Journal of Asian Economics 84 (2023) 101579

Contents lists available at ScienceDirect

Journal of Asian Economics

journal homepage: www.elsevier.com/locate/asieco

Parental socioeconomic status and children's cognitive ability in China☆

Hui Xu [a], Zheyuan Zhang [b,*], Zhong Zhao [b]

[a] Business School, Beijing Normal University, Beijing 100875, China
[b] School of Labor and Human Resources, Renmin University of China, Beijing 100872, China

ARTICLE INFO

JEL classification in this article:
J13
J24

Keywords:
Socioeconomic status
Cognitive ability
Parental investment
Parenting productivity
Beliefs

ABSTRACT

It is widely recognized that intergenerational transmission is one of the primary causes of persistent social inequality. Using nationally representative data, the China Family Panel Studies, this paper is one of the first to comprehensively investigate parental SES and children's cognitive outcomes in China and moves beyond existing work by accounting for the direct intergenerational transmission of cognitive ability and by examining various novel mechanisms. Our results show that parents' education rather than income is positively associated with their children's cognitive abilities. The analysis of mechanisms shows that educational disparity widens the gap in parental investment, as well as parental beliefs regarding education and expectations for their children. Nevertheless, we do not find differences in parenting productivity. In addition, we find that the impact is more prominent in rural areas where education resources are much more limited. Various tests have been performed to prove the robustness of our findings.

1. Introduction

Cognitive ability is found to be highly related to children's school performance (Almlund et al., 2011; Reynolds et al., 2010), as well as labor market outcomes, such as educational attainment, wage, crime, and etc. (Currie & Thomas, 2001; Heckman et al., 2006). Parents play an important role in the formation of their children's cognitive skills, making a persistent difference in the early stage of child development (Heckman et al., 2006). Parental socioeconomic status (SES hereafter) could influence parental styles and behaviors, which further lead to differences in children's cognitive abilities, causing inequality in offspring. As suggested by List et al. (2021), socioeconomic gaps, with the associated disparities in parental investment in children, become apparent early in child development. As documented in *Our Kids: The American Dream in Crisis* (Putnam, 2016), there is currently a sharp contrast between the upper and the lower classes and the opportunity gap is still widening in the US.

China has experienced rapid economic growth together with widening income inequality since the reform and opening up in the

☆ We would like to thank the handling editor and two anonymous referees whose comments have improved the paper greatly. We are grateful to participants of the seminar of China Center for the Economics of Human Development at Beijing Normal University for their comments. We also thank the Institute of Social Survey at Peking University for providing the China Family Panel Study data used in this paper.

* Correspondence to: School of Labor and Human Resources, Renmin University of China, 59# Zhongguancun Street, Haidian district, Beijing 100872, China.
E-mail addresses: xuhui@bnu.edu.cn (H. Xu), zhangzheyuan@ruc.edu.cn (Z. Zhang), mr.zhong.zhao@gmail.com (Z. Zhao).

https://doi.org/10.1016/j.asieco.2022.101579
Received 8 August 2022; Received in revised form 1 December 2022; Accepted 28 December 2022
Available online 29 December 2022

late 1970 s; the GINI coefficients increased from 0.30 in 1980–0.55 in 2012, which is far more than the GINI coefficient of 0.45 in the US (Xie & Zhou, 2014),[1] and the inequality of opportunity accounts for a large share of income inequality (Shi, 2022). How does inequality transmit to children in terms of their cognitive development?

The relationship between parental SES and children's cognitive development has been studied in an important branch of the developmental psychology (see, e.g., Bradley & Corwyn, 2002 for a review) and economic literature (Cunha & Heckman, 2008; Falk et al., 2021; Heckman, 2006), which suggests a persistent transmission of inequality from parents to children.[2] As one of the largest developing countries, how would that pattern of transmission differ from that of other countries? Few studies have systematically investigated the Chinese case, although it is undoubtedly an important research question given the rising social inequality in the process of economic transition in China. The investigation also has important policy implications for the alleviation of social inequality by increasing intergenerational mobility.

By using nationally representative data, the China Family Panel Studies (CFPS hereafter), this paper systematically examines the impacts of parental SES on children's cognitive abilities and explores the underlying mechanism. In addition to the extensive information on parental and family characteristics, a significant advantage of the data is that the cognitive abilities of both parents and children are assessed. This allows us to account for intergenerational transmission of cognitive ability, which is likely to be the primary endogenous confounding factor. In line with other studies on SES, we use both fathers' and mothers' education and income as measures of parental SES (e.g., Falk et al., 2021; Khanam & Nghiem, 2016).

In the literature of intergenerational transmission of income and education, endogenous parental background is a prevalent barrier. Researchers adopt a variety of techniques to identify the causal effects and separate the component attributable to nature influences. Natural experiments and instrumental variables are most frequently used to obtain exogenous variation in parental income and education (e.g., Currie & Almond, 2011; Black et al., 2005). To minimize inherited genetic differences, other methods include using twins' samples (e.g., Behrman & Rosenzweig, 2002; Bingley et al., 2009) and adoptees (e.g., Björklund et al., 2006; Plug, 2004). In this study, we take a different approach to address endogeneity. We use both father's and mother's cognitive test scores as proxy for genetic inheritance because the CFPS conducts cognitive tests for each adult using the same question as children and allows us to match parent's cognitive ability to that of the child.

The main finding of the paper shows that both fathers' and mothers' education levels are positively associated with children's word and math cognitive abilities. The association is, however, insignificant in terms of parental income. The results are similar when we account for parent' own cognitive abilities.

Several channels are further investigated. First, the literature reveals that parental investment in children is one of the critical inputs in the production of child skills (Aiyagari et al., 2002; Cunha & Heckman, 2006, 2007, 2007), and evidence also shows that the levels of such investment differ across SES levels (Hoff, 2003; Huttenlocher et al., 2010; List et al., 2021). In line with the literature, we also find that parents with higher SES invest more in their children in terms of both material and time.

The second channel we investigate is parental productivity, that is, the cognitive outcomes of children with different parental SES given the same amount of parental investment in both time and material. As suggested by theoretical models, parents with different skills might have various levels of productivity in terms of parental investment (Heckman & Mosso, 2014). We find that the productivity of parental inputs does not differ considerably across SES groups. Combined with the finding from the first channel, this finding implies that the quantity rather than quality of investment is more important in driving the different cognitive outcomes of children in China at the country's current development stage. The productivity effect has important policy implications since it would widen the disparity in children's cognitive development if parents with a higher SES were more productive in terms of parental input. Our study is one of the first to quantify the productivity effect of parental SES on children's cognition in the Chinese case.

