy away from competition. But as only child get more confident, she will more embrace competition than her comparatively equivalent counterpart.

Key Words: Only child; Child with siblings; Competition; Self-assessment

JEL Codes: J24; D82; M12;

1. Introduction

Does the only child more like competition than child with siblings? Or more generally speaking, does the only child behave differently from the child with siblings in the labor market? This question attracts substantial attention from policy makers, researchers and even hiring managers alike. Among many countries, China, enforcing one child policy in the late 1970s, is particularly attractive. For example, a recent study by Cameron et al (2013, Science) designed an experiment in urban China and found that only child is significantly less trusting, less trustworthy, more risk-averse, more pessimistic and less conscientious than child with siblings. In particular, Cameron et al. (2013) find only child is less competitive.

This article studies whether only child and child with siblings have different preference toward competition. Due to constraints in parent's resources such as time, money, attention, discrepancy between only child and child with siblings could be in multiple dimensions. The classical model of trade-off between child quality and quantity by Becker and Lewis (1973) predicts negative relationship between childhood family size and their adulthood outcomes. Children in larger families are found to have lower levels of educational attainment and worse outcomes in terms of risky behaviors and delinquency (Steelman et al. 2002). Furthermore, according to the intra-household allocation model of Becker and Tomes (1976), parents choose to allocate more resources to the more able child so as to maximize the lifetime income of all children, holding aversion to inequality among children constant. Compared with larger family, parents of only child do not face such a resource allocation problem within the household. Therefore, labor market outcomes for only child are presumably *ceteris paribus* better than child with siblings, although the recent empirical evidence is mixed (Angrist, Lavy and Schlosser, 2010). It could be true that only child, exceeding her counterparts in performance, is more confident and then tends to compete. This could be reinforced by the fact that only child, ruled by parents who help their kids be distinguished in fierce competition, may form a habit like preference toward competition.

Siblings compete for limited resources within the household. This taste toward competition for resources may be formed since childhood and continue to adulthood. Even after holding family characteristics and child characteristics constant, growing environment and experience shape children's personality and preference in different ways. As far as preference toward competition is concerned, competition among siblings to distinguish themselves from each other is regarded to be an inevitable part of family life. As reported by Maraño (2010), 82% of Americans with siblings typically spend their early years interacting with each other far more than with outsiders, and sibling strife allows for the emergence of distinct personalities and identities. In the same tone, some people believe that only children might have lower tendency in competition because they are more vulnerable than children with siblings.

We focus on experimental Chinese labor market. The One Child Policy, unique in the world, imposes exogeneneity of only child in our study. China had limited food supply, with just 7% of world's arable land but a quarter of the world's population. Following Great Famine around 1960s, Cultural Revolution in the 1960s and sluggish agricultural production made food security problem even more severe. In 1979, the Chinese government launched One Child Policy, in order to increase life quality. The government provided both economic incentives and severe punishment to restrict female fertility and then reduce family size. A monthly subsidy (about 5 RMB Yuan in cities) was given for compliance and dismissal from work and substantial fines was enforced for noncompliance. Moreover, the One Child Policy was strictly enforced for urban residents and government employees. However, there are some exceptions: both parents work in high-risk occupations; both parents are single child themselves; minorities are allowed to have two children. Parents in rural areas are allowed to have another kid if the first baby is a girl.

There are other considerably different personalities between singletons and children from a larger family. In order to eliminate other factors that may cause only child to be over - or underrepresented in competitive jobs. To do so, we conducted a controlled laboratory experiment to examine individual choices between competitive and noncompetitive payment schemes in a nondiscriminatory environment. This environment enables us to objectively measure productivity of each type of subjects while at the same time controlling other unobserved preferences that may be correlated with competition preferences.

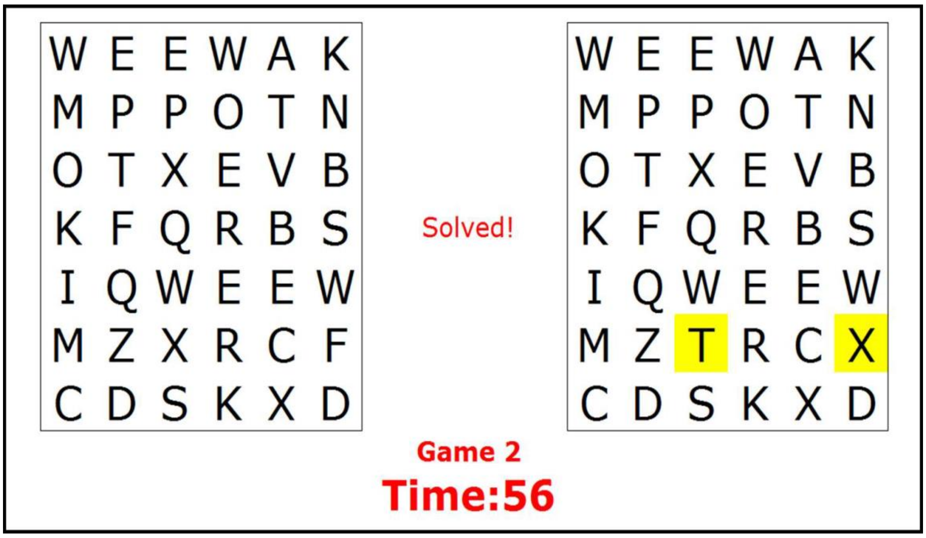
As implied by the tournament theory, individuals are more willing to sort into the competition contract if they believe they have a higher chance to win. When asymmetric information about opponent's performance exists, individuals will make choices based on their self-assessed distribution function about opponent's performance, so as they can infer to what extent they can win. We find that only child is significantly more responsive to this sorting mechanism than her counterpart. On average, only child avoids competition if perceived winning probability is less than 62% but embraces competition if winning probability rises beyond 62%. In particular, only child is willing to pay 2.2 RMB Yuan to sort into competition contract for a 10 percent increase in perceived winning probability, 1.5 Yuan more than child with siblings.

The structure of the article is as follows. We first present our experimental design. We then set up a theoretical model and propose that differential self-assessment about winning distribution may cause only child and child with siblings to make different choices over compensation schemes. Baseline regression results follows. In Section 4, we conduct a series of robustness check. We eliminate differences in risk attitude, social preference, performance in experimental tasks, ability, gender, rural urban origins, in order to examine if the choices of compensation scheme of the two types of children still differ. Finally, Section 5 concludes and discusses the results in connection to the existing literature. Future related research is also directed.

2. Experimental Design

The main idea of the experiment is to compare (different) competitive preference between only child and child with siblings while controlling their productivity and other individual characteristics. Our design thus include three parts as follows: in the first part of productivity elicitation, we elicit subjects' individual productivity levels, by solving similar real-effort tasks, in a non-competitive piece-rate pay scheme and then in a competitive tournament pay scheme. Next, in the second part of competitive preference elicitation, each subject is required to state her preference for those two types of incentive schemes. Furthermore, in order to gather more individual personality characteristics (i.e. risk attitude, social preference) and personal demographic characteristics, the third part of our experimental protocol involves two diagnostic tasks conducted prior to the main real-effort tasks and also a follow-up survey after the experiment.

The real-effort task of our experiment is to solve puzzles as many as possible in 3 minutes. Here is an example puzzle below:



The square with characters on the right differs from the square of characters on the left in two letters. Subjects had to find the two letters and click on them to solve the puzzle. Whenever they clicked a letter other than those two letters, the remaining time was deducted by 1 second. Therefore, subjects should make best efforts in identifying the two different letters and could not loaf on the job by clicking every letter. As the warming-up, each subject was given three practice examples to familiarize himself with the task, in which no payment was involved. And then, within a 3 minute period, each subject was asked to solve as many puzzles as possible. A clock on the screen informed how many seconds they had used. At the end of 3 minutes, everyone clearly knew how many puzzles she had solved and therefore was aware of her own absolute performance but not anything about the performance of others. Subjects were given a brief introduction of the whole experiment at the very beginning, so they knew that they had to complete several tasks but did not know what these tasks would look like. Just before beginning each task, subjects were informed of the rules and payment for that task. Earnings from the whole experiment would be determined by their performance in one randomly selected task, plus a show up fee of 10 Yuan. By paying only for one task, we diminish the chance that decisions in a given task may be used to hedge against outcomes in other tasks. The specific descriptions of the tasks are as follows.

In the first task, all subjects were asked to solve puzzles in 3 minutes and paid by a piece rate scheme: subjects would receive 1 Yuan for each solved puzzle. Apparently, there is an intrinsic motivation to make optimal efforts: the better a subject performs, the more she earns. Therefore, the piece rate scheme is regarded as a good proxy for subjects' productivity. The major reason why we choose the piece rate scheme as the monetary incentive used in task 1 is because individual's payment is decided by their absolute performance, which is unrelated with results from competing with others. Therefore, by treating piece rate as a benchmark incentive without competition, we will then compare it with the competitive incentive scheme later. It is worth noting that after completing the puzzle-solving task paid by piece rate scheme, each subject was asked to estimate the probability that her performance in the piece rate task was better than a randomly selected other player in the lab room[1]. This estimation will measure individual self-assessment about their relative performance in competitiveness.

In the second task, all subjects were asked to solve puzzles in another 3 minutes and paid by tournament scheme. All subjects were first randomly matched in pairs and then they competed with their matched opponent to win the prize of tournament. Each subject would only be paid if she solved more puzzles than her opponent in 3 minutes and could receive 2 Yuan for every solved puzzle. Otherwise, she would get nothing.

In the third task, before subjects started to solve puzzles in the last 3 minutes, we first elicit individual attitude towards competition by allowing subjects to self-select their preferred pay schemes from piece rate and tournament in the final puzzle-solving task. If piece rate scheme is determined as the pay scheme, the subject would receive 1 Yuan per solve puzzle in task 3. On the other hand, if someone chose tournament, she would receive 2 Yuan per solved puzzle in the last task if her performance in task 3 exceeded that of her opponent in the previous task 2, otherwise she would receive nothing in the competition. Hence, winners of the task-3 tournament are determined based on the comparison relative to opponents' task-2 rather than task-3 performance. This has several advantages: it avoids a potential source of error through biased beliefs about other participants' choices. Furthermore,

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[1] Subjects could increase their earnings by submitting a good estimate. We used a novel crossover mechanism to elicit their self-assessment about their relative performance. We presented this mechanism in a simple narrative form. We told subjects that they were paired with a "helper robot" who would also take the puzzle-solving task and who had a certain fixed probability of winning against a randomly selected player. This probability was between 0 and 100% but unknown to the subject. Subjects were told that they could have their winnings based on their robot's performance rather than their own, and asked to indicate a threshold level of above which they preferred to use the robot's performance. As a result, in order to maximize the probability of earning an extra 10 Yuan, subjects would choose the threshold equal to their own subjective probability of being better than some other player. This approach is also used in recent studies (Mobius et al. 2011).

a participant's tournament entry does not affect the payment of any other participant, so it can rule out the possibility that someone may be reluctant to compete because by winning the tournament she imposes a negative externality on others.

More importantly, an innovation in the experiment design is that we measure sorting toward competition in a continuous variable: we elicited each subject's compensating differential between piece rate and tournament. In specific, we introduced a "signup-bonus" method: the system will generate two random numbers between 0 and 10 Yuan, which are assigned to be the additional signup-bonus for piece rate and tournament scheme respectively. For everyone no matter which scheme she selected, the payment in the final task would be calculated by the performance-based payoff plus the sign-up bonus. Thus, in order to elicit compensating differential, subjects had to answer how much greater of a signup-bonus the less preferred scheme would pay to make them switch from their more preferred option. For example, if someone selected "tournament" as her first best choice and left "piece rate" as the second choice, then there was a question below: How much larger signup-bonus would the tournament pay scheme have to pay over the piece rate scheme to make you accept the less preferred incentive i.e. piece rate, rather than the tournament scheme? As a result, this signup-bonus differential gives us utility difference in terms of money.[2] In particular, if consider piece rate as the baseline option, only by simple calculation, then we can measure individual utility difference between tournament and the baseline piece rate for each participant[3].

[2] In fact, this signup-bonus design is a variant of the Becker-DeGroot-Marschak (BDM) mechanism to make subjects tell the truth when answering those valuation questions in open-ended format. According to subjects' stated rankings and compensating differentials, our experimental system applies the following rule to determine the matched scheme and sign-up bonus for each subject: it first compares two signup-bonuses of subject's preferred choice and her less preferred option. If the difference is less than the minimum of her required compensating differential, then the subject could reject the less preferred pay scheme and then retain his best choice in the last task; otherwise, the subject should give up her first best choice and switch to the second best option.

[3] Accordingly, a positive compensating differential means piece rate is preferred by the subject; a negative number means tournament is preferred; and a zero implies indifference between two pay schemes.

In 2011, the experiment was implemented at Central University of Finance and Economics (CUFE) in Beijing, China. We had 401 complete observations, including 201 only children and 200 children with siblings in our subject pool. All of individuals were university students who are seniors and gradates[4]. There are 180 males and 221 females and the average age was 23 due to high composition of post graduates among participants. Only 2% of the participants were married. Finally, the average level of GPA was 3.30 (on a 4.0 scale) with a standard deviation of 0.35. However, since subjects' grades were self-reported, we cannot guarantee the accuracy of this information and treat it as a quite limited index to personal academic performance. A total of 21 experiment sessions took place in the same computer lab at the university, and the average size of those sessions was 19.1 participants (with a standard deviation of 6.6). Each session lasted, on average about 50 minutes. Final payments for subjects were based on one randomly selected task out of all assigned tasks during the experiment, plus a fixed show-up fee of 10 Yuan. The average payment was 30.8 Yuan.

3. A Descriptive Theoretical Model and Findings

In this section, we theoretically model how self-assessment in performance might affect sorting of individuals into tournament incentive schemes and to what extent individuals with different attitude will affect this sorting differently. Following the framework by Bull et al. (1987), assume that individual maximizes utility $U(w(y), C(y))$, where $y \in [0, y_{max}]$ is the output level, measuring performance in the task, *w* denotes the payment to the individual and *C* denotes the cost function ($\frac{\partial C}{\partial y} > 0$). Conventional convexity properties hold under assumption too: $\frac{\partial U}{\partial w} > 0, \frac{\partial^2 U}{\partial w^2} < 0, \frac{\partial U}{\partial C} < 0, \frac{\partial^2 U}{\partial C^2} < 0$.

[4] CUFE has two campuses in Beijing. We conducted the experiment in the main campus which includes only seniors and graduates. Freshmen, sophomore and juniors are all in the other campus which is much further away from center of Beijing.

Under the Piece Rate (P-R, thereafter) payment scheme, individuals maximize expected utility by choosing optimal output level $\bar{y}$. According to the design of P-R contract in the first task, $\bar{w}(y) = 1 * \bar{y}$. We further denote optimal utility level in P-R task is $U(\bar{y})$.

Under the tournament payment scheme, a representative individual maximizes her expected utility $Max_y\, EU\big(w_1(y); w_2(y); F(y); C(y)\big)$ where $w_1(y) = 2 * y$ if she wins and $w_2(y) = 0$ if she loses according to the competition result. The probability that wins the high prize $w_1(y)$ depends upon her performance y, and also upon the performance distribution of the randomly matched opponent. Because of asymmetric information about opponent's performance, each subject at best is able to estimate the cumulative density function of opponent's performance so as to know to what extent she can win a tournament. Let the opponent's performance be a random variable Y, which has a CDF of$F(\cdot)$. So $F(y) = Pr(Y \leq y)$ indicates the perceived or self-assessment probability to win in the tournament. Therefore, the problem of individuals under tournament pay scheme is to

$$\max_y F(y) * U(w_1(y), C(y)) + (1 - F(y)) * U(w_2(y), C(y))$$

The optimal output level, denoted as y^*, depends on perceived performance distribution $F(\cdot)$. The maximum expected utility level in tournament is denoted as $EU(y^*) = F(y^*) \cdot U_1(y^*) + (1 - F(y^*)) \cdot U_2(y^*)$.

Next, we make a crucial assumption that only child might differ from child with siblings in the self-assessment on probability to win, *ceteris paribus*. It goes, the self-estimated likelihood function might be different between only child and child with siblings.

Suppose the cumulative density function (CDF), linear in unobserved true CDF function F^{true}, is F^1 and F^0 for only child and child with siblings respectively.

$$F^1 = \beta_1 * F^{true} + \alpha_1;$$

$$F^0 = \beta_0 * F^{true} + \alpha_0$$

If two types of subjects are not differentiated in self-assessed distributions of their potential opponents, we should have $\beta_0 = \beta_1$ and $\alpha_1 = \alpha_0$. Then we use our experimental data and plot in Figure 1 the self-assessed probability versus the true winning probability for each subject. In general, subjects of low ability tend to be overconfident, whereas subjects with high performance are more likely to underestimate their relative performance. . In particular, on average only child has a larger response to true winning distribution ($\beta_1 > \beta_0$), but she is not ubiquitously as confident as child with siblings ($\alpha_1 < \alpha_0$). Consequently, from the experimental data, we find that the majority of children with siblings, located above the 45 degree line in Figure 1, are over confident meaning they overestimate their winning probabilities. In contrast, , we find that half of only children actually have at least 60% to win but they tend to underestimate their winning probabilities.. Anyway, only child has a more accurate self-assessment on distribution function F(.) but child with siblings deviates more by being over confident. It is worth noting that our finding is different from the results in Cameron et al. (2013), which documented insignificant difference of self-confidence between Chinese only children and children with siblings.

In a tournament, subjects could alter winning chances by endogenously making more efforts so as to maximize expected utility. The level of optimal output y^* in tournament crucially depends on estimated distribution of random opponent's performance F(.). Given that only child and child with siblings differ in perceived winning chances, we expect $y^*(F^1(.)) \neq y^*(F^0(.))$. In fact, it can be shown that $y^*(F^1(.)) > y^*(F^0(.))$, derived from the finding $\beta_1 > \beta_0$ and $\alpha_1 < \alpha_0$. (See Appendix for more details about the relation between tournament performance and self-assessment!) In our experiment, we find only child excels her counterparts by 0.84 on average performance in the tournament. The difference is statistically significant at 5% level. That is, compared to child with siblings, only child makes significantly more outputs in the tournament due to the different self-assessment about the relative performance.

Given the elaborated analysis on subject's optimal behavior under different payment contracts, now we are able to address different sorting behavior between only child and child with siblings. We measure the willingness to participate in competition by "compensating differential" (*CD*, thereafter) requested by switching from P-R and tournament scheme in task 3 of our experiment to tournament scheme. To facilitate our analysis, we further assume individual utility function is quasi-linear which is linear in the argument of CD. Hence,

$$
\begin{aligned}
CD &= U(\bar{y}) - [F(y^*) \cdot U_1(y^*) + (1 - F(y^*)) \cdot U_2(y^*)] \\
&= [U(\bar{y}) - U_2(y^*)] - F(y^*) * [U_1(y^*) - U_2(y^*)]
\end{aligned}
$$

Because only child and child with sibling have different self-assessed winning probabilities, we hypothesize that their sorting into competition contract will be accordingly different.

Hypothesis 1: The sorting behavior differs between only child and child with siblings.

Because the individual decision of optimal output in the P-R pay scheme is independent with their (self-assessed) relative performance compared to others, so we theoretically predict that performances should be the same for only child and child with siblings in the P-R scheme $(\bar{y}^1 = \bar{y}^0)$. On the contrary, the level of optimal output in tournament crucially depends on individual self-assessment about their relative performance. By both theoretical proof and experimental evidence, we have verified that only children tend to make more outputs than their counterpart in the tournament because of the different self-assessed relative performance.

The variable *CD* is therefore defined as the amount of money representing the utility difference between P-R payment scheme and tournament scheme. A positive value means subjects requires more money to select tournament scheme while a negative value means subjects would like to give up some bonus and sort into tournament.

Based on our descriptive theoretical model, in a coordinate with perceived winning probability *F* on x-axis and *CD* on y-axis, we expect that only child has a steeper negative slope and also a higher interception (See Appendix for more details about the different sorting behavior between only child and child with siblings). As shown in Figure 2, the scatter plot and fitted lines are consistent with the pattern predicted from the model. Rational sorting into competition is more sensitive to their perceived probability for only child than child with siblings. At the same time, we run an OLS regression, linking perceived probability and types of players to compensation differentials. The baseline model, as shown in the first column of Table 2, clearly shows that a 10% increase in perceived winning probability will motivate individuals to sort into competition by reducing compensation differentials of 2.4 Yuan for only child but 0.9 Yuan for child with siblings. Furthermore, for subjects who have no hope to win, only child requires 8.7 Yuan more to switch to tournament pay scheme than child with siblings. However, for subjects who have 58% probability to win, there is no difference in required compensation to sort into tournament between two types. For subjects who have 75% probability to win, only child would like to pay 2.6 Yuan more out of pocket to select tournament scheme than her counterpart. Therefore, we cannot reject *Hypothesis 1*.

4. Robustness Check

Other preference and characteristics

Another apparent important driver of selecting tournament contract is a subject's attitude toward risk. Less risk-averse subjects prefer tournament scheme to piece rate scheme. If only child is more risk-averse than her counterpart and at the same time, she also tends to underestimate her relative performance compared to others, our estimates will be biased. For example, Cameron et al. (2013) have found that only child is significantly more risk-averse than child with siblings. This raises the concern of omitted variable bias or endogeneity that is caused by correlation between unobserved attributes of subjects and key variables. Similarly, other relevant characteristics like social preference, gender and social economics attributes are suspiciously correlated with both subject's sorting and self-assessment in the competition.

In the remaining three steps, we collected data by designing two prior diagnostic tasks and a follow-up survey to obtain subjects' individual characteristics (i.e. risk attitude, social preference) and personal demographic characteristics. The details of experiments of eliciting risk preference and social preference is shown in the Appendix B.

The first prior task is to elicit subjects' risk attitude using simple lottery choices. We then define a variable of risk-aversion accordingly. Moreover, we apply the second prior task to elicit subjects' social preferences with the help of a dictator game, similar to Leider et al. (2009). We therefore define a variable inequality aversion to measure preference toward fairness. As shown in Table 1, we did not find a statistically significant difference in their risk attitudes or in inequality aversion as Cameron et al. (2013) did. Only child is not more risk-averse or selfish than her counterpart. In addition, after all the tasks were finished, subjects were asked to complete a questionnaire for personal data on socioeconomic characteristics (including gender, age, marital status), on educational achievement (major fields of study, GPA, score of university-entrance examination) and feedback about this experiment experience (the clearness of the instruction, the length of the experiment, the difficulty of the tasks).

Moreover, we find there is a significant performance difference between only child and child with siblings in the P-R pay scheme. On average, only child could finish 1.9 more puzzles than child with siblings. According to the intra-household allocation model of Becker and Tomes (1976), parents choose to allocate more resources to the more able child so as to maximize the lifetime income of all children, holding aversion to inequality among children constant. Compared with larger family, parents of only child do not face such a resource allocation problem within the household. Therefore, labor market outcomes for only children are presumably *ceteris paribus* better than children with siblings. For instance, children in larger families are found to have lower levels of educational attainment (Steelman et al. 2002); and only children are verified to be more able than children with siblings at a math task (i.e. adding up five two-digit numbers) during the behavioral experiment of Cameron et al. (2013). If more able subjects are more confident in winning a tournament, they would sort into tournament contract. At the same time, if only child is more able than child with siblings, our estimates will be biased if we did not control their differences in abilities. We therefore use two measures to approximate subjects' ability, the number of puzzles finished in P-R tasks and GPA score in college.

As a consequence, in the expanded regression, we control for these characteristics of individuals and report the regression results in the second column of Table 2. Qualitatively consistent with our baseline regression results, difference in attitudes towards competition between only child and the counterpart is still significant at 5% significance level. Only child is more responsive to winning probabilities than her counterpart. In particular, a 10 percent increase in perceived winning probability will motivate individuals to sort into competition by reducing compensation differential of 2.2 Yuan for only child but 0.7 Yuan for child with siblings. At the winning probability of 62%, there is no difference in required compensation to sort into tournament between two types of kids. Beyond 62%, only child would more like to pay extra to sort into tournament.

We also find subjects with high performance in the P-R task tend to reduce compensations and more willing to select a tournament scheme. Males show a much stronger preference for competitive pay scheme than females, which is a similar finding with Niederle and Vesterlund (2007).

In addition to risk aversion and other personal characteristics, we suspect the potential systematic correlation between child type and other unobserved characteristics, in which case, there will be omitted variable bias in estimating the difference between only child and child with siblings. One possibility is embedded in the one child policy, which is unique in China. There are some minor exceptions in one child policy. For example, the policy is stricter for urban residents than for rural residents. Parents in rural areas are allowed to have another kid if the first baby is a girl. Family could have two kids and even three kids for some rare minorities. At the same time, the majority of minorities reside in rural areas. In contrast, parents living in the urban areas, especially those working in state owned enterprises, schools, hospitals, government and other private firms are not allowed to have the second kid. Violation will result in large amount of fines, loss of jobs and criticism. Therefore, such "biased" policy results in lower cost of "illegal" baby in rural areas than in urban areas. This leads to the fact that only child is more likely to live in urban areas and child with siblings is more likely to live in rural areas. In fact, the correlation between dummy variable *urban* and only child is around 0.6, a strong evidence of the favor toward minorities and rural residents in the policy. Because growing environment in rural and urban area is different too, if rural kids are more likely to compete for limited resources in rural areas than urban kids, we could observe child with siblings prefers competition.

However, we could not observe the residence for the whole sample. We only asked the participants in December of 2011[5] about their rural urban origin, which resulted in a rather limited sample of 57 observations. The regression results are reported in the last two columns of Table 2. Because of reduced sample size, the standard errors are all increased. But

[5] We conducted 14 sessions in March 2011, and then added 7 sessions in December 2011.

we can still see that the difference in marginal sorting effect of perceived winning probability between two types of kids is statistically different from zero, which is consistent with our conclusion.

Feedback Mechanism

We find only child is not sufficiently confident and tends to overestimate their random opponent's ability so that she avoids competition, even after we control for risk preference and other characteristics. This conclusion is built on a key assumption that individuals know nothing about competitor's information and therefore cannot precisely estimate winning probability in a tournament. In order to disentangle the effect of self-assessment (the initial perceived probability to win without feedback) on individual choice to competition and any other potential factors that make someone "instantly" sticks to a certain pay scheme, we introduced an exogenous feedback mechanism in our experiment. If it is purely because of innate bias toward competition but not because of the asymmetric information in selecting incentive schemes, we should observe the sorting behavior would remain the same between the two types of children even if asymmetric information was removed. In contrast, with availability of feedback information or richer information about distribution of competitors, the updated perceived probability F with feedback becomes the true probability to win in the tournament F^{true} , and it should be independent of individual initial self-assessment. By comparing the self-evaluated probability to win and released actual probability to win, individuals should adjust strategies by choosing different levels of compensating differentials if they initially had biased estimations. We propose that feedback mechanism helps reduce the gap between only child and child with siblings on their sorting behaviors in competition because released information about relative performance will correct the biased self-assessments for both types of kids.[6]

In the experiment, after the self-assessments were elicited, we randomly assigned participants into two different groups. Half subjects were given the list of all subjects' performance in the piece rate task (Task 1), and they were clear about how well they did in that task relative to other players (see the screenshot of feedback information during the experiment in the Appendix C). In contrast, another half subjects were not provided with any information about the relative performance in Task 1.

The regression results for the subjects who received feedback information on opponent's performance distribution is shown in Table 3. We find that differences of compensating differentials between only child and child with siblings are no longer statistically significant. In addition, when we control the individual performance and personalities, the regression result is qualitatively similar as the one from the baseline models. Therefore, we can conclude that one prominent reason for the gap between only child and child with siblings is that they have heterogeneous self-assessment which leads to differential sorting behaviors.

Birth order

Recent studies also find consistent evidence of birth-order differences across a wide range of children's outcomes. For instance, children who are born later tend to have worse outcomes. Moreover, Price (2008) further finds that the amount of parent-child quality time decreases as children get older, providing a plausible explanation on the birth order effect. We expect that younger kids, born to be child with siblings more love competition than their elder siblings and also more than the only child. The conclusion we have made in the above

[6] Lisa Kahn (2013, AEJ) finds asymmetric information between outside employers and incumbent employers but the differences fades out once information asymmetry is reduced.

analysis should be confirmed by studying the sorting behavior of the three groups: the only child, the first child and the younger child. Unfortunately, we lack the information about birth order. We then sent e-mails to invite our participants to finish a retrospective survey. 97 out of 401 participants returned the survey.

The regression results are presented in Panel A of Table 4. Surprisingly, there is no significant difference between only child and younger kids. However, the first kid in a larger family has a significant different behavior in sorting into competition compared to the only child. The first child tends to avoid competition even though she believes she could win with a high probability. This result may be biased due to rather limited data. However, it is consistent with the Chinese tradition that parents frequently indoctrinate to elder kids that they need to take care of their younger siblings and should render resources too. The first kid is therefore more caring and avoids competition. In fact, we do find that younger kids are significantly more selfish than their elder sisters or brothers.

Furthermore, we show that there is a significant difference in sorting behavior between the first kids and younger kids in Panel B of Table 4. This verifies that younger kids love competition more than their elder siblings. Once the feedback information is introduced, the difference disappears. Even if there are rather limited observations, we still find a consistent result that subjects with different family structures responds differently to asymmetric information and this leads to their different decisions in selecting a tournament compensation scheme.

5. Conclusion

We study how only child and child with siblings differ in their sorting into competition. We focus on Chinese labor market where there exists an unobservable but exogenous effect from One Child Policy. By designing a well-controlled laboratory experiment, we find a significant differential sorting behavior into tournament between only child and child with siblings, even after controlling for gender, ability, risk preference, social preference and other individual characteristics. Only child tends to underestimate her winning chances and is shy away from competition. But as only child gets more confident, she will more embrace competition than her comparatively equivalent counterpart.

The stereotype for only child includes lonely, selfish and risk averse. Past research offers mixed evidence on different personalities, although a trade-off between child quality and quantity is confirmed. We focus instead on their differential responds to entering competition for the two types of children. Conditional on *ceteris paribus* ability, risk attitude, social preference, we explore whether singletons and their counterparts are equally willing to self-select into a competition.

This paper contributes to a literature in several ways. First, it helps improve understanding how kids growing in different family sizes behave differently. Lucas (1988) particularly attributes the experience in shaping and driving productivity growth to explain increasing returns to human capital. Indeed, Lucas argues that "on-the-job-training or learning by doing appear to be at least as important as schooling in the formation of human capital". Extended from Lucas's central idea, it derives that family background and social economic childhood environment where a child grows will affect her preferences toward achieving human capital and selecting occupations in adulthood. This echoes the findings by sociologists and psychologists who have shown the noncognitive skills play an important role in predicting occupational attainment, wages, schooling performance and adolescents (Heckman, Stixrud, and Urzua, 2006).

Second, human resource management practices have been found increasingly used to increase firm productivity (Renee, Nicholas Bloom, John Van Reenen, 2011). Among them, competition is effectively provides incentives to increase labor productivity due to larger pay raise. Some firms or some positions within a firm naturally require competition to provide incentives for innovation and creativity. Since only child is more responsive to competition incentives, such management practices will result in separating equilibrium, efficiently sorting employees into different positions. Moreover, by the observable sorting behaviors, two types of children also send different signals to hiring managers, which could reduce screening cost to elicit their unobservable personalities.

Third, according to different self-selections into competition contracts, only child and child with siblings may have different occupations in different industries. This argument is in line with Lazear and Rosen (1992) who find that gender differences in unobservable preference toward leisure and home production drive individuals to select different occupations, and then end up with different promotion opportunities. Therefore, controlling for industries and occupations that have different levels of competition may help explain large gender wage gaps. Similarly, when comparing labor market outcomes between the two types of children, occupations and industry with different levels of competition are not longer negligible.

Fourth, this study sheds light on linking demography with income inequality evolution. Due to the intervention of Only Child Policy in the late 1970s, demographics of China, especially urban China are changing. The following implication is that only child and child with siblings may behave quiet differently in the labor market so that income inequality evolves dramatically as the composition of population has been changing over time.

Some puzzles remain that need further research. For example, if only child responds more to competition schemes than child with siblings, does this mean only child is more likely to avoid team work? Does only child regard her own type in the same way as the child with siblings in the cooperation? How will the team composition affect team productivity? To what extent does birth order and birth spacing matter in sorting into competition in particular and in other behaviors in general? These interesting topics are worthy to study in the new future.

Reference

Angrist, Joshua, Victor Lavy and Analia Schlosser. 2010. Multiple Experiments for the Causal Link between the Quantity and Quality of Children. *Journal of Labor Economics* 28(4): 773 – 824.

Becker, Gary, and Nigel Tomes. 1976. Child Endowments and the Quantity and Quality of Children. *Journal of Political Economy* 84(4):S143–62.

Black, S., Devereux, P. and Salvanes, K.. 2011. Older and Wiser? Birth Order and IQ of Young Men. *CESifo Economic Studies*, Vol. 57, 1.

Bloom, Nicholas and John Van Reenen. 2011. Human Resource Management and Productivity. Handbook of Labor Economics 4(B): 1697 – 1767.

Bull, Clive; Schotter, Andrew; and Weigelt, Keith. 1987. Tournaments and Piece Rates: An Experimental Study. *Journal of Political Economy* 95(1): 1-33.

Cameron L, Erkal N, Gangadharan L, Meng X. 2013. Little emperors: behavioral impacts of China's One-Child Policy. *Science* 22 339(6122): 953-957.

Dohmen, Thomas and Armin Falk. 2011. Performance Pay and Multidimensional Sorting: Productivity, Preferences, and Gender. *American Economic Review* 101: 556–590.

Stephen Leider, Markus M. Möbius, Tanya Rosenblat and Quoc-Anh Do. 2009. Directed Altruism and Enforced Reciprocity in Social Networks. *The Quarterly Journal of Economics* 124(4): 1815-1851.

Heckman, James, Jora Stixrud and Sergio Urzua. 2006. The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. Journal of Labor Economics 24(3): 411-482.

Holt, Charles, and Susan Laury. 2002. Risk Aversion and Incentive Effects. *American Economic Review* 92(5): 1644 – 55.

Lazear Edward and Sherwin Rosen. 1990. Male-Female Wage Differentials in Job Ladders. *Journal of Labor Economics* 8(1): 106-123.

Kahn, Lisa. 2013. Asymmetric Information between Employers. *American Economic Journal: Applied Economics*.

Maraño, Hara Estroff. 2010. “Oh, Brother”. *Psychology Today* July/August 2010.

Mobius, Markus, Muriel Niederle, Paul Niehaus and Tanya Rosenblat. 2011. Managing Self-Confidence: Theory and Experimental Evidence. *Working Paper*. Niederle, Muriel and Lise Vesterlund. 2007. Do women shy away from competition? Do men compete too much? *The Quarterly Journal of Economics* 122(30): 1067 – 1101.

Price, Joseph. 2008. Parent-Child Quality Time, Does Birth Order Matter? *The Journal of Human Resources* XLIII: 240-265.

Price, Joseph. 2008. Gender differences in the Response to Competition. *Industrial and Labor Relations Review* 61(3): 320 – 333.

Sandler, Lauren. 2013. One and Only: the Freedom of Having an Only Child, and the Joy of Being One. Simon and Schuster. New York.

Steelman, Lala, Brian Powell, Regina Werum, and Scott Carter. 2002. ‘‘Reconsidering the Effects of Sibling Configuration: Recent Advances and Challenges.’’ *Annual Review of Sociology* 28(1):243–69.

Table 1 Summary statistics for only child and child with siblings

	Child with sibling		Only Child			
	Mean	St Dev	Mean	St Dev	Difference	p-value
Task_Piecerate (Performance in Piece rate)	11.64	2.62	13.54	2.82	1.90***	0.0002
Performance in Tournament	12.62	2.57	13.72	2.83	1.10**	0.03
Perceive (Self-assessment of relative performance)	58.86	18.5	59.2	19.29	0.34	0.92
True relative performance	37.04	29.14	53.6	29.89	16.56***	0.003
Compensating Differential	2.78	10.66	1.08	11.18	-1.70	0.40
Female	0.6	0.49	0.64	0.48	0.04	0.69
Risk Aversion	67.76	16.33	64.26	13.35	-3.50	0.20
Inequality aversion	0.57	0.50	0.51	0.50	-0.06	0.51
GPA score (on a 4.0 scale)	3.3	0.33	3.35	0.36	0.05	0.42
Age	23.28	2.37	22.13	1.89	-1.15***	0.005
Married	0.03	0.18	0.02	0.13	-0.01	0.53
Number of observations		200		201		

*** p<0.01, ** p<0.05, * p<0.1

Table 2 Regression results of sorting into tournament

Dependent variable: CD	Baseline	Expanded	Expanded +	Expanded
Only Child	8.683*	9.871**	21.356*	20.173*
	(4.824)	(4.856)	(11.040)	(10.544)
Perceive	-0.0912*	-0.0674	0.046	0.040
	(0.0539)	(0.0557)	(0.126)	(0.123)
*Perceive*Only Child*	-0.151**	-0.159**	-0.364	-0.356
	(0.0747)	(0.0756)	(0.166)**	(0.163)**
Task_piecerate		-0.549*	0.061	0.029
		(0.326)	(0.586)	(0.576)
Improve_c		-0.449	-1.113*	-1.159
		(0.289)	(0.584)	(0.567)**
Female		2.582*	2.055	1.854
		(1.477)	(2.511)	(2.439)
Risk Aversion		0.0938**	0.180	0.185
		(0.0445)	(0.087)**	(0.086)**
GPA Score		-4.150**	-0.445	-0.071
		(1.964)	(3.799)	(3.651)
Urban			-1.390	
			(3.469)	
Constant	7.831**	19.20**	-11.840	-13.024
	(3.393)	(7.587)	(14.572)	(14.145)
Observations	201	201	57	57
R-squared	0.115	0.170	0.37	0.36

*** p<0.01, ** p<0.05, * p<0.1

Table 3 Regression results of sorting into tournament with feedback on winning probabilities

Dependent Variable: CD	Baseline	Expanded
Only Child	0.911	0.968
	(2.55)	(2.52)
Perceive	-0.108***	-0.0922*
	(0.03)	(0.05)
*Perceive*Only Child*	-0.0493	-0.0371
	(0.05)	(0.05)
Task_piecerate		-0.547
		(0.58)
Improve_c		-0.544*
		(0.30)
Female		2.429
		(1.49)
Risk Aversion		0.124**
		(0.05)
GPA Score		-5.110**
		(2.18)
Constant	9.415***	22.74**
	(1.60)	(9.08)
Observations	200	200
R-squared	0.147	0.221

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

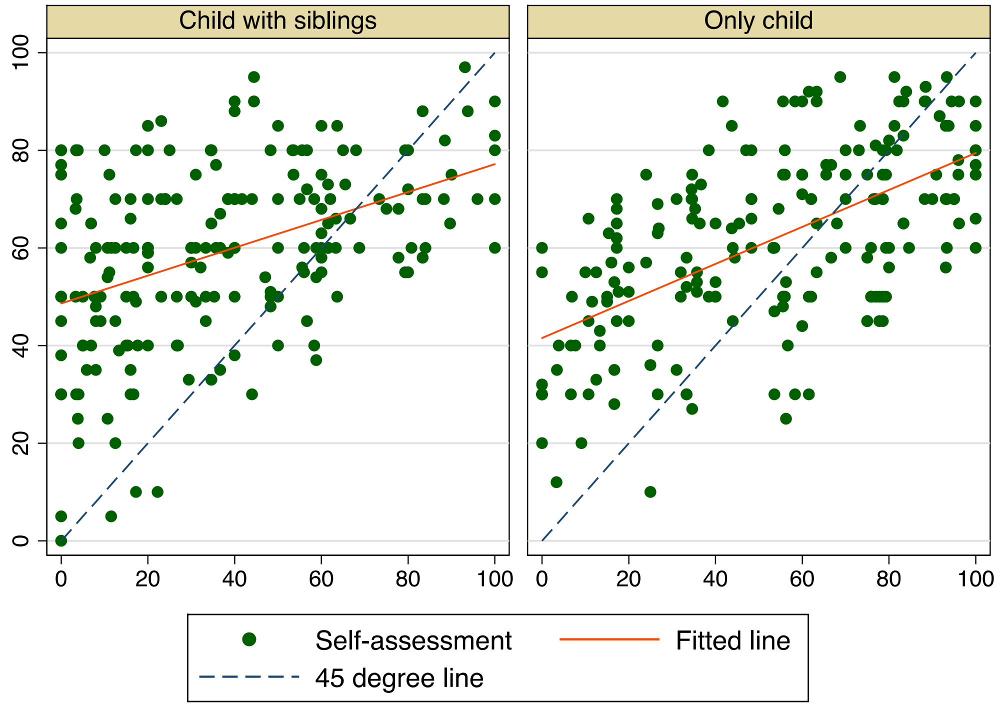
Table 4 Multiple child type and sorting behaviors

Panel A	Without Feedback		With Feedback	
Variables	coefficient	t-value	coefficient	t-value
Perceive	-0.26	-5.04***	-0.16	-4.39***
First Child	-26.94	-2.17**	-4.09	-0.95
Younger Child	-2.03	-0.13	0.16	0.04
*First Child * Perceive*	0.50	2.48**	0.06	0.74
*Younger Child * Perceive*	0.05	0.22	-0.10	-1.13
GPA	-4.03	-1.66*	-4.58	-1.83*
_cons	30.92	3.33***	25.35	3.00***
Observations	130		129	
R^2	0.20		0.22	

Panel B		
Perceive	0.25	1.52
Younger Kid	23.34	1.42
*Younger Kid * Perceive*	-0.43	-1.74*
Task_piecerate	1.53	1.89*
_cons	-29.03	-2.06**
Observations	23	
R^2	0.32	

Note: Dependant variable is compensation differentials (CD) . *First Child* and *Younger Child* are dummy variables with only child as the base. Variables that are not significant are not reported due to limited degree of freedom. *Younger Kid* is a dummy variable, equal to one if the subject is a younger kid, 0 if she is the eldest kid. This is the variable only for children with siblings. *** p<0.01, ** p<0.05, * p<0.1

Figure 1 Relationship between self-assessment distribution and true distribution by child types



Note: Regression results are shown below.

$$F_{self-assess} = \underset{(1.885)}{48.62} - \underset{(2.980)}{7.056}\, Only + \underset{(0.0406)}{0.285}\, F_{True} + \underset{(0.0557)}{0.094}\, F_{True} * Only\ Child, \quad R^2 = 0.275$$

Standard errors in parentheses.

Figure 2 Relationship between compensation differentials and estimated winning probability

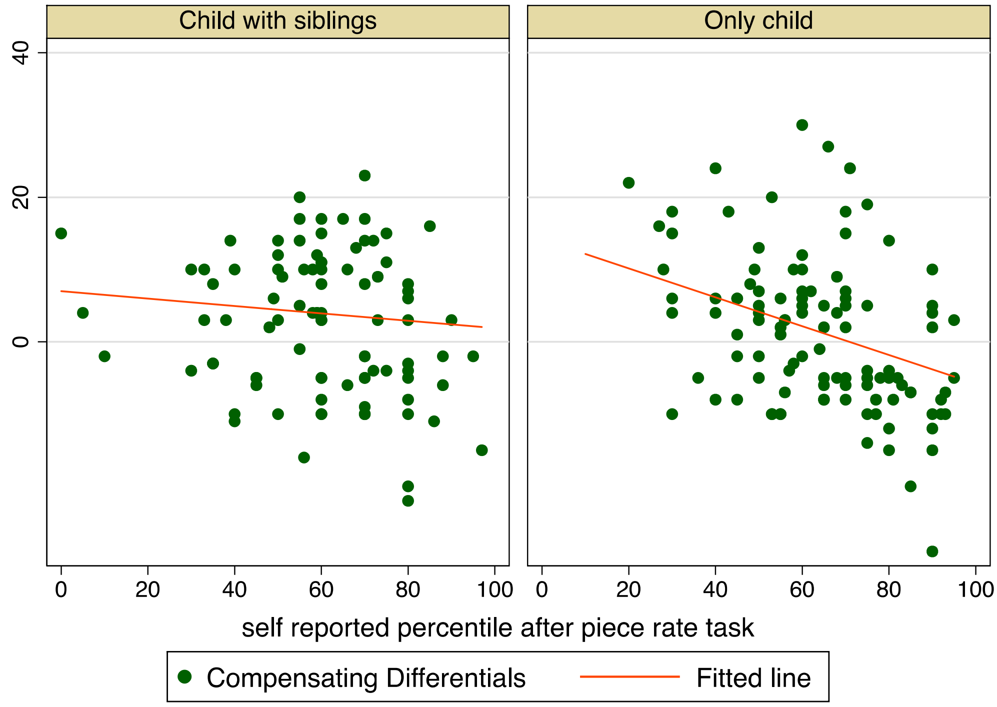
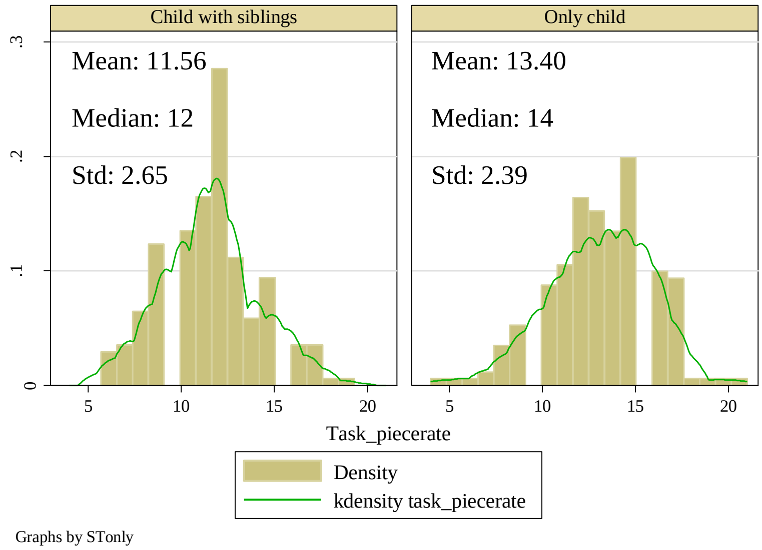
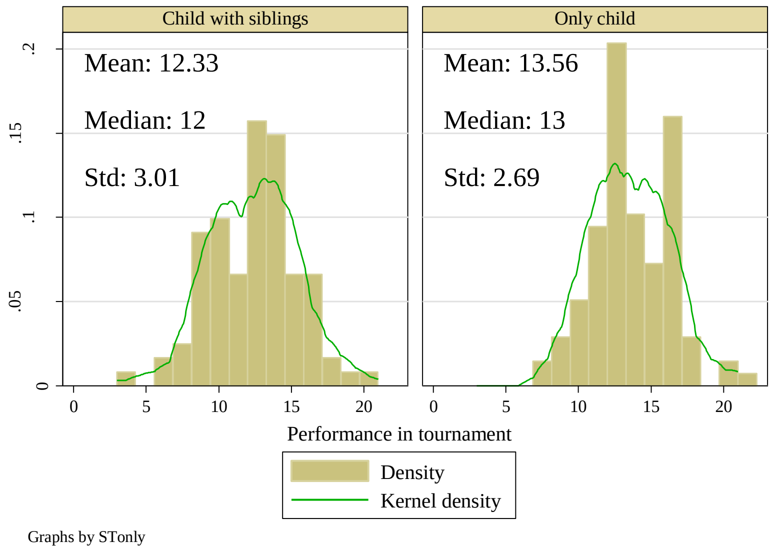


Figure 3(a) Histogram of performance under the piece rate scheme for only child and child with siblings



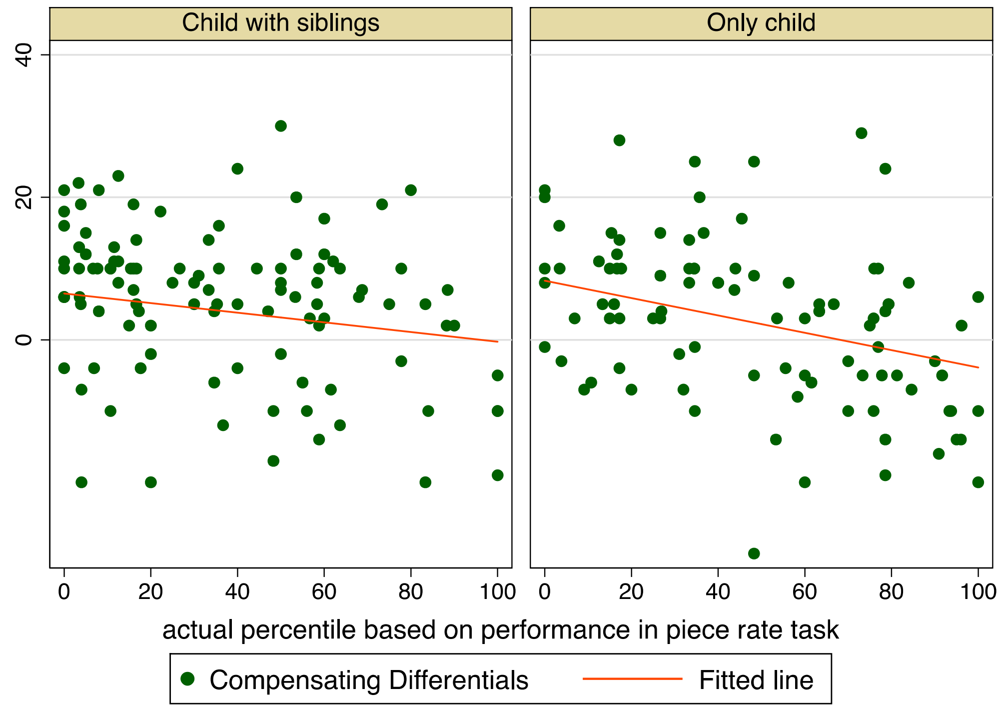
Note: the difference in average performance between only child and child with siblings is 1.84, which is statistically different from zero at the significance level of 5% (t-statistic is 5.16).

Figure 3(b) Histogram of performance under the tournament scheme



Note: the difference in average performance between only child and child with siblings is 1.23, which is statistically different from zero at the significance level of 1% (t-statistic is 3.06).

Figure 4 Relationship between compensation differentials and true winning probability with feedback on winning probabilities



Appendix A

In the tournament,

$$\max_y EU\big(y; F(y)\big) = \max_y F(y) * U_1(y) + \big(1 - F(y)\big) * U_2(y)$$

$$= \max_y [\beta \cdot F^{true}(y) + \alpha] * U_1(y) + [1 - \beta \cdot F^{true}(y) - \alpha] * U_2(y)$$

$$= \max_y \beta \cdot \big[F^{true}(y) * U_1(y) + \big(1 - F^{true}(y)\big) * U_2(y)\big] + \alpha \cdot [U_1(y)$$

$$- U_2(y)] + (1 - \beta) * U_2(y)$$

F.O.C

$$\frac{dEU(y; F(y))}{dy} = \beta \cdot \frac{dEU\big(y; F^{true}(y)\big)}{dy} + \alpha \cdot \frac{\partial U}{\partial w_1} \cdot 2 + (1 - \beta) \cdot \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y}$$

but are different in tournament scheme, $y^{*1} > y^{*0}$, we have

$$\bar{U} - U_2\big(y^{*1}\big) > \bar{U} - U_2\big(y^{*0}\big) > 0$$

and

$$U_1\big(y^{*1}\big) - U_2\big(y^{*1}\big) > U_1\big(y^{*0}\big) - U_2\big(y^{*0}\big) > 0$$ [7]

In the treatment group with feedback, both only child and child with siblings would update their belief to the true distribution, so $\beta^1_{inform} = \beta^0_{inform} = 1$ and $\alpha^1_{inform} = \alpha^0_{inform} = 0$. Hence, the optimal tournament performance ${y^*}^1_{inform} = {y^*}^0_{inform}$ satisfies

[7] This could be easily shown by $\frac{d[\bar{U} - U_2(y^*)]}{dy^*} = 0 - \frac{\partial U}{\partial w_2} \cdot \frac{\partial w_2}{\partial y^*} - \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y^*} = 0 - \frac{\partial U}{\partial w_2} \cdot 0 - \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y^*} = -\frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y^*} > 0$ and $\frac{d[U_1(y^*) - U_2(y^*)]}{dy^*} = \frac{\partial U}{\partial w_1} \cdot \frac{\partial w_1}{\partial y^*} + \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y^*} - \frac{\partial U}{\partial w_2} \cdot \frac{\partial w_2}{\partial y^*} - \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y^*} = \frac{\partial U}{\partial w_1} \cdot \frac{\partial w_1}{\partial y^*} = \frac{\partial U}{\partial w_1} \cdot 2 > 0$.

$$\frac{dEU(y;F(y))}{dy}|_{y=y^*_{inform}} = \frac{dEU\big(y;F^{true}(y)\big)}{dy}|_{y=y^*_{inform}} = 0$$

By contrast, in the control group without feedback, we have verified that $0 < \beta^0_{NOinform} < \beta^1_{NOinform} < 1$ and $\alpha^0_{NOinform} > \alpha^1_{NOinform} > 0$.

Suppose $\alpha^0_{NOinform} \cdot \frac{\partial U}{\partial w_1} \cdot 2 + \left(1 - \beta^0_{NOinform}\right) \cdot \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y}|_{y=y^*_{inform}} < 0 < \alpha^1_{NOinform} \cdot \frac{\partial U}{\partial w_1} \cdot 2 + (1 - \beta^1_{NOinform}) \cdot \frac{\partial U}{\partial C} \cdot \frac{\partial C}{\partial y}|_{y=y^*_{inform}}$, then

$$\frac{dEU(y;F^0_{NOinform}(y))}{dy}|_{y=y^*_{inform}} < 0 < \frac{dEU(y;F^1_{NOinform}(y))}{dy}|_{y=y^*_{inform}}$$

Hence, ${y^*}^0_{NOinform} < {y^*}^0_{inform} = {y^*}^1_{inform} < {y^*}^1_{NOinform}$

Appendix B

We used lottery choices to elicit subject's risk preferences, follow Holt and Laury (2002). Subjects were asked to answer 10 binary choices questions as shown in Figure A1. In each question, subjects need to decide whether they prefer a safe option or playing a lottery. The safe option is always the same in each question, which is 20 Chinese Yuan as the fixed payoff. However, the lotteries vary and the risk of lottery option decreases from question to question. In other words, the probability of winning 40 Chinese Yuan increases from 10% to 100% in the end. Now suppose a subject has consistent risk preference on lotteries, she will prefer the safe option to the lottery with a certain risk level, and then switch to preferring the lottery option in all subsequent choice questions. Therefore, the switching point of winning 40 Chinese Yuan in a lottery indicates the subject's risk attitude. That is, the higher this switching point is, the more risk-averse she is.

Subjects' inequality aversion was elicited by a dictator game (see Leider et al., 2009). In the dictator game, each participant was randomly matched with another participant in the lab room, playing the role of a dictator or a receiver. As a dictator, she could get 30 Chinese Yuan as endowment at the beginning of the game, and could either keep all money or send some amount to another person, i.e. the receiver. Corresponding, as a receiver, she had no endowment, but could receive something if the dictator passed money to her/him. Moreover, whatever amount the dictator decided to send, the money was doubled by the experimenter and then added to the receiver's payoff. In order to classify each subject, everyone had to play the role of dictator and decide how much sent to the receiver from an endowment of 30 Chinese Yuan. After all choices made, subjects were randomly matched in pairs and two roles within each pair were assigned by a random draw. At the end of the experiment, if this task would be determined for the final pay, then subjects' choices would be implemented, and they would be paid accordingly.

From the individual choices in this dictator game, we are able to identify the social preference for each subject. According to the game rule, if and only if the dictator sends 10 Chinese Yuan to the receiver, then both players can receive 20 Chinese Yuan equally. Otherwise, the receiver gets less than the dictator if the transfer amount is lower than 10 whereas the receiver gets more than the dictator if the transfer amount is higher than 10. Therefore, based on each dictator's wealth distribution between the receiver and her/himself, we define the equity aversion as the social preference for fairness and resistance to incidental inequalities, which is equal to 1 if the dictator sends 10 Chinese Yuan and equal to 0 otherwise.

Figure A1. Tasks eliciting risk preference by 10 comparisons of lotteries

For each of the following choices, please select either the fixed payment or the lottery. One of your choices will be randomly selected for payment.

Choice 1	Get 20 Yuan for sure.	OR	Get 40 Yuan with 10% probability and 0 Yuan with 90% probability
Choice 2	Get 20 Yuan for sure.	OR	Get 40 Yuan with 20% probability and 0 Yuan with 80% probability
Choice 3	Get 20 Yuan for sure.	OR	Get 40 Yuan with 30% probability and 0 Yuan with 70% probability
Choice 4	Get 20 Yuan for sure.	OR	Get 40 Yuan with 40% probability and 0 Yuan with 60% probability
Choice 5	Get 20 Yuan for sure.	OR	Get 40 Yuan with 50% probability and 0 Yuan with 50% probability
Choice 6	Get 20 Yuan for sure.	OR	Get 40 Yuan with 60% probability and 0 Yuan with 40% probability
Choice 7	Get 20 Yuan for sure.	OR	Get 40 Yuan with 70% probability and 0 Yuan with 30% probability
Choice 8	Get 20 Yuan for sure.	OR	Get 40 Yuan with 80% probability and 0 Yuan with 20% probability
Choice 9	Get 20 Yuan for sure.	OR	Get 40 Yuan with 90% probability and 0 Yuan with 10% probability
Choice 10	Get 20 Yuan for sure.	OR	Get 40 Yuan with 100% probability and 0 Yuan with 0% probability

Figure 1(b)