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Hui Xu
Business School, Beijing Normal University

Zheyuan Zhang
School of Public Finance and Taxation, Capital University of Economics and Business

Zhong Zhao
School of Labor and Human Resources, Renmin University of China and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Only-Child Parents and the Language Cognitive Ability of Their Children in China

Social interaction plays an important role in early language development, and family is considered a major arena for socialization. However, little is known about the potential impact of one particular demographic group of parents, notably those parents who were themselves only children. This paper empirically examines the effect of being only-child parents on the language ability of their children. The results show that children whose parents are both only children have significantly lower language skills. We further examine urban and rural children respectively, and find that the lower language ability is mainly driven by rural children as they are more constrained by their family socio-economic background. Three channels have been identified to explore the relationship between only-child parents and the lower language ability of their children: intergenerational cognitive transmission; parental engagement in the school life of their children; children's social relationship. Contrary to language ability, the math ability is not affected, suggesting that social interaction plays an important role in the development of language, but does not influence math cognitive skills.

JEL Classification: J12, J13, J24

Keywords: only-child, child development, cognitive skill, parental investment, social interaction

Corresponding author:
Zheyuan Zhang
School of Public Finance and Taxation
Capital University of Economics and Business
Boyuan Building, 121# Huaxiang Street
Fengtai district
Beijing 100071
China

E-mail: dr.zheyuan.zhang@gmail.com

I. INTRODUCTION

Cognitive ability is a fundamental determinant of decision making with regards to economic models. Extensive studies have shown that higher cognitive ability is associate with better labor market outcomes (Currie & Thomas, 1999; Heckman, Stixrud, & Urzua, 2006; Glewwe et al., 2017; Glewwe et al., 2022). Differences in the cognitive abilities of children start early on in life. Hernández-Alava1 and Popli (2017) suggested that wide differences in cognitive abilities have already started to emerge by the time children reach school age, with evidence showing that children from disadvantaged households fare worse in terms of cognitive and behavioral development (Heckman, 2006; Kiernan & Huerta, 2008). These early gaps are highly persistent over time (Carneiro, Heckman, & Masterov, 2005; Cunha, Heckman, Lochner, & Masterov, 2006; Neal & Johnson, 1996), which is one important potential explanation for persistent inequality (Anger & Heineck, 2010), among other undesired outcomes. Understanding what drives the potential cognitive gaps in early life are therefore of great importance both for academic research and policy formation.

Household characteristics play an important role in child development in various dimensions. For example, earlier researches based on the classic Quantity and Quality (Q-Q) model (Becker & Lewis, 1973; Becker & Tomas, 1976), have empirically investigated whether and how the quality of children vary dependent on the number of siblings (Angrist, Lavy, & Schlosser, 2010; Li, Zhang, & Zhu, 2008; Black, Devereux, & Salvanes, 2005). Parents play an important role in children's cognitive development as demonstrated by former studies that have revealed the intergenerational transmission of cognitive ability through the "nature" and "nurture" channels (Anger & Heineck, 2010).

However, little research has focused on the potential impact of one particular demographic group of parents, notably those parents who were themselves only children. Due to the family planning policy in China, the number of only-child parents has significantly

increased in recent decades. As the strict one-child policy was initiated in 1979, an increasing number of those born into a one-child family have now reached marriage age and have their own children. According to the 2015 China national population census, amongst 422 million married women aged between 15 and 50, the proportion of one of the couples being an only child accounted for 11%, whilst 3.74% couples were both only children. As shown in Figure 1, the percentage of only-child parents is increasing with time. For married women born after 1979 one-child policy (aged 35 and under), the proportion of at least one of the couple being an only child is 20%, with about 5% to 8% of the couples both being only children. Amongst both groups more than 80% have surviving children.

[Figure 1 near here]

Cameron, Erkal, Gangadharan, & Meng (2013) carried out experimental economic research in China and found that the behavior of an only-child differs to that of a sibling child: only children were found to be less cooperative and less trustworthy. Cameron et al. (2013) has two important implications for our study. Firstly, only children are less pro-social than sibling children. Secondly, the parenting behavior of only-child parents and that of parents with siblings may differ. As language skills are considered to be particularly affected by social interaction, it is reasonable to hypothesize that a comparison of the cognitive development of children born to parents with siblings and those with only-child parents may differ. That is the main question this paper aims to address. Indeed, we find that children born to parents who were both only children have significantly lower language skills.

In the paper, we also investigate the potential channels from the only-child parents to the lower language ability of their children and compare findings in language ability with math ability. Considering that our main study sample was born before the initiation of the one-child policy in China, we also compare the parenting behavior of parents born before and after the one-child policy to check the external validity.

Data used in this paper comes from the 2010 China Family Panel Studies (CFPS 2010), a nationally representative household survey covering urban and rural areas of 25 designated provinces. It provides a cognitive test score of both parents and children, detailed information of parenting behavior, and household characteristics.

Our study finds that children whose parents are both only children have a significantly lower level of language skills than those children of sibling parents. This result is particularly true for rural children. Three channels are identified as important in determining such gaps: intergenerational cognitive transmission, parental engagement in the school life of their children, and children's social relationship. Nevertheless, we do not find similar patterns relating to children's math ability. Finally, the parenting behavior of those parents born after and before the one-child policy exhibits no differences, suggesting that our finding also has important policy implications for the population of one-child parents born after the one-child policy.

The remainder of this paper is organized as follows: section 2 reviews related literature; section 3 describes the empirical strategy and data; section presents the main results; section 5 investigates the inherent channels; section 6 is further analysis of the relevance of the extended sample to those born after the one-child policy; section 7 concludes the paper.

II. LITERATURE REVIEW

The purpose of this paper is to investigate how only-child parents impact on their children's language ability. Our study therefore links closely to three branches of literature: parent-child transmission; only-child behavior; social contexts and language development. We will briefly review and comment on the relevant studies below.

1. Parent-Child Transmission

Parents play an important role in developing the cognitive skills of their children. Anger and Heineck (2010) summarized two main channels of intergenerational transmission of cognitive skills: "nature" and "nurture". The first is through genetic inheritance (Plomin, Owen, & Mcguffin, 1994), which is biological. The second is an outcome of positive productivity of parental education (Ermisch, 2008) such as parenting style, parental investment etc. Those parents who are more able and engaged are more successful at helping develop their children's cognitive skills (Heckman et al., 2006). For instance, a study conducted in the US discovered that children whose parents worked more at evening and night shifts had lower word or math cognitive ability as a result of poor parent-child relationships and fewer after-school activities (Han & Fox, 2011). Research on the UK has shown that parental investment and parenting style has a significant effect on children's development in the Millennium cohort (Hernández-Alava1 & Popli, 2017; Ermisch, 2008). Cunha and Heckman (2007) point out that the assumed separability of nature and nurture is obsolete, as both mechanisms interact in more complex ways. Indeed, the separation of the two channels is usually difficult to clearly identify empirically, but the intergenerational transmission has been greatly confirmed from various studies in different countries, such as for Carlson and Corcoran (2001) in the US, Anger and Heineck (2010) in Germany, and Black, Devereux, and Salvanes (2009) in Norway.

Our study also relates to the branch of literature on the intergenerational transmission of cognitive skills. However, we mainly focus on a particular demographic group of parents, the parents who were themselves only children. To the best of our knowledge, previous research has not explored this question. Our specific interest in only-child parents closely relates to the important discussion on the differences between only child and sibling child behaviors in existing literature as will be discussed below, and with the increasing importance of this particular demographic group in China.

2. *Only-Child Behavior*

The classic quantity-quality (Q-Q) model (Becker & Lewis, 1973; Becker & Tomes, 1976) implies that exogenous reduction in family size should increase parental investment and therefore improve the welfare and human capital of the offspring. Thus, in theory an unplanned increase in family size should reduce parental investment, and therefore reduce the child quality. Under this framework, an only-child should have better "quality" than a sibling child, if all other things are equal. However, empirical evidences are mixed.

Some studies indeed find results consistent with the prediction. For example, Blake (1981) undertook a study in the USA and found that only children are educationally and occupationally more achieving and often happier and more satisfied with other important aspects of their life. Li et al. (2008) used sample of Chinese twins, and examined the effect of family size on children's educational attainment. They found a negative correlation between family size and children's outcome. They also found the effect of family size was more evident in rural China, where the public education system is poor. However, some other studies did not find consistent evidences as suggested by Q-Q theory. For example, using multiple sources of exogenous variations, Angrist et al. (2010) found no evidence that increased sibship size had negative consequences on outcomes. Black et al. (2005) used a rich nationwide data set gathered from Norway over an extended period of time, and found that the effects of the family size are negligible.

Furthermore, certain literature has found a positive relationship between family size and children's outcomes, particularly in regard to child behavior. For example, Cameron et al. (2013) conducted economic experiments using 412 individuals born just before and just after the introduction of China's one-child policy in 1979, and found that only children are significantly less trusting, less trustworthy, more risk-averse, less competitive, more pessimistic, and less conscientious. Downey and Condron (2004) examined whether having

siblings affected children's social skills and non-cognitive ability. They found that children with at least one sibling exhibited better interpersonal skills, less externalizing problem behaviors, and better self-control in comparison to those only children. Jiao, Ji, and Jing (1986) also found that only children in China were more egocentric, whereas sibling children possessed the positive qualities of persistence, cooperation, and peer prestige.

In line with these studies, it is reasonable to hypothesize that only-child parents may behave differently to sibling parents in terms of parenting behavior. For example, if the only-children are indeed more egocentric and less cooperative, then only-child parents should be less likely to invest in time with children than sibling parents. Also, such unfavorable behavior may have a negative impact on family social networks and the development of children's social relationships. We are going to test these hypotheses in this study.

3. Social Contexts and Language Development

According to Maccoby (1992), family is considered a major—perhaps the major—arena for socialization. He identified that socialization and re-socialization can occur at any point in the life cycle, with childhood being a particularly malleable period, as it is the period of life when enduring social skills, personality attributes, and social orientations and values are laid down. Many studies have proved that social interaction plays a role in early language development. For example, Kuhl, Tsao, and Liu (2003) found that exposure to recorded Mandarin, without interpersonal interaction, had no effect on the language development of children, suggesting that language learning is enhanced by social interaction. Family structure is critical for intra-household interaction, parenting quality, and the development of children's cognition. Berger and McLanahan (2015) discovered that children living with their married biological parents demonstrated superior cognitive abilities compared to children in other two-parent family types. Additionally, children raised by stepfather had a higher quality of parental relationship and parenting, which facilitated their cognitive development. Dunifon and

Kowaleski-Jones (2007) found that white children living with a single mother and also a grandparent had significantly higher reading cognitive scores than those who lived with a single mother only. Children's language exposure varies substantially in relation to their socioeconomic status (SES). On average, children from lower-SES backgrounds hear fewer and less complex utterances than their more advantaged peers (Rowe 2008). In a landmark study, Hart and Risley (1995) estimated that by age 3, children from higher-SES backgrounds had heard 30 million more words than children from lower-SES backgrounds, and other studies report similar trends (Hoff, 2006).

It is interesting that unlike the language ability, math skills are less likely to be affected by social contexts. For example, Jordan (1992) found that middle-income children performed better than low-income children on each verbal calculation task; the performance of both groups did not differ in the nonverbal calculation task, suggesting that nonverbal task format is less sensitive to socioeconomic variation.

The above literature has important implications for our study. Firstly, if family and social interaction play an important role in a child's early language development, then theoretically only-child parents should themselves be less developed in language ability due to having lacked sibling interaction in the family environment. This low language ability may then negatively affect the language ability of their offspring through intergenerational transmission. Secondly, if the SES influences language development, the impacts on children from different SES groups should vary; for example, the language development may differ between rural children and urban children.

III. EMPIRICAL STRATEGY AND DATA

1. Empirical Approach

Our research primarily aims to investigate whether the language cognitive development of the

offspring of only-child parents is affected by their parents having been only children. Therefore, there are four possible family types: 1) both parents are only children; 2) only the father is an only child; 3) only the mother is an only child; 4) neither parents are only children. We therefore estimate the following model:

$$y_i = \alpha + \beta x_i + \gamma z_i + \tau c_i + \varepsilon_i \qquad (1)$$

where y_i is child i's cognitive ability measured by test scores. x_i is the dummy representing the four types of family as defined above. z_i is a vector of child i's characteristics, and c_i is a vector of parental and family characteristics for child i. ε_i denotes the error term.

A major challenge for our study is the concern over sample selection issues. Most parents in our sample were born before the one-child policy implementation in 1979. Thus, the fertility decision of the grandparents is more likely to be a voluntary decision. If the fertility decision is not exogenous, then there may be unobservable family characteristics which determine both the fertility decisions of the grandparents and cognitive ability of the offspring of the grandparents. The ideal would have been to obtain information on how grandparents made their fertility decisions, but our data sample does not allow us to investigate this issue. Nevertheless, we have information on the cognitive ability of the parents, which could potentially allow us to at least control for the intergenerational cognitive transmission. Furthermore, we have a series of rich control variables relating to parental and family social economic characteristics.

2. Data Source

Our main dataset is drawn from the 2010 baseline survey of the China Family Panel Studies (CFPS 2010), a nationally representative, longitudinal survey of Chinese communities, families, and individuals launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University.

The nationwide CFPS baseline survey in 2010 successfully interviewed 14,798 households from 635 communities, including 33,600 adults and 8,990 children, in 25 designated provinces, with an approximate response rate of 81%, and the majority of non-responses were due to non-contact (Xu & Xie, 2013). The stratified multi-stage sampling strategy ensures the CFPS sample represents 95% of the total population in 2010 (Xie, 2012). The CFPS 2010 includes a questionnaire on the cognitive ability of adults and children aged 10 and 15 years. As this study aims to understand the cognitive ability, we focus on the sample of children aged 10 to 15 years. We then match the parent-child data together and drop the observations with missing values of relevant variables. As the CFPS investigates all household family members, the parents and children could be matched completely. Finally, we obtained 2,739 observations of children with complete information on whether their parents having siblings.

3. Measures of Cognitive Ability: Language and Math

The CFPS 2010 has two tests to measure cognitive ability: word test and math test, and both are designed for all adults and children aged 10 to 15 years with the same rules and questions.

The word test measures the ability to recognize and pronounce words in Mandarin. It consists of eight sheets and each sheet has 34 words or phrases. The math test measures the cognitive ability in mathematics and logic analysis. The math test contains four problem sets with 24 questions in each set. Please refer to the Data Appendix for details.

4. Descriptive Statistics

Table 1 shows the descriptive statistics of the main variables used in the estimation by sibling status of children's parents. Of the children surveyed, around 92% had parents who both had siblings, around 3% of children had an only-child father, around 3% had an only-child mother, and around 3% had parents who were both an only child.

[Table 1 near here]

Table 1 also shows the differences in both the raw language and math scores of children going by the sibling status of their parents, along with other differences on the characteristics of children, their parents and their family. The average language scores of children of sibling parents are higher than the children of the other three parent types. In particular, children whose parents both have siblings is 1.03 points higher than children whose parents are both only children in language score; the difference is statistically insignificant. In terms of math score, we do not find any significant differences amongst the children with parents of different sibling status.

IV. MAIN RESULTS

Table 2 shows the results of OLS estimation on the effect of parental sibling status on children's cognitive ability in language (Column 1) and math (Column 2). In the estimation, we use standardized scores rather than raw scores for both the language and math tests. Specifically, standardized *Word Test* score of individual i equals raw *Word Test* score of individual i minus average *Word Test* score of sample, divided by standard deviation of *Word Test* score of sample. The same approach is adopted for calculating the standardized *Math Test* score.

Column 1 shows that children whose parents are both only children exhibit a significantly lower language ability compared to children whose parents both have siblings. The results also indicate that providing either one of parents has siblings, the language ability of children is not significantly different to that of children whose parents both having siblings. Column 2 shows there is no significant difference in the math test score of children from the four family types. Overall, only child parents do affect the language skill of their children, but not their math ability. These findings in language ability and math ability are consistent with

the literature and highlight the important role social interaction plays in early language ability development, but not in math ability development.

[Table 2 near here]

The large differences in social and economic development in rural and urban China, cause us to further divide the sample into rural children and urban children. Table 3 shows the results for the rural and urban sample. The findings suggest that in rural areas where both parents are only children, the language ability of their children is negatively affected, but this is not the case in urban areas.

[Table 3 near here]

In order to ascertain the importance of socio-economic conditions on the language cognitive skills of children, besides the heterogeneous analysis of rural and urban sub-samples, we carry out two additional exercises. Firstly, we further divide the rural (or urban) sub-sample by dropout rates.

In the above analysis, we found that children from rural areas suffer from low language ability when both parents are only children, but this is not true for children from urban areas. One plausible explanation is that higher educational levels and better public education in urban areas permit children to be less affected by the characteristics and behaviors of parents and family. On the contrary, in rural areas where the educational infrastructure is relatively poor, parents and family are required to play a more significant role in children's language development.

In order to test the above hypothesis, we use the dropout rate of school-aged children at province level; higher dropout rate indicates that educational level and enforcement of public education are relatively lower. China initiated the Compulsory Schooling Laws in 1986 which requests children aged 6 should receive nine years of compulsory education. We divide the rural (or urban) sample into two groups according to dropout rate of the children aged 6-15

years of rural (or urban) areas in each province. Dropout ratio is calculated using Chinese 2010 Census data.

In rural areas, the negative effect of both parents being only children on children's language ability is larger and more significant in provinces with a higher dropout rate, i.e., in provinces with lower educational level. Regardless of the drop-out rates, results consistently show that the math ability of rural children whose parents were both only children, was not affected and did not differ from that of urban children, which is consistent with the main findings.

[Supplemental Table 1 & Table 2]

Secondly, we divide up the rural (or urban) sub-sample by income level. In order to further investigate the role of socio-economic condition, we take the higher income of the father or mother and divide the rural (or urban) sample into two groups based on whether higher income of father or mother exceeds the sample median. The effects of both parents being only children on the language abilities of children within low- and high-income groups in rural areas were similar (coefficient is -0.37 in low-income group, -0.36 in high-income group). In line with the main results, no significant results are found in urban areas. These results are in the online supplemental materials.

[Supplemental Table 3 & Table 4]

V. CHANNELS

Why would only-child parents in rural areas negatively affect their children's language ability? In this section, we investigate three possible channels: intergenerational language transmission; parenting behavior; children's social relationship. Firstly, we estimate the relationship between the only-child parents and the three channels. Secondly, we test the three channels by integrating them one by one into the main estimation. Eventually, we conduct the same tests

on children's math ability, which is theoretically less affected by parenting and social-economic factors.

1. Intergenerational Language Transmission

Appendix Table 1 shows the results on the relationship between only-child parents and their own language ability. The results show that for mothers, being an only-child has a significantly negative correlation with their own language ability, whilst it is insignificant for the father. This finding suggests the existence of gender differences in terms of language skill development. Female language ability may be more dependent on the family than male language ability. A family with more than one child enlarges the interaction and communication amongst family members, which benefits the development of the female child's language skills.

We integrate the language scores of the parents into the main estimation in order to further investigate the role of intergenerational language transmission. Column 1 of Table 4 shows the baseline results, which is the same as Column 1 of Table 2. Column 2 shows the new estimated results by including parent cognitive tests scores as control variables. The results show that language test scores of both the father and mother are positively correlated with their children's language ability. For example, parents with a higher language ability are more likely to have children with a higher language ability. Results are consistent with previous studies on intergenerational language transmission (Agee & Crocker, 2002; Anger & Heinect, 2010). Furthermore, the absolute value of the coefficient of the variable Both, i.e. both parents are only children, has reduced from 0.352 in baseline estimation in Column 1 to 0.274 in the new estimation in Column 2. This suggests the negative impact of only-child parents on their offspring's language ability could be partly explained by the intergenerational transmission of language ability between parents, in particular, the mothers who themselves are negatively influenced by being an only-child.

[Table 4 near here]

2. Parenting Behavior

As noted previously, some studies have found that only children tend to be more self-centered (Cameron et al., 2013). If this is so, then the parenting of only-child parents and sibling parents may differ; the different parenting behavior may end up affecting the cognitive ability of their children (e.g. Han and Fox 2011). One important piece of information in our data relating to parenting behavior is the time devoted to the children. For exact questions in the survey, please refer to the Data Appendix for details. We therefore investigate whether there are any differences between only-child parents and sibling parents in terms of time devoted to their children. We exploit a series of dummy variables relating to the frequency of parental engagement with their children to measure parenting behavior.

We use an OLS model to estimate the relationship between only-child parents and parental engagement. The results are presented in Column (1) of Appendix Table 2. We can see that only-child parents engage significantly less in their children's school affairs. There are several explanations. Only-child parents may be more self-centered, and thus tend to engage less in children's school affairs, leaving more time to themselves. Or simply the only-child parents may not know how to involve themselves in children's education. Or grandparents are more likely to live with only-child parents, and thus play the role of substitute parents for their grandchildren.

We then again add the dummy variables relating to the frequency of parental engagement into the main regression, and the results are shown in Column 3 of Table 4. As expected, the more frequently the parents discuss school life with children, the more significantly likely they are to have a higher level of language skill. The magnitude of effects increases as parents become more involved in children's school life. Also, the absolute value of the coefficient of the variable Both, i.e. both parents are only children, has further decreased

from 0.274 in Column 2 to 0.260 in Column 3. As such, the negative effects of only-child parents on children's language ability could be further explained by less engagement in children's school life.

3. Children's Social Relationship

Language ability could be developed through intimate interaction and communication with others. In our data, we have information on children's social relationship which allows us to use a binary *Probit* model to test the relationship of only-child parents and their children's social relationship. For exact questions in the survey, please refer to the Data Appendix for details.

The results in Column (1) of Appendix Table 2 show that when both parents are only-children, the possibility of their children to have good friends significantly decreases. This indicates that being only-child parents is negatively correlated with their children's social relationship. One possible explanation is that if both parents are only children, their offspring have no chance of having cousins. As Maccoby (1992) suggests that the family as a major—perhaps the major—arena for socialization, the lack of interaction with cousins could definitely reduce children's opportunities of intimate contact with extended family, possibly further limiting children's development in social interaction.

We then further investigate whether this disadvantaged social relationship may affect their language ability. As such, we add the dummy variable have good friends in the main estimation. Column 4 of Table 4 shows that having good friends can significantly improve a child's language cognitive ability. The results confirm our hypothesis that a disadvantaged social relationship would negatively affect the development of communication and therefore language skill. Meanwhile, the coefficient of Both, i.e. both parents are only children, becomes insignificant after controlling for children's social relationship. This suggests that the social relationship of children, along with intergenerational transmission of language ability and

parenting behavior could explain the negative impact on language skills where both parents are only-children.

4. Only-Child Parents and Children's Math Ability

Compared to language skills which are largely influenced by social-economic factors and social interaction as discussed above, the math skills may be less likely to be influenced by both parents being only children. Jordan (1992) found that the middle-income children performed better than low-income children on each of the verbal calculation tasks, but the two income groups did not differ in performance on the nonverbal calculation tasks, suggesting the nonverbal task format is less sensitive to socioeconomic variation than the verbal task formats. As such, we conducted a parallel analysis on math ability and the results are presented in Table 5.

Column 1 shows the baseline analysis, and it suggests no significant relationship between the only-child parents and their children's math test scores. Again, we investigate the three channels. In terms of intergenerational cognitive transmission, the results show the language ability of both mother and father positively impact on children's math ability. However, the math test results of both parents have no impact on children's math ability. Therefore, our results indicate that parental behavior hardly has any impact on children's math ability. In terms of social relationship, having good friends also positively affects children's math abilities.

[Table 5 near here]

VI. RELEVANCE TO THE ONLY-CHILD PARENTS BORN AFTER THE ONE-CHILD POLICY

The analysis in Section 5 uses a sample of children aged 10-15 years in the 2010 survey. Correspondingly, the father's and mother's average ages are 40 years and 38 years, respectively, with the average birth year of the father and mother being 1970 and 1972, respectively. This

suggests most parents in our study sample were born before the initiation of the one-child policy in 1979. This raises two concerns: firstly, the fertility decision of the grandparents to have only one child was not affected by the exogenous one-child policy, but rather a voluntary family decision; secondly, whether or not the findings in Section 5 are also valid for only-child parents born after the one-child policy. We try to address these two concerns within this section.

1.Empirical Set-Up

As mentioned, we may encounter the endogenous problem that unobservable factors may jointly determine the fertility decision of the grandparents and the cognitive ability of their offspring. As before, we have controlled a series of family and parent characteristics to exclude the observed confounding factors. To further check whether or not the sample has a serious selection problem, we compare the parenting behavior of the parents born before 1979 and after 1979 in two ways: parent engagement in the children's school life and parent belief in having children.

We enlarge our sample by including parents who were born after 1979 (including the year 1979) and whose children were aged 6-9 years. The average age of the parents of these children is around 27 years for the father and 27 years for the mother. This sample had no cognitive tests, but provides both information on the engagement of parents in their children's school life, and surveys the subjective attitudes of parents. As such, it allows us to compare the differences in parental behavior with regards to engagement in children's school life.

We construct a new dummy variable which equals to 1 if both parents were born after 1979, and 0 otherwise. The purpose of this analysis is to see whether only-child parents born before 1979 behave differently to only-child parents born after 1979, with respect to the parental engagement in the school life of their children. Therefore, we conduct the following difference-in-differences (DID) estimation:

$$y_i = \alpha + \beta_1 both_i * after_i + \beta_2 both_i + \beta_3 after_i + \gamma z_i + \tau c_i + \varepsilon_i \quad (2)$$

where y_i is child i's parental engagement/parenting values/reasons to have children, $both_i$ is the dummy whether child i's parents are both only children or not, $after_i$ is the dummy whether child i's parents were both born after 1979, z_i is a vector of child i's characteristics, and c_i is a vector of parental and family characteristics for child i, ε_i denotes the error term. β_1 is the DID estimator, the key parameter of interest. If β_1 shows no significant difference, this suggests that the differences of parenting behavior between only-child parents and sibling parents born after 1979 and the differences of the two groups before 1979 is not significantly different.

2. Parenting Behavior in Children's School Engagement

Table 6 shows the results, which are consistent with the previous results in Appendix Table 2. Only-child parents tend to decrease parental engagement in children's school life. The estimated coefficient of the interaction term both*after is not significant, indicating that the decreasing degree of engagement between only-child parents and sibling parents born before 1979 is not significantly different with the decreasing degree of the two groups born after 1979. Therefore, this sample result clearly indicates no systematic difference in terms of parental engagement in children's school life between only-child parents born before and after one-child policy was implemented.

[Table 6 near here]

3. Parenting Values and Reasons to Have Children

The CFPS 2010 has a series of seven questions relating to subjective parenting values and nine questions about the reasons to have children. We use 16 continuous variables in our analysis, which correspond to these questions, and take the values of 1-5 to indicate parent subjective importance to each question from high to low. Please refer to the Data Appendix for exact details on the questions.

We separately conduct the DID regressions to estimate whether there is a systematic difference between only-child parents born before 1979 and those born after 1979 in terms of parenting values and the reason for having children. Results are presented in Table 7. In terms of parenting values, the interaction terms both*after are insignificant for nearly all dependent variables, suggesting there are almost no significant differences exhibited in parenting values between only-child parents born before 1979 and those after 1979, and the differences in subjective values between only-child parents and sibling parents hold constant before and after 1979. In terms of reasons to have children, the interaction terms are not significant in all nine estimations, suggesting that only-child parents before 1979 and those after 1979 share the same reasons for having children.

Overall, the above results again confirm that our only-child parents sample born mainly before 1979 shows no systematic differences with the parents born after 1979. Therefore, we can reasonably conclude that the findings on systematic differences in children's language ability due to the only-child parents could be extended to the larger sample who are influenced by the one-child policy after 1979. As more and more only-child parents born after 1979 are getting married and having their own children, the findings have important policy implications for this increasing group of only-child parents and their children in general, and suggest that is important to government to formulate relevant policies to help the cognitive development of children born today, especially for the children in the lower-SES and rural household.

[Table 7 near here]

VII. CONCLUSION

We have used data from the 2010 China Family Panel Studies to investigate the relationship between only-child parents and the language ability of their offspring. Our findings suggest only-child parents negatively affect their children's language ability. This is particularly true

for rural children.

Only child parents may influence children's language skills in three ways: (1) only child parents themselves have lower language ability than sibling parents, and this disadvantage is passed onto their children through intergenerational transmission; (2) only child parents are less likely to engage in children's school life compared to sibling parents, which again negatively impacts on their children's language ability; (3) being only-child parents negatively impacts on children's social interaction, which then further affects their children's language skills due to a lack of intimate relationship.

Further analysis has suggested our finding may be extended to the population of only child parents in general, including those born after the one-child policy.

Our findings confirm the social function of language cognitive skills, which is consistent with previous studies on the importance of social interaction in early language development (Kuhl et al., 2003). Also, the differences between rural and urban children indicate that rural areas are more constrained by family background. It is possible that the potential negative impact on urban children has been offset by better education services and resources in urban schools. In line with the findings of the large cognitive gap between urban and rural China in the study of Zhao, Ye, Li, and Xue (2017), our result suggests that one potential factor to explain the rural-urban cognitive gap may be the negative impact of only-child parents in rural areas.

We believe that our study has important policy implications. As suggested by Cunha and Heckman (2007), ability gaps in children from socioeconomic groups can be reduced if remediation is attempted at early ages. This suggests that policy makers should consider early interventions to alleviate the potential disadvantages of children of only-child parents, particularly in rural areas, through provision of better education services and resources. Additionally, in terms of parenting, our study indicates that it is helpful to consider enlarging

the social relationship and providing more opportunities for children with only-child parents in order to have intimate social interactions to alleviate the potential disadvantages on children's language development. Also, parental involvement and engagement in children's school life is always helpful to improve children's language cognitive ability.

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Table 1. *Descriptive Statistics by Sibling Status of Parents*

	Sibling parents		Only-child father		Only-child mother		Only-child both	
Variables	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Cognitive ability								
Word test	21.99	7.09	21.53	7.70	21.69	7.11	20.96	8.06
Math test	11.32	4.42	11.22	4.87	11.47	4.94	11.68	5.06
Children's characteristics								
Male (=1)	0.51	0.50	0.47	0.50	0.43	0.50	0.54	0.50
Age	12.55	1.72	12.17*	1.60	12.22	1.863	12.92*	1.77
Urban *Hukou* (=1)	0.21	0.41	0.41***	0.50	0.28	0.45	0.40***	0.49
Han (=1)	0.89	0.32	0.90	0.31	0.92	0.28	0.92	0.28
Weight (kilo)	38.43	10.99	36.66	11.46	38.92	11.11	39.60	10.93
Height (cm)	146.80	16.59	145.70	16.11	146.00	17.41	145.90	19.37
Kindergarten (Ever attended=1)	0.63	0.48	0.70	0.46	0.68	0.47	0.75**	0.44
Primary school (=1)	0.61	0.49	0.66	0.48	0.65	0.48	0.58	0.50
Junior middle school (=1)	0.38	0.49	0.34	0.48	0.29	0.46	0.42	0.50
Senior high or above (=1)	0.01	0.11	0	0	0.06***	0.23	0.00	0.00
No. of siblings	1.61	1.40	1.17***	1.27	1.68	1.56	1.18**	1.37
Having good friend(s) (=1)	0.92	0.27	0.90	0.31	0.90	0.30	0.81***	0.40
Parental and family characteristics								
Father's age	40.14	4.74	39.93	4.94	40.82	5.39	39.65	5.45
Mother's age	38.84	4.48	38.42	4.82	38.64	5.84	39.07	5.26
Father's education								
Illiteracy (=1)	0.21	0.41	0.28	0.45	0.13*	0.33	0.26	0.44
Primary school (=1)	0.27	0.45	0.18*	0.39	0.24	0.43	0.28	0.45
Junior middle school (=1)	0.34	0.48	0.32	0.47	0.44*	0.50	0.26	0.44
Senior high school (=1)	0.12	0.32	0.09	0.29	0.08	0.28	0.08	0.28
College and above (=1)	0.06	0.23	0.13***	0.34	0.11**	0.32	0.11**	0.32
Mother's education								
Illiteracy (=1)	0.32	0.47	0.30	0.46	0.38	0.49	0.28	0.45
Primary school (=1)	0.27	0.44	0.22	0.42	0.25	0.44	0.24	0.43
Junior middle school (=1)	0.28	0.45	0.25	0.44	0.21	0.41	0.29	0.46
Senior high school (=1)	0.08	0.27	0.15*	0.35	0.11	0.32	0.10	0.30
College and above (=1)	0.05	0.21	0.08	0.27	0.56	0.23	0.10**	0.30
Father's health status (any chronic disease =1)	0.11	0.31	0.16	0.37	0.15	0.36	0.03**	0.16
Mother's health status (any chronic disease =1)	0.13	0.34	0.07*	0.25	0.06*	0.23	0.06*	0.23
Father's word test	18.61	9.46	20.70*	8.85	21.51***	8.06	17.28	10.44
Mother's word test	16.43	10.53	17.41	11.53	15.64	10.78	15.93	10.91
Father's math test	10.63	5.68	11.30	6.03	11.79*	5.05	10.24	7.12
Mother's math test	8.91	6.01	9.47	7.04	8.65	6.32	9.74	7.04
Household income per capita (in thousand *yuan*)	5.67	7.20	5.93	8.77	7.70**	10.37	7.71**	10.07
Household size	4.63	1.46	4.71	1.45	5.28***	2.10	4.75	1.79
Parental company (1-5)	3.12	1.18	3.00	1.11	3.14	1.13	2.97	1.23
No. of observations	2519		76		72		72	

***Source*：** The CFPS 2010

Note: t-tests are conducted between each of the three groups (Only-child father, Only-child mother, Only-child both) and sibling parents; * p<0.1; ** p<0.05; *** p<0.01

Table 2. *OLS Estimation on the Effects of Only-Child Parents on Children's Cognitive Ability*

Independent variable	(1)	(2)
	Dependent variable	
	Word Test	Math Test
Whether parent(s) are only child(ren)		
(Neither (=1) as baseline)		
Only father (=1)	-0.041	0.044
	(0.09)	(0.09)
Only mother (=1)	0.001	0.079
	(0.10)	(0.08)
Both (=1)	-0.230**	-0.036
	(0.11)	(0.09)
Male (=1)	-0.194***	-0.002
	(0.03)	(0.02)
Age	1.031***	0.677***
	(0.16)	(0.13)
Age squared	-0.037***	-0.021***
	(0.01)	(0.01)
Urban *Hukou* (=1)	0.076*	0.079**
	(0.05)	(0.04)
Han (=1)	0.228***	0.096**
	(0.05)	(0.05)
Weight	0.003	0.004**
	(0.002)	(0.002)
Height	0.011***	0.005***
	(0.002)	(0.001)
Kindergarten	0.075**	-0.006
	(0.04)	(0.03)
Education (Primary school(=1) as baseline)		
Junior middle school (=1)	0.377***	0.894***
	(0.05)	(0.05)
Senior high or above (=1)	0.639***	1.482***
	(0.11)	(0.09)
Num. of Siblings	-0.029**	-0.030**
	(0.01)	(0.01)
Parental and family characteristics	√	√
Constant	-8.428***	-6.187***
	(0.98)	(0.80)
N	2,739	2,739
R^2	0.391	0.601

Notes: Robust standard errors are in parentheses; The word and math test scores are standardized separately; Parental and family characteristics include: (1) parents' information: *both father's and mother's Age*, *Education*, *Health status*, *Job dummy variables*; (2) family information: *Household income per capita* and *Household size*; * p<0.1; ** p<0.05; *** p<0.01.

Table 3. *OLS Estimation on the Effects of Only-Child Parents on Children's Cognitive Ability: Rural and Urban Heterogeneity*

Independent variable	(1)	(2)	(3)	(4)
	Rural areas		Urban areas	
	Dependent variable		Dependent variable	
	Word Test	Math Test	Word Test	Math Test
Whether parent(s) are only child(ren)				
(Neither (=1) as baseline)				
Only father (=1)	-0.106	0.031	0.096	0.059
	(0.13)	(0.12)	(0.10)	(0.12)
Only mother (=1)	-0.085	0.045	0.163	0.165
	(0.13)	(0.10)	(0.16)	(0.11)
Both (=1)	-0.352**	-0.185	-0.032	0.182*
	(0.15)	(0.12)	(0.13)	(0.10)
Male (=1)	-0.200***	-0.014	-0.173***	0.022
	(0.04)	(0.03)	(0.06)	(0.05)
Age	1.059***	0.699***	0.942***	0.845***
	(0.19)	(0.15)	(0.29)	(0.23)
Age squared	-0.037***	-0.022***	-0.036***	-0.025***
	(0.01)	(0.01)	(0.01)	(0.01)
Han (=1)	0.259***	0.102*	0.039	0.028
	(0.06)	(0.05)	(0.12)	(0.11)
Weight	0.004*	0.005**	-0.004	-0.001
	(0.002)	(0.002)	(0.004)	(0.003)
Height	0.009***	0.004***	0.021***	0.008***
	(0.002)	(0.002)	(0.004)	(0.003)
Kindergarten	0.070*	-0.016	0.194	0.038
	(0.04)	(0.03)	(0.12)	(0.10)
Education				
(Primary school(=1) as baseline)				
Junior middle school (=1)	0.404***	0.973***	0.355***	0.497***
	(0.06)	(0.05)	(0.12)	(0.10)
Senior high or above (=1)	0.767***	1.809***	0.577***	0.878***
	(0.14)	(0.14)	(0.20)	(0.14)
Num. of Siblings	-0.035**	-0.034**	0.006	-0.014
	(0.02)	(0.02)	(0.03)	(0.02)
Parental and family characteristics	√	√	√	√
Constant	-8.441***	-6.135***	-8.692***	-7.728***
	(1.16)	(0.94)	(1.82)	(1.46)
N	2,123	2,123	616	616
R^2	0.376	0.590	0.394	0.640

***Notes*:** Robust standard errors are in parentheses; the word and math test scores are standardized separately; parental and family characteristics include: (1) parents' information: *both father's and mother's Age*, *Education*, *Health status*, *Job dummy variables*; (2) family information: *Household income per capita* and *Household size*; * p<0.1; ** p<0.05; *** p<0.01.

Table 4. *OLS Estimation on the Effects of Parents as Only Child on Children's Language Ability: Channels*

	(1)	(2)	(3)	(4)
Independent variable	Dependent variable: Child's Word Test			
whether parent(s) are only child(ren) (Neither (=1) as baseline)				
Only father (=1)	-0.106	-0.123	-0.124	-0.114
	(0.13)	(0.12)	(0.12)	(0.12)
Only mother (=1)	-0.085	-0.079	-0.079	-0.057
	(0.13)	(0.12)	(0.12)	(0.13)
Both (=1)	-0.352**	-0.274*	-0.260*	-0.212
	(0.15)	(0.14)	(0.14)	(0.13)
Parental engagement (Never as baseline)				
Seldom			0.058	0.074
			(0.065)	(0.064)
Occasionally			0.102*	0.127**
			(0.06)	(0.06)
Often			0.111*	0.116**
			(0.06)	(0.06)
Always			0.219**	0.243***
			(0.09)	(0.09)
Have (a) good friend(s) (=1)				0.422***
				(0.07)
Father's math test		0.008	0.009	-0.001
		(0.05)	(0.05)	(0.05)
Father's word test		0.145***	0.144***	0.138***
		(0.032)	(0.03)	(0.03)
Mother's math test		0.043	0.044	0.026
		(0.05)	(0.05)	(0.05)
Mother's word test		0.142***	0.139***	0.133***
		(0.04)	(0.03)	(0.04)
Other control variables	√	√	√	√
Constant	-8.441***	-8.451***	-8.458***	-8.694***
	(1.16)	(1.13)	(1.13)	(1.12)
N	2,123	2,123	2,123	2,123
R^2	0.376	0.406	0.408	0.421

Notes: Robust standard errors are in parentheses; Other control variables include: (1) children's information: *Gender*, *Age*, *Age squared*, *Hukou*, *Ethnicity*, *Weight*, *Height*, *Ever attended kindergarten*, *Education*, *Number of Siblings*; (2) parents' information: *father's and mother's Age*, *Education*, *Health status*, *Job dummy variables*; (3) family information: *Household income per capita* and *Household size*; * p<0.1; ** p<0.05; *** p<0.01.

Table 5. *OLS Estimation on The Effects of Parents as Only Child on Children's Math Ability: Channels*

	(1)	(2)	(3)	(4)
Independent variable	Dependent variable: Child's math test			
whether parent(s) are only child(ren) (Neither (=1) as baseline)				
Only father (=1)	0.031	0.031	0.029	0.035
	(0.12)	(0.12)	(0.12)	(0.12)
Only mother (=1)	0.045	0.055	0.058	0.071
	(0.10)	(0.10)	(0.10)	(0.10)
Both (=1)	-0.185	-0.140	-0.133	-0.104
	(0.12)	(0.12)	(0.12)	(0.12)
Parental company (Never as baseline)				
Seldom			0.067	0.076
			(0.05)	(0.05)
Occasionally			0.073	0.088*
			(0.05)	(0.05)
Often			0.066	0.069
			(0.05)	(0.05)
Always			0.012	0.027
			(0.07)	(0.07)
Have (a) good friend(s) (=1)				0.256***
				(0.06)
Father's math test		0.032	0.031	0.026
		(0.05)	(0.05)	(0.05)
Father's word test		0.043*	0.043*	0.040
		(0.02)	(0.02)	(0.02)
Mother's math test		0.090*	0.088*	0.077
		(0.05)	(0.05)	(0.05)
Mother's word test		0.064**	0.063**	0.059**
		(0.03)	(0.03)	(0.03)
Other control variables	√	√	√	√
Constant	-6.135***	-6.048***	-6.132***	-6.274***
	(0.94)	(0.93)	(0.93)	(0.93)
N	2,123	2,123	2,123	2,123
R^2	0.590	0.599	0.600	0.604

Notes: Robust standard errors are in parentheses; Other control variables include: (1) children's information: *Gender*, *Age*, *Age squared*, *Hukou*, *Ethnicity*, *Weight*, *Height*, *Ever attended kindergarten*, *Education*, *Number of Siblings*; (2) parents' information: *father's and mother's Age*, *Education*, *Health status*, *Job dummy variables*; (3) family information: *Household income per capita* and *Household size*; * p<0.1; ** p<0.05; *** p<0.01

Table 6. *DID Estimation on Parental Engagement Before vs. After Only-Child Policy*

Independent variable	*Parental engagement*
*Both*after*	-0.433
	(0.41)
both	-0.363*
	(0.19)
after	0.225
	(0.16)
Other control variables	√
Constant	2.671***
	(0.97)
Observations	2,244
R-squared	0.081

Notes: Robust standard errors are in parentheses; Other control variables include: (1) children's information: *Gender, Age, Age squared, Hukou, Ethnicity, Weight, Height, Ever attended kindergarten, Education, Number of Siblings;* (2) parents' information: *father's and mother's Age, Education, Health status, Job dummy variables;* (3) family information: *Household income per capita and Household size;* * p<0.1; ** p<0.05; *** p<0.01

Table 7. *DID Estimation on Parenting Values and Reasons to Have Children for Only Child Parents Born Before vs. After Only-Child Policy*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
	Dependent variable: parenting concept								
Independent variable	Q1	Q2	Q3	Q4	Q5	Q6	Q7		
*both*after*	-0.147	-0.575	-0.074	-0.494*	-0.046	0.178	0.310		
	(0.25)	(0.38)	(0.19)	(0.26)	(0.21)	(0.30)	(0.40)		
both	0.466**	0.243	0.072	0.456***	0.439***	0.162	0.134		
	(0.18)	(0.25)	(0.12)	(0.16)	(0.11)	(0.23)	(0.32)		
after	0.081	-0.028	0.047	0.168	0.295**	0.205	0.167		
	(0.14)	(0.15)	(0.10)	(0.11)	(0.14)	(0.16)	(0.16)		
Other control variables	√	√	√	√	√	√	√		
Constant	3.167***	3.050***	3.637***	3.058***	2.561***	3.025***	2.525***		
	(0.40)	(0.42)	(0.28)	(0.33)	(0.41)	(0.43)	(0.45)		
Observations	745	744	748	744	733	731	728		
R-squared	0.035	0.062	0.024	0.032	0.055	0.060	0.086		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent variable: reasons for having children								
VARIABLES	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
*both*after*	0.043	-0.403	0.361	0.072	-0.102	0.155	0.124	0.126	0.244
	(0.31)	(0.44)	(0.45)	(0.19)	(0.08)	(0.20)	(0.40)	(0.20)	(0.52)
both	0.066	0.154	-0.297	-0.052	0.131***	-0.030	-0.260	0.093	-0.252
	(0.17)	(0.23)	(0.31)	(0.18)	(0.04)	(0.19)	(0.30)	(0.18)	(0.31)
after	0.058	0.285***	0.177	0.121*	0.122	0.237***	0.134	0.057	0.175*
	(0.09)	(0.10)	(0.11)	(0.07)	(0.08)	(0.08)	(0.09)	(0.09)	(0.10)
Other control variables	√	√	√	√	√	√	√	√	√
Constant	3.013***	2.433***	2.292***	3.871***	3.801***	3.530***	3.609***	3.316***	3.127***
	(0.26)	(0.29)	(0.32)	(0.19)	(0.21)	(0.23)	(0.24)	(0.24)	(0.29)
Observations	1,001	999	996	996	997	991	986	979	985
R-squared	0.047	0.060	0.112	0.023	0.022	0.025	0.033	0.024	0.038

Notes: Robust standard errors are in parentheses; Other control variables include: (1) parents' information: *father's and mother's Age, Education, Health status, Job dummy variables*; (2) family information: *Household income per capita* and *Household size*; * p<0.1; ** p<0.05; *** p<0.01

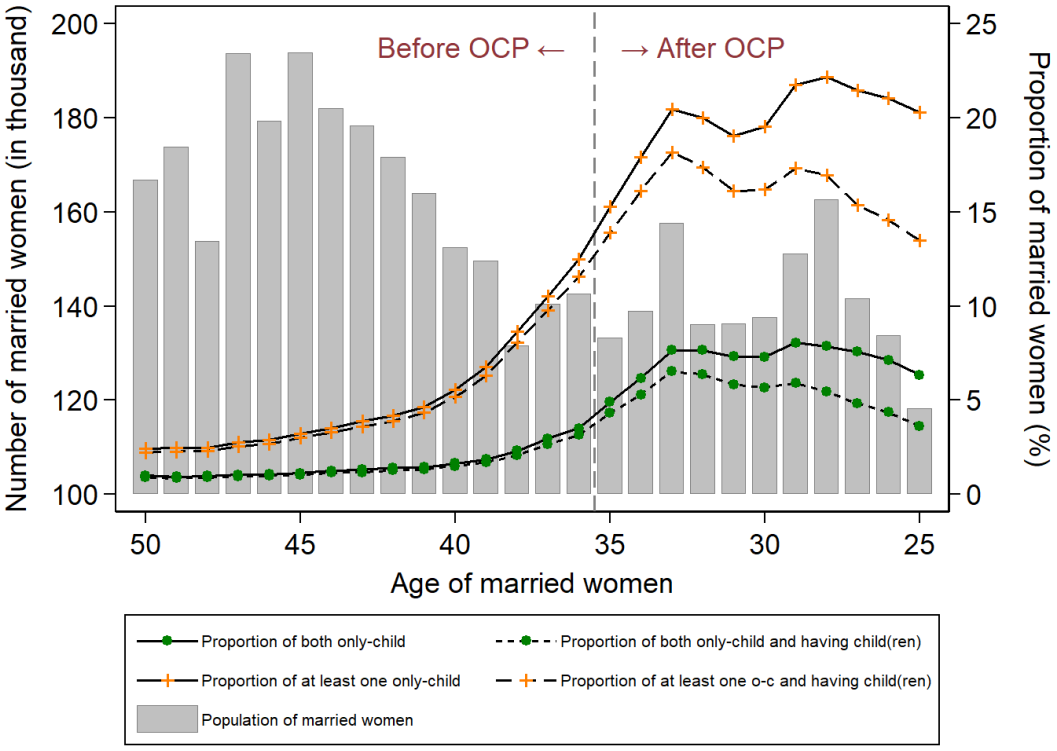

FIGURE 1. POPULATION AND PROPORTION OF MARRIED WOMEN AGED 25-50, BY THE SIBLING STATUS OF THE COUPLES

***Source*：** China 2015 National Population Census, National Bureau of Statistical of China.

Notes: China 2015 Census represents 1% of total population in China. We draw the number of married women aged 25-50 in 2015 census, along with the proportion of women who and whose husband are both only children or at least one person of the couple is only-child, as well as the proportion of women who and whose husband are both only children or at least one person of the couple is only-child and have surviving children. The vertical dash line divides the population at the critical age of 35. The left side represents women born after the one-child policy in 1979 and the right side represents women born after the policy.

Appendix Tables

Appendix Table 1. *Only-Child Parents and Their Own Language Ability: OLS Estimation*

	Dependent variable:		Dependent variable:
Independent variable	Father's Word Test	Variables	Mother's Word Test
Father being only child	-0.005	Mother being only child	-0.191***
	(0.09)		(0.07)
Father's education		Mother's education	
Illiteracy (=1) as baseline		Illiteracy (=1) as baseline	
Primary school (=1)	0.919***	Primary school (=1)	1.012***
	(0.05)		(0.04)
Junior middle school (=1)	1.446***	Junior middle school (=1)	1.492***
	(0.04)		(0.04)
Senior high school (=1)	1.928***	Senior high school (=1)	1.927***
	(0.05)		(0.05)
College and above (=1)	2.038***	College and above (=1)	1.638***
	(0.11)		(0.15)
Father's age	-0.017***	Mother's age	-0.019***
	(0.003)		(0.003)
Father's income	0.0003	Mother's income	0.001
(in thousand yuan)	(0.001)	(in thousand yuan)	(0.002)
Father's health status	0.089	Mother's health status	0.033
	(0.06)		(0.05)
Father's occupation	√	Mother's occupation	√
(Dummy variables)		(Dummy variables)	
Constant	-0.469***	Constant	-0.218*
	(0.15)		(0.13)
N	2,123	N	2,123
R^2	0.436	R^2	0.508

Notes: Robust standard errors are in parentheses; dependent variables are standardized word test scores; * p<0.1; ** p<0.05; *** p<0.01

Appendix Table 2. *Only-Child Parents and Their Parenting Behavior/ Children's Social Relationship*

	(1)	(2)
	Dependent variable	
Independent variable	*Parental engagement*	*Have (a) good friends or not*
whether parents are only child (Neither (=1) as baseline)		
Only father (=1)	-0.136	-0.326
	(0.17)	(0.23)
Only mother (=1)	-0.053	-0.302
	(0.17)	(0.23)
Both (=1)	-0.379**	-0.716***
	(0.19)	(0.22)
Child's Gender (1=Male)	-0.083	-0.006
	(0.05)	(0.08)
Child's Age	0.219	0.055
	(0.26)	(0.04)
Child's Num. of Siblings	-0.082***	-0.065**
	(0.03)	(0.03)
Other control variables	√	√
Constant	1.782	-1.686***
	(1.60)	(0.45)
N	2,123	2,123
R^2	0.082	-

Notes: The results in Column (1) are based on OLS model, and dependent variable is *Parental engagement* which takes the value 1=*Never*, 2=*Seldom*, 3=*Occasionally*, 4=*Often*, 5=*Always*; The results in Column (2) are based on Probit model, and dependent variable is whether children *Have (a) good friends or not*; The robust standard errors are in parentheses; other control variables include: (1) children's information: *Age squared*, *Hukou*, *Ethnicity*, *Weight*, *Height*, *Ever attended kindergarten*, *Education*; (2) parents' information: *father's and mother's Age, Job dummy variables*, *Education*; (3) family information: *Household income per capita*, *Household size*; * p<0.1; ** p<0.05; *** p<0.01