Another channel is parental beliefs about education and parental expectations for their children. Beliefs often fulfill important psychological and functional needs of individuals. We investigate whether and how parents of different SES levels value the importance of education and their expectation for the highest education level that their children might attain differently. Consistent with the existing studies, our results show that higher SES parents value higher levels of education and hard work, and they have higher expectations for their children's education. Moreover, children from higher SES families also have higher expectations regarding their own education.

Finally, due to the sharp rural-urban disparity in China, we examine how the impacts of parental SES on the cognitive development of their children differ in rural and urban areas. We find that the gap in the cognitive abilities of children with low- and high-SES parents is more prominent in rural areas than in urban areas, implying that rural families are more constrained by family resources because of their relatively less developed education. Therefore, public policies aimed at improving social mobility and reducing inequality should focus more on rural areas.

Overall, our paper contributes to the literature mainly in the following ways. First, the effect of family SES on children's cognition partially reflects the intergenerational transmission of cognition via genetic inheritance or the nurturing effect (Anger & Heineck, 2010). A significant limitation of the few existing studies on Chinese cases is that they did not take into consideration parents' cognitive abilities, which may result in endogenous problems (Liu et al., 2020; Zhang, 2021). The CFPS data has detailed information on both parents' cognitive tests, which allows us to control for this important confounding factor.

[1] The GINI coefficients published by China National Bureau of Statistics are slightly smaller, which peaked of 0.49 in 2008 and 2009, and remained 0.46–0.48 afterward.

[2] Early economics studies focused more on the impact of parental characteristics on children's labor market outcomes, such as education and income. Please see Solon (1999) and Black and Devereux (2011) for reviews.

Second, inferring the causal effect of parental characteristics frequently relies on a policy experiment in which the causal effect is restricted to those who complied with the policy (Imbens & Angrist, 1994). Different from these studies using policy experiments in China (Cui et al., 2019 for education; Zhou et al., 2020 for income), examining the effect of family SES provides a more complete picture across a larger population regarding the distribution and inequality of child cognitive ability. SES contains multiple dimensions related to a family's social and economic status, while the policy effect usually focuses on one dimension, either education or income. It is critical to integrate them into the same framework to analyze them more thoroughly.

Third, our study carefully examines the potential underlying mechanisms. We not only examine the channel of parental investment, which is frequently discussed in the literature, we also investigate the gap in parental productivity between high- and low-SES families. Additionally, we extend the previous research by further studying parental beliefs and parental expectations for their children, which have been shown to be predictors of children's outcomes (Favara, 2017; Foley et al., 2014; Jacob & Linkow, 2011; Kottelenberg & Lehrer, 2019; Murayama et al., 2016; Yamamoto & Holloway, 2010).

The rest of the paper is arranged as follows: Section 2 briefly reviews the previous literature. Section 3 presents the data, sample, and empirical research design. Section 4 presents the main results and the underlying mechanisms. Section 5 presents the results of robustness checks. We conclude the paper in Section 6.

2. Literature review

Parents play a critical role in children's cognitive development. Intergenerational transmission has been empirically examined in various countries, e.g., Anger and Heineck (2010) in Germany and Black et al. (2009) in Norway. Anger and Heineck (2010) identified two main channels of intergenerational transmission of cognitive ability, nature and nurture. The former is through inheritance of genes, which is biological (Plomin et al., 1994), and the latter is the positive result of parents' behaviors (Ermisch, 2008). However, as Cunha and Heckman (2007) pointed out, it is obsolete to distinguish between nature and nurture factors because there are more complex interaction mechanisms behind the two. The effect of parental SES on children's cognition partially reflects the intergenerational transmission of cognition via genetic inheritance or the nurturing effect (Anger & Heineck, 2010). We will briefly review the related studies below.

2.1. How parents' SES impacts children's cognitive skills

Numerous studies demonstrate that the socioeconomic level of parents has a strong correlation with their children's cognitive abilities. Differences in cognitive abilities across children from diverse backgrounds are evident at an early age. Hart and Risley (1995) discovered that children from high socioeconomic status households heard 215,000 words per week, while children from middle class families heard 125,000 words and children from low socioeconomic status families only heard 62,000 words per week. Khanam and Nghiem (2016) demonstrated, using a sample of children in Australia, that parents' income and educational level, which serve as indicators of socioeconomic position, are strongly associated with children's cognitive abilities. Duncan and Magnuson (2005) discovered that disparities in family socioeconomic resources accounted for approximately half of the standard deviation of children's scores, which is approximately eight. Dahl and Lochner (2012) also found that a $1000 increase in income might boost children's reading and math performances by a 6% standard deviation in the near term, with the effect being greater for disadvantaged children. In terms of the context of China, Zhang (2021) found that family SES is positively related to the amount of parental investment and the cognitive abilities of adolescents. Liu et al. (2020) also suggested that young children aged 3 or less from higher SES families exhibited higher cognitive abilities.

2.1.1. The impact of parental income

In terms of income, the following two theories account for the effect of parents' socioeconomic status on children's development (Khanam & Nghiem, 2016): investment theory (Becker & Tomes, 1986; Becker, 1981) and family anxiety theory (Smith & Brooks-Gunn, 1997; Yeung et al., 2002). According to investment theory, parents invest money and time in their children to maximize their own utility. Increased family income enables them to improve their children's learning environment, choose a better community, obtain better health care, and enroll their children in better preschools (Dahl & Lochner, 2012). According to family anxiety theory, income affects a parent's ability to raise their children, as economic hardship has a negative effect on the mental health of parents. Poverty is frequently accompanied by anxiety, depression, and poor health in parents, all of which can negatively impact the nurturing and growth of their children (McLoyd, 1990). For example, Parker et al. (1999) found that low-income parents have a depressed relationship with their children, and their children are more likely to struggle with language development, have difficulty concentrating in class, and exhibit hostility toward other students. Two studies conducted in Canada and the United States demonstrate that income transfer can improve families' emotional well-being (Milligan & Stabile, 2011; Evans & Garthwaite, 2014). Psychologically anxious parents are less likely to be able to promote family functioning and their children's development (Smith & Brooks-Gunn, 1997; Yamauchi, 2010; Yeung et al., 2002). Additionally, parents' socioeconomic status influences their choice of residence community (Khanam & Nghiem, 2016), which has an effect on their children's development. According to some empirical studies, children who live in impoverished communities perform worse academically and have more behavioral and health problems (Contoyannis & Li, 2011; Pebley & Sastry, 2004). In terms of studies in China, Zhou et al. (2020) showed that cash transfer did not significantly affect children's cognitive achievements.

2.1.2. The impact of parental education

Children whose parents have a higher level of education generally achieve greater cognitive and academic achievements than children whose parents have a lower level of education (Duncan & Magnuson, 2005). In addition to the income effect of parental education, which is nonexclusive to the effect of parental income mentioned above, parents with higher education levels are likely to possess greater scientific parenting knowledge and skills, which enables them to choose more effective parenting methods, as evidenced by their time investment and parenting quality. For instance, Doepke et al. (2019) showed that parents with college degrees invest significantly more time in their children than parents with only a high school education in the U.S. and the Netherlands. In the 1970 s, there was little difference in the amount of time parents with a high or low level of education invested in their children in the United States; however, today, parents with a higher education levels invest three hours more per week than parents with lower education levels.

Studies have long investigated the causal role of parental education on children's education, i.e., the intergenerational transmission of education, using instrumental variables (e.g., Black et al., 2005), adopted children (e.g., Björklund et al., 2006), and twin parents (e.g., Behrman & Rosenzweig, 2002).[3] More recent studies have focused on the causal effects of parental education on other outcomes of children, e.g., cognitive and noncognitive skills. Lundborg et al. (2014) found that maternal education had positive effects on the cognitive skills of sons. Carneiro et al. (2013) and Sutin et al. (2017) suggested that parental education plays a role in children's noncognitive development. In China's context, Cui et al. (2019) found a positive causal effect of maternal education on children's cognitive ability using the implementation of compulsory schooling laws in China as an instrumental variable. Leight and Liu (2020) and Wang et al. (2020) investigated the relation between parental education and children's noncognitive abilities. In conclusion, a positive effect of parental education on various outcomes of children is often suggested. In comparison, the association between parental income and children's cognition is relatively mixed after accounting for parental education (Heckman & Mosso, 2014).

2.2. Why parents' SES levels impact children's cognitive skills

2.2.1. Parental SES, parental investment, and productivity

Earlier economic research has established a link between parental characteristics and human capital investment in children and their outcomes (Aiyagari et al., 2002; Becker & Tomes, 1986; Mayer, 1997). Basically, parents who have higher abilities and invest more in parenting are able to achieve more in terms of children's skill development (Heckman et al., 2006). Based on economic theories, developmental psychological researchers developed a framework named *family investment models* to characterize the relationship between parental SES, parental investment and children's cognitive abilities (e.g., Conger & Dogan, 2007; Conger & Donnellan, 2007). Heckman and colleagues' recent studies are among the first to use dynamic structural models to characterize the process and predictors of children's cognitive development (Cunha & Heckman, 2006, 2007, 2007). All of these studies indicated that parental investment plays a role in the cognitive development differences between children from various socioeconomic backgrounds. Consistent evidence in empirical studies was also supportive. For example, it was found that parental investments and parenting styles are important for the development of millennials in England (Hernandez-Alava & Popli, 2017; Ermisch, 2008), and parental investments differ in terms of different family SES levels, resulting in various outcomes for children in the US (List et al., 2021).

Productivity measures the effect of the same amount of parental investment on the cognitive outcomes of children, which may vary according to the parents' SES level; for example, highly educated parents are able to invest more in their children, such as providing them with high-quality accompanying or choosing high-quality learning materials. Early structural models, as mentioned above, often assume that parental qualities and investment have a consistent production function across SES groups. However, the structural model developed by Heckman and Mosso (2014) allowed the return to parental investment to differ with different parental skills, and a recent study by Falk et al. (2021) focused on the heterogeneity in the production function of parental investment across different SES families and empirically examined the difference in productivity using US data. Little is known about the productivity of parental investment in a developing country such as China, which might have different patterns.

2.2.2. Parental SES, parental beliefs, and expectations

While the effect of parental SES and investment on children's outcomes has been well established, very few studies have focused on the significance of parental beliefs and expectations, as these aspects are difficult to measure (Kottelenberg & Lehrer, 2019). Recent economic and developmental psychological research has examined the roles of parents' view of education (Foley et al., 2014; Jacob & Linkow, 2011; Kottelenberg & Lehrer, 2019) and parental expectations for children (Favara, 2017; Murayama et al., 2016; Yamamoto & Holloway, 2010) in children's school performance and educational attainment. Using US data, List et al. (2021) show that parents of different SES exhibit different beliefs about human capital investment. Their field experiment supported that belief and thus parental behavior and children's readiness outcomes can be changed through intervention. Studies conducted among Chinese families also demonstrate the importance of parental belief and expectation in children's growth (Phillipson & Phillipson, 2017; Zhong et al., 2020). However, little is known about how parental beliefs and expectations vary according to family background and thus account for the achievement gap between children, especially regarding cognitive development.

[3] Please see Black and Devereux (2011) and Holmlund et al. (2011) for detailed reviews.

3. Data and methodology

3.1. Data source

Our main dataset is drawn from three waves of China Family Panel Studies (CFPS), i.e., 2010, 2014 and 2018, which is 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 8990 children, in 25 designated provinces, with an approximate response rate of 81%, and the majority of non-responses were due to noncontact (Xu & Xie, 2015). The stratified multistage sampling strategy ensures that the CFPS sample represents 95% of the total population in 2010 (Xie, 2012). To enlarge the sample size, we combined the three waves of the CFPS (2010, 2014 and 2018) into pooled cross-sectional data, as the same questionnaire was used for the three years that the survey on the cognitive ability of children aged 10 and 15 years was administered. We then match the parent–child data and drop the observations with missing values for relevant variables. As the CFPS investigates all household family members, the parents and children could be matched completely. We eventually form a sample of 5207 children aged 10–15 with complete household and parental information. Among the sample children, 814 were observed in both 2010 and 2014, 644 were observed in both 2014 and 2018, and the rest were observed only once.[4]

3.2. Main variables

3.2.1. Measures of cognitive ability: language and math

The CFPS 2010, 2014 and 2018 has two tests to measure cognitive ability, i.e., the word test and math tests, and both are designed to be taken by both adults and children aged 10–15 years with the same rules and questions. The test questions and scores are comparable for the three survey years.

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 cognitive ability in mathematics and logic analysis. The math test contains four problem sets with 24 questions in each set. In the estimation, we use standardized scores rather than raw scores for both the language and math tests.[5]

3.2.2. Measures of parents' socioeconomic status

In line with common classifications (e.g., Falk et al., 2021), we use parental income and education to quantify SES. To capture the heterogeneous influence of fathers and mothers separately, we compute fathers' and mothers' income and education as four dummy indicators for parents' SES. Specifically, the income variables indicate whether a father's/mother's income is greater than the median income of the entire father/mother sample in each survey year. Similarly, the education variables indicate whether the father/mother has completed at least junior high school. In the robustness check, we also used the combined measurements of both parents' income/education, as well as continuous variables of father's/mother's income and their respective schooling years.

3.2.3. Measures of parental investment

We use three variables to measure parental investment. Among them, "*parental accompanying*" measures the frequency with which parents spend time with and care about their children. "*Education expenditure*" measures the family spending on the children's schooling. Finally, "*extracurricular class*" indicates whether the child is enrolled in after school classes or not. All these variables are derived from questions in the CFPS child survey that are answered by the parent who had a better understanding of their children's situation.

3.3. Summary statistics

Table 1 shows the descriptive statistics of the main variables used in the estimations. In the sample, while the maximum score that one can achieve is 34 points in word and 24 points in math, the average word test score of the children in our sample is 21.58 points, and the average math test score is 11.14 points. In general, fathers have higher education levels than mothers, as well as income. In terms of children's characteristics, the average age of the children in the sample is 12 years old, with 52% being males. Twenty-one percent of the children in the sample hold urban *Hukou,* and the majority (88%) are of Han ethnicity. In the sample, approximately 25% of the children are only children. In terms of parental cognitive ability, fathers generally have higher word and math cognitive ability levels than mothers. Additionally, on average, both fathers and mothers have lower scores than their children in both language and math.

Table 2 presents a mean comparison of the key variables between high and low parental SES levels, distinguishing both fathers' and

[4] As a robustness check, we drop the 2nd observation of those observed twice, and the results are constant.

[5] Specifically, the standardized *word test* score of individual *i* equals the raw *word test* score of individual *i* minus the average *word test* score of the sample, divided by the standard deviation of the *word test* score of the sample. The same approach is adopted for calculating the standardized *math test* score.

Table 1
Descriptive statistics of the main variables.

Variables	Obs.	Mean	S.D.	Min	Median	Max
Cognitive ability						
Word test	5207	21.58	7.95	0.00	23.00	34.00
Math test	5053	11.14	4.45	0.00	11.00	24.00
Parental SES						
Mother's educational level						
Illiteracy	5207	0.28	0.45	0.00	0.00	1.00
Primary school	5207	0.27	0.44	0.00	0.00	1.00
Junior high school	5207	0.30	0.46	0.00	0.00	1.00
Senior high school and above	5207	0.15	0.36	0.00	0.00	1.00
Father's educational level						
Illiteracy	5207	0.16	0.36	0.00	0.00	1.00
Primary school	5207	0.27	0.44	0.00	0.00	1.00
Junior high school	5207	0.37	0.48	0.00	0.00	1.00
Senior high school and above	5207	0.20	0.40	0.00	0.00	1.00
Mother's income (yearly, in thousand *yuan*)	5207	8.90	20.76	0.00	0.30	800.00
Father's income (yearly, in thousand *yuan*)	5207	18.95	27.23	0.00	10.00	581.00
Children's characteristics						
Male	5207	0.52	0.50	0.00	1.00	1.00
Age	5207	12.49	1.73	10.00	12.00	15.00
Urban *Hukou*	5207	0.21	0.41	0.00	0.00	1.00
Ethnicity (Han=1)	5207	0.88	0.33	0.00	1.00	1.00
Weight (kilo)	5207	81.14	23.51	5.00	80.00	200.00
Height (cm)	5207	148.70	16.18	50.00	150.00	186.00
No schooling	5207	0.00	0.05	0.00	0.00	1.00
Primary school	5207	0.58	0.49	0.00	1.00	1.00
Junior high school and above	5207	0.42	0.49	0.00	0.00	1.00
Only child	5207	0.25	0.43	0.00	0.00	1.00
Parental and family characteristics						
Mother's word test	5105	16.46	10.98	0.00	20.00	34.00
Mother's math test	4889	9.10	6.02	0.00	9.00	24.00
Father's word test	5020	18.61	10.05	0.00	21.00	34.00
Father's math test	4693	11.18	5.36	0.00	12.00	24.00
Mother's age	5207	39.08	4.95	23.00	39.00	76.00
Father's age	5207	40.92	5.16	27.00	40.00	80.00
Household size	5207	4.86	1.65	2.00	5.00	17.00

Table 2
Statistics of children's cognition and parenting investments by parents' SES.

	Fathers' income		Mothers' income		Parents' income	
	Low	*High*	*Low*	*High*	*Low*	*High*
Word Test	21.4	23.2 ***	21.6	23.0 ***	20.7	23.3 ***
Math Test	10.8	11.8 ***	10.8	11.8 ***	10.4	11.9 ***
Parental accompanying	3.2	3.3 ***	3.2	3.3 ***	3.0	3.4 ***
Educational expenditure	6.6	7.1 ***	6.7	7.0 ***	6.4	7.1 ***
Extracurricular class	0.16	0.25 * **	0.16	0.25 ***	0.10	0.27 ***
No. of observations	2578	1994	2586	1986	1965	2607
	Fathers' education		Mothers' education		Parents' education	
	Low	*High*	*Low*	*High*	*Low*	*High*
Word test	20.7	23.3 ***	20.9	23.8 ***	20.9	23.8 ***
Math test	10.4	11.9 ***	10.4	12.2 ***	10.4	12.2 ***
Accompany	3.0	3.4 ***	3.0	3.5 ***	3.0	3.5 ***
Educational expenditure	6.4	7.1 ***	6.4	7.4 ***	6.4	7.3 ***
Extracurricular class	0.10	0.27 ***	0.10	0.32 ***	0.10	0.32 ***
No. of observation	1965	2607	2530	2042	2530	2042

Notes: Father's (or mother's) income is *high* if the father's (or mother's) income exceeds the sample median. Parents' income is *high* if both the father's and mother's income is *high*. Father's (or mother's) education is *high* if the father (or mother) completed junior high school education or above. Parents' education is *high* if both the father and mother have junior high school education or above. *Word test* and *Math test* are the raw scores of the child's cognition tests. *Parental accompanying* is a scale variable with a value from 1 to 5 indicating the frequency that parents accompany their children from *never* to *always*. *Educational expenditure* is the logged yearly total expenditure on a child's education. *Extracurricular class* is a dummy variable indicating whether a child is enrolled in extracurricular class after school.

mothers' education and income. Overall, the results show a consistent gap between the high and low groups. That is, children of high SES parents (high education/income of either parent) have significantly higher scores on the word and math tests. In addition, parents of high SES spend significantly more time with their children, invest more in education materials and are more likely to have children

enrolled in extracurricular classes.

Furthermore, following Falk et al. (2021), we combine both fathers' and mothers' incomes, as well as their education levels to compute a family index and classify the children into two groups, i.e., either high SES family or not. Fig. 1 demonstrates that children from high-SES families have significantly greater cognitive abilities and parental investment levels (*parental accompanying, education expenditure, extracurricular class*) than children from low-SES families.

4. Empirical results

4.1. Empirical approach

Our main research question is the impact of parents' SES on their children's cognitive abilities. We therefore estimate the following ordinary least square model:

$$y_i = \alpha + \beta SES_i + \delta Cognition_i^P + \gamma \boldsymbol{x_i} + Province_i + Survey\_year_i + \varepsilon_i \quad (1)$$

where y_i is child i's cognitive ability measured by word and math test scores. SES_i is the parents' socioeconomic status of child i, for which we use four dummy variables to measure both the father's and mother's income and education levels. $Cognition_i^P$ is the cognitive ability of the parents of child i. The intergenerational transmission of cognitive ability is the main concern in the estimation. Fortunately, in the CFPS data, the parents were asked to complete the same word and math cognitive tests as the children, which allows us to account for parents' cognitive abilities. This is important: as the cognitive ability of parents is likely to be associated with their own SES and it may also capture some unobservable family characteristics, omitting this variable might result in serious endogeneity problems. We standardized fathers' and mothers' word and math test scores by educational level. $\boldsymbol{x_i}$ is a vector of child i's individual, household, and parental characteristics, including child's gender, education, age, height, weight, ethnicity, hukou status, being an only child or not, household size and income, and both the father's and mother's age and job dummies. Finally, we also control for provincial fixed effects and the survey year dummies to account for the unobservable heterogeneity that is invariant within provinces and survey years. ε_i denotes the error term.

4.2. Baseline results

Table 3 presents the main findings.[6] We begin by examining the effects of parents' SES on children's word and math cognitive test scores without controlling for parents' cognitive abilities in Columns (1) and (2). Columns (3) and (4) contain estimates of the effects after taking into consideration the father's and mother's word and math cognitive test scores. As observed, either the father's or mother's education level has a significant impact on the cognitive abilities of the children. Specifically, when a father has a high education level, his child's word and math scores are both significantly higher by 7.6 standard deviations than when a father has a low educational SES. Similarly, children of mothers with a high levels of education have scores 7.4% and 11.2% standard deviations higher on the word and math cognitive tests, respectively. The effect of parental education on children's math abilities is slightly greater than the effect of parental education on children's word abilities. In terms of income, we do not find a significant difference in the word and math abilities of children with high- and low-income-SES parents.[7] This insignificant effect of parental income on children's cognition is in line with the theoretical analyses of Heckman and Mosso (2014), which implies that when controlling for parental education and maternal ability, the effect of family income on children's outcomes is largely eliminated. Empirical evidence also suggests that after accounting for confounding factors, the impact of income on children's outcomes is less clear (Carneiro & Heckman, 2002; Duncan et al., 1998; Løken, 2010). In terms of China's context, Zhou et al. (2020) also showed that an increase in income had an insignificant impact on children's cognition using a cash transfer program in rural China. Consistent with the prediction, parents' language scores are significantly associated with children's cognitive abilities both in language and math, whereas parents' math scores are only related to children's math abilities.

4.3. Mechanisms

We explore the underlying mechanisms by which parental SES affects children's cognitive outcomes in the following ways. We first consider three potential channels through which parental SES may affect children's cognitive outcomes, including parental investment (level effect), parenting productivity (efficiency effect), and beliefs and expectations. Given the regional disparity between rural and urban areas in China, we also investigate rural-urban heterogeneity.

4.3.1. SES and parental investment

Previous literature shows that apart from the nature effect (genetic inheritance), parents' income and education have a nurturing

[6] In the robustness check, we also used the continuous variables of father and mother's income and schooling years, as well as the dummies of parents' income and education as measurements of parental SES. The results are consistent.

[7] The results are similar if we add parent's income and squared income in the regression, or if we use five quantiles of income to measure parental SES.

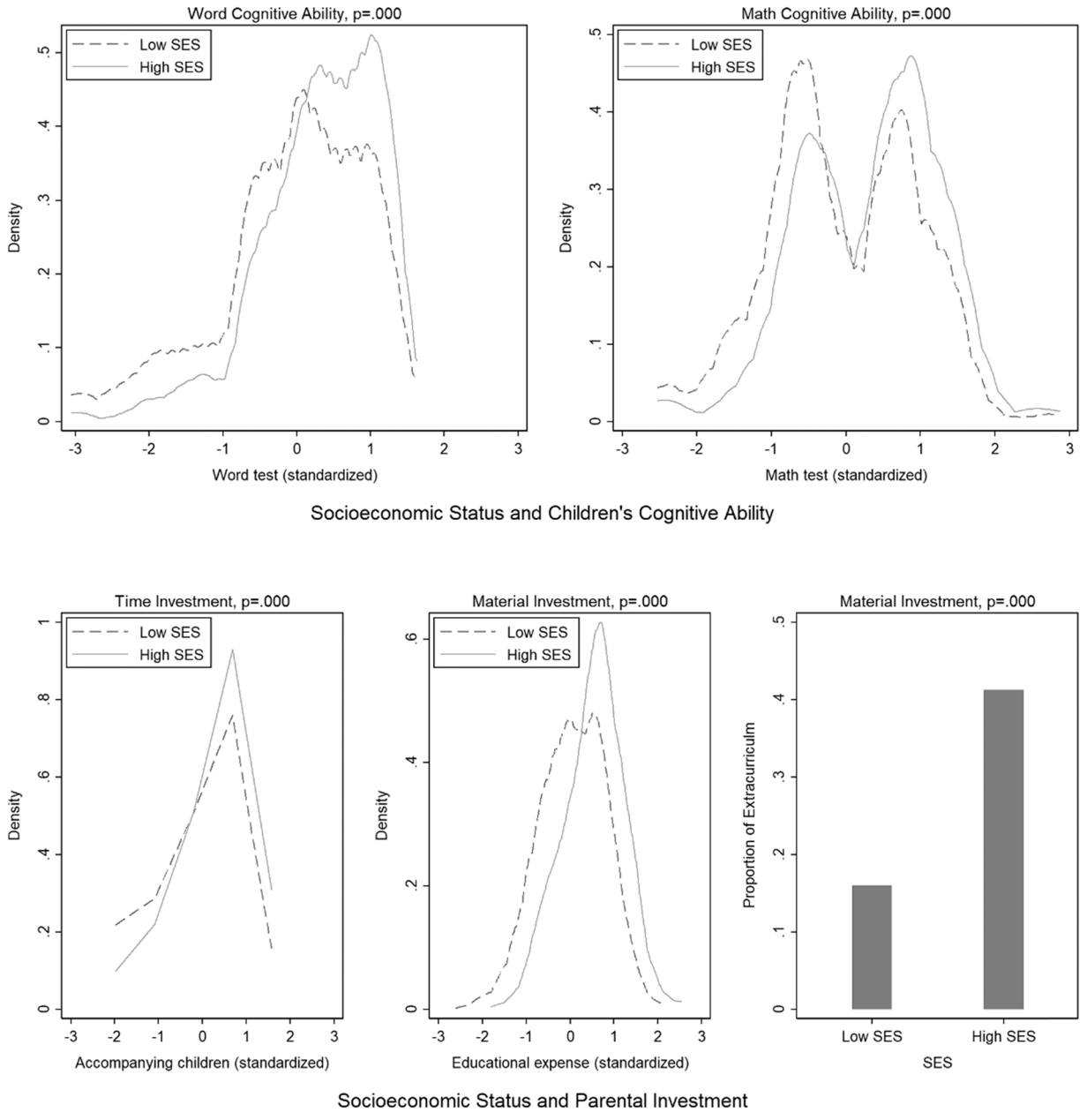

Fig. 1. Socioeconomic status, children's cognitive abilities and parental investment.

effect on their children's outcomes through, for example, financial investment and parenting (Black & Devereux, 2011). By estimating the following equation, we examine the effect of parents' SES on parental investment, which serves as a potential channel of the effect of parents' SES on children's cognitive outcomes:

$$z_i = \alpha + \beta SES_i + \delta Cognition_i^P + \gamma \boldsymbol{x_i} + Province_i + Survey\_year_i + \varepsilon_i \tag{2}$$

where z_i denotes parental investment in child i. As in the literature, parental investment can be either in terms of time investment or material investment. In our study, we have information on parental accompaniment, which can serve as a proxy for parental investment in time. *Parental accompanying* is a scale variable with a value from 1 to 5 indicating the frequency with which parents accompany children, with 1 indicating the lowest level of "never" and 5 indicating the highest level of "always".

In terms of material investment, we have the variable *education expenditure*, which is the logged yearly total expenditure on children's education. In addition, we have information on whether the child has taken an extracurricular class after school or not, represented by the dummy variable *extracurricular class*. This variable could be considered as parental investment both in time and

Table 3
OLS Estimation of the Effects of Parents' SES on Children's Cognitive Abilities.

Independent variable	(1)	(2)	(3)	(4)
	Dependent variable			
	Word Test	*Math Test*	*Word Test*	*Math Test*
Parental SES				
High education of mother	0.067 **	0.111 ***	0.075 ***	0.114 ***
	(0.030)	(0.027)	(0.027)	(0.028)
High education of father	0.071 **	0.088 ***	0.076 **	0.077 ***
	(0.033)	(0.029)	(0.030)	(0.029)
High income of mother	0.020	0.019	0.004	0.008
	(0.034)	(0.028)	(0.030)	(0.029)
High income of father	0.031	0.018	0.032	-0.010
	(0.027)	(0.024)	(0.025)	(0.025)
Parents' cognitive abilities				
Mother's word test			0.128 ***	0.104 ***
			(0.020)	(0.019)
Mother's math test			0.014	0.058 ***
			(0.016)	(0.014)
Father's word test			0.150 ***	0.099 ***
			(0.026)	(0.025)
Father's math test			-0.009	0.024*
			(0.013)	(0.014)
Control variables	YES	YES	YES	YES
Observations	5207	5053	4591	4569
R-squared	0.263	0.467	0.387	0.498

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; Control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

material, as after-school classes are usually outside of regular school, parents need to take the children to the class and to be enrolled in these classes is an additional cost. The results are presented in Table 4. Neither mothers' nor fathers' incomes have any impacts on either of the dependent variables, suggesting that parental income is not related to parental investment. In terms of education, compared to a low-educated mother/father, a high-educated mother or father is significantly more likely to invest in their children either in time or in material. Specifically, a highly educated mother and father tend to spend more time with their children, the effect being even more prominent for the mothers. They are also more likely to enroll children in extracurricular activities. In addition, a highly educated father also tends to spend significantly more on his children's education.

4.3.2. SES and parenting efficiency

Previous studies suggest that parents of different SESs might differ in terms of their parenting productivity (Falk et al., 2021; Heckman & Mosso, 2014). That is, given the same amount of time and material invested in children, children from high-SES families may have better outcomes in terms of cognitive development. We investigate this channel regarding whether and how parents of different SESs result in different parenting efficiencies with the following equation:

$$y_i = \alpha + \beta_1 SES_i * z_i + \beta_2 SES_i + \beta_3 z_i + \delta Cognition_i^P + \gamma \boldsymbol{x_i} + Province_i + Survey\_year_i + \varepsilon_i \quad (3)$$

where z_i represents parental investment in children *i*. The interaction term $SES_i * z_i$ therefore quantifies the difference in parental investment output between parents with high and low SES, i.e., the difference in parenting efficiency. To simplify the estimation, we compute a single indicator of SES_i for fathers and mothers. It equals one if a father/mother is in the category of high income and high education and zero otherwise.[8] Table 5 presents the findings. Interestingly, all the interaction terms are insignificant, implying that the effect of parental productivity on children's cognitive outcomes does not differ among parents of different SESs. Combined with the results of the first channel above, the finding suggests that the influence of parental investment of parents of different SESs on their children only matters through the quantity of investment (level effect) rather than the productivity (efficiency effect).

4.3.3. Beliefs and expectations

Finally, we examine the channel of beliefs and expectations. It has been shown that the level at which parents value education (Foley et al., 2014; Jacob & Linkow, 2011; Kottelenberg & Lehrer, 2019) and the expectations of parents for their children (Favara, 2017; Murayama et al., 2016; Yamamoto & Holloway, 2010) affect children's human capital outcomes and school performance. Parents of different SESs might value the importance of education differently and have different expectations regarding education for

[8] The results are consistent if we use four dummies, father's and mother's income and education as in the baseline analysis.

Table 4
OLS Estimation of the Effects of Parents' SES on Parental Investment.

Independent variable	(1)	(2)	(3)
	Dependent variable		
	Accompany	*Education expenditure*	*Extracurricular class*
Parental SES			
High education of mother	0.322 ***	0.123 *	0.053 ***
	(0.045)	(0.064)	(0.014)
High education of father	0.066	0.148 **	0.027 **
	(0.044)	(0.060)	(0.012)
High income of mother	0.021	0.050	0.014
	(0.045)	(0.073)	(0.014)
High income of father	-0.026	0.154 **	0.014
	(0.043)	(0.062)	(0.014)
Parent's cognitive ability	YES	YES	YES
Control variables	YES	YES	YES
Observations	4515	4577	4585
R-squared	0.104	0.307	0.223

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5
OLS Estimation of the Effects of Parents' SES on Parenting Productivity.

Independent variable	(1)	(2)
	Dependent variable	
	Word Test	*Math Test*
Parental SES		
High SES of mother* Accompany	0.004	0.007
	(0.029)	(0.023)
High SES of father * Accompany	-0.017	-0.029
	(0.026)	(0.024)
High SES of mother * Education expenditure	0.007	0.015
	(0.019)	(0.014)
High SES of father * Education expenditure	-0.009	-0.010
	(0.017)	(0.015)
High SES of mother * Extracurricular class	-0.029	0.003
	(0.062)	(0.059)
High SES of father * Extracurricular class	0.014	-0.056
	(0.058)	(0.061)
Parent's cognitive ability	YES	YES
Control variables	YES	YES
Observations	4509	4487
R-squared	0.392	0.507

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; Control variables include (1) *high SES of father*, *high SES of mother*, *parental accompanying, education expenditure, extracurricular class*; (2) children's information, i.e., *gender*, *age*, *age squared*, *hukou* (not included in Columns (3) to (6)), *ethnicity*, *weight*, *height*, *education*, and *only child*; (3) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (4) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

their children. Children from different SESs might also have different educational expectations for themselves. As such, in this section, we examine the following questions: in terms of parents, we study whether parents of varying SESs have different beliefs regarding the importance of children's education for achievement and how they place the role of children's effort in achievement; we also examine whether they have varying expectations regarding education for their children. In terms of children, we examine whether children from varying SESs have different education expectations for themselves.

Table 6 exhibits the findings, showing that mothers with higher levels of education value the importance of education in achievement and the role of effort in achieving success more. Table 7 shows that fathers and mothers with higher levels of education exhibit significantly higher expectations for their children's education level. In addition, children of parents with higher education levels also hold significantly higher expectations of their own education.

Table 6
OLS Estimation of the Effects of Parents' SES on Parental Beliefs.

Independent variable	(1)	(2)
	Dependent variable	
	Importance of Child's education	Importance of Child's effort
Parental SES		
High education of mother	0.276 *	0.433 **
	(0.142)	(0.153)
High education of father	-0.038	-0.033
	(0.130)	(0.146)
High income of mother	-0.218	-0.172
	(0.152)	(0.167)
High income of father	0.153	0.102
	(0.155)	(0.166)
Parent's cognition tests	YES	YES
Control variables	YES	YES
Observations	1230	1226
R-squared	0.108	0.078

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 7
OLS Estimation of the Effects of Parents' SES on Education Expectation.

Independent variable	(1)	(2)
	Dependent variable	
	Parents' expectation for child's education	Children' expectation for their own education
Parental SES		
High education of mother	0.085 *	0.253 ***
	(0.045)	(0.050)
High education of father	0.207 ***	0.189 ***
	(0.041)	(0.049)
High income of mother	0.041	-0.036
	(0.059)	(0.053)
High income of father	0.026	0.013
	(0.046)	(0.048)
Parent's cognition tests	YES	YES
Control variables	YES	YES
Observations	3936	4800
R-squared	0.106	0.141

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

4.3.4. Urban-Rural gaps

Given the development disparity between rural and urban regions in China, we further separate the rural and urban samples and study how the impact of parental SES may vary between the two regions. Table 8 illustrates the heterogeneous effects in rural and urban areas. Interestingly, the impact of parental education is more prominent in rural areas. Specifically, children of highly educated mothers or fathers are more likely to have higher scores on both word and math tests in rural areas. In urban areas, only mothers' education has a positive impact on children's word scores. One plausible explanation is that public education is less developed in rural than in urban areas in China; as a result, children's cognitive development could be more dependent on family background in rural areas. Another potential reason is that compared to urban areas, education-related information is also much more limited in rural areas. However, highly educated parents in rural areas are likely to have better access to efficient education information or parenting knowledge through the internet or other channels. Such differences would then further enlarge the disparity between the high- and low-educated parents in rural areas, whereas in urban areas, the information is more widely spread such that parents of different SESs

Table 8
OLS Estimation of the Effects of Parents' SES on Children's Cognitive Abilities, Rural vs. Urban Samples.

Independent variable	(1)	(2)	(3)	(4)
	Rural sample		Urban sample	
	Dependent variable			
	Word Test	*Math Test*	*Word Test*	*Math Test*
Parents' SES				
High education of mother	0.066 **	0.132 ***	0.137 **	0.028
	(0.030)	(0.030)	(0.070)	(0.065)
High education of father	0.076 **	0.066 * *	0.067	0.124
	(0.033)	(0.031)	(0.059)	(0.080)
High income of mother	-0.003	0.012	-0.002	-0.026
	(0.033)	(0.032)	(0.058)	(0.063)
High income of father	0.045	0.029	-0.032	-0.106 **
	(0.028)	(0.030)	(0.050)	(0.051)
Mother's word test	0.129 ***	0.098 ***	0.114 ***	0.154 ***
	(0.022)	(0.021)	(0.037)	(0.042)
Mother's math test	0.013	0.058 ***	0.022	0.056 **
	(0.020)	(0.016)	(0.022)	(0.025)
Father's word test	0.151 ***	0.097 ***	0.119 ***	0.074 *
	(0.030)	(0.028)	(0.034)	(0.043)
Father's math test	-0.012	0.028 *	-0.004	0.022
	(0.016)	(0.016)	(0.022)	(0.023)
Control variables	YES	YES	YES	YES
Observations	3583	3561	1008	1008
R-squared	0.359	0.476	0.426	0.548

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age, age squared*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's age, job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

may not have large differences in accessing education and parenting knowledge.

In terms of income, a father's income is shown to have a positive effect on his children's word and math abilities in rural areas but has a negative effect in urban areas. This indicates that the income effect in rural areas is more important because families with high-income fathers face fewer financial constraints. However, in urban areas, it seems that the substitution effect is more important and in order to work and earn more money, fathers may face time constraints, which affect their ability to accompany their children.[9] This result is consistent with the findings of Han and Fox (2011), who found that children with parents who work night shifts suffered from lower reading and math abilities. In China's context, the study of parental migration and left behind children share the similar implications (Liu et al., 2021).

5. Robustness check

5.1. Alternative measurements of SES

At the baseline, we use fathers' and mothers' incomes and education levels separately to measure SES. For the robustness check, we compute SES in two different ways. First, we combine both fathers' and mothers' incomes and education levels to compute high or low family income and high or low family education level as two dummy variables for SES. For example, if both parents are in the high-income group, then the family income is in the high-SES group, and if both parents are in the high-education group, the family education is in the high-SES group. Thus, instead of using four dummies as in the baseline, we use only two dummies in the robustness check. Second, different from the baseline, we use the continuous variables of income (precisely the logged form) and education (measured by years of schooling) rather than the dummy variables for both the father and the mother.

The results are presented in Tables 9 and 10. As the tables show, the results are rather consistent with the baseline. That is, only the parents' education levels affect the children's cognitive abilities.

5.2. Control for potential omitted variables regarding parents' attitudes toward wealth

Parents' attitudes toward wealth may affect their efforts to attain a higher SES and potentially affect children's cognitive outcomes simultaneously through parental influence. Omitting this control might result in endogenous problems. The survey also recorded

[9] In line with this argument, we found that parents with high incomes spent less time accompanying their children in urban areas, although statistically insignificant, while in rural areas the difference in parental accompanying between low- and high-income parents is small. These results are not reported but are available upon request.

Table 9
Robustness check: combination of mother's and father's SES.

Independent variable	(1)	(2)
	Dependent variable	
	Word Test	*Math Test*
Parental SES		
High education of parents	0.117 ***	0.132 ***
	(0.028)	(0.030)
High income of parents	0.014	-0.032
	(0.030)	(0.028)
Parent s′ cognition tests	YES	YES
Control variables	YES	YES
Observations	4591	4569
R-squared	0.386	0.496

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 10
Robustness check: continuous variables as measurements for SES.

Independent variable	(1)	(2)
	Dependent variable	
	Word Test	*Math Test*
Parents' SES		
Mother's years of schooling	0.010 **	0.009 **
	(0.004)	(0.004)
Father's years of schooling	0.021 ***	0.020 ***
	(0.004)	(0.004)
Mother's income (logged)	-0.003	0.001
	(0.003)	(0.003)
Father's income (logged)	0.003	-0.002
	(0.003)	(0.004)
Parents' cognition tests	YES	YES
Control variables	YES	YES
Observations	4591	4569
R-squared	0.393	0.500

Notes: Robust standard errors are in parentheses; parental SES is measured by both parents' schooling years and logged income; the word and math test scores are standardized separately; the control variables include: (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, *household income per capita*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

parents' attitudes toward wealth through three specific questions that ask for their subjective value of wealth, their agreement with the statement that wealth reflects personal achievement, and their agreement with the statement that hard work pays off. As such, we could test the robustness of the findings by further controlling these variables. As Table 11 shows, the main findings remain unchanged when parental attitudes toward wealth are considered.

In addition, parents' non-cognitive skills might also be omitted as they could affect children's cognitive development through parental style. As a robustness check, we control for father's and mother's non-cognitive abilities and the results are similar. We did not tabulate the results for brevity.

5.3. Control for public welfare and public policies

As the last robustness check, we take into consideration public welfare and public policies. As we have three waves of the survey with a maximum time length of eight years, it is possible that the parents in our sample have experienced different specific public policies, which may be confounding factors influencing both the parental SESs and children's cognitive outcomes. For example, parents of the generation who have been exposed to the compulsory education law are likely to benefit from the policy, and these positive effects may also influence their offspring's education outcomes.

Table 11
Robustness check: control for parents' attitudes toward wealth.

Independent variable	(1)	(2)
	Dependent variable	
	Word Test	*Math Test*
Parents' SES		
High education of mother	0.064 **	0.110 ***
	(0.027)	(0.029)
High education of father	0.087 ***	0.069 **
	(0.030)	(0.029)
High income of mother	0.002	0.016
	(0.031)	(0.030)
High income of father	0.020	-0.016
	(0.024)	(0.026)
Father's and mother's attitudes	YES	YES
Parents' cognition tests	YES	YES
Control variables	YES	YES
Observations	4280	4258
R-squared	0.384	0.506

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

We consider the following three main factors, which have been demonstrated to contribute significantly to cognitive abilities in China in the previous literature (Cheng et al., 2018; Cui et al., 2019): parents' enrollment in public health insurance and public pension, as well as their exposure to the 1986 compulsory schooling laws. The results in Table 12 show that controlling for these factors does not change the main results, which further confirms the robustness of our findings.

6. Conclusions

China has experienced increasing inequality in recent years. How does inequality affect the cognitive development of the next generation? Using nationally representative data from the CFPS (2010, 2014, and 2018), this paper is one of the first to provide a comprehensive investigation of parental SES and children's cognitive outcomes in China. Our study moves beyond the existing work by

Table 12
Robustness check: control for public welfare and public policies.

Independent variable	(1)	(2)	(3)	(4)
	Dependent variable			
	Word Test	*Math Test*	*Word Test*	*Math Test*
Parental SES				
High education of mother	0.075 ***	0.114 ***	0.076 ***	0.115 ***
	(0.027)	(0.028)	(0.027)	(0.028)
High education of father	0.075 **	0.076 ***	0.078 ***	0.077 ***
	(0.030)	(0.029)	(0.030)	(0.029)
High income of mother	0.005	0.009	0.001	0.008
	(0.030)	(0.029)	(0.030)	(0.029)
High income of father	0.031	-0.010	0.031	-0.010
	(0.025)	(0.025)	(0.025)	(0.025)
Father has public health insurance	YES	YES		
Mother has public health insurance	YES	YES		
Father has a public pension	YES	YES		
Mother has a public pension	YES	YES		
Father's exposure to CSLs			YES	YES
Mother's exposure to CSLs			YES	YES
Parent's cognition tests	YES	YES	YES	YES
Control variables	YES	YES	YES	YES
Observations	4591	4569	4591	4569
R-squared	0.387	0.498	0.388	0.498

Notes: Standard errors clustered at interviewer level are in parentheses; the word and math test scores are standardized separately; the control variables include (1) children's information, i.e., *gender*, *age*, *age squared*, *hukou*, *ethnicity*, *weight*, *height*, *education*, and *only child*; (2) family and parents' information, i.e., *father's and mother's word test*, *math test*, *age*, *job dummy variables*, and *household size*; (3) *province dummy variables, and survey year dummy variables*. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

using parent's cognitive scores as proxies for genetic inheritance and by examining various novel mechanisms within the same framework. After taking into consideration the potential endogeneity caused by the direct intergenerational transmission of cognitive ability, the results show that parents' education levels rather than income levels are positively associated with their children's cognitive abilities. The main mechanisms are as follows: parents of high SESs (specifically highly educated parents) invest more in their children both in terms of time and material investments, and they value the role of children's education in achievement more and place higher importance on children's effort in success, as well as hold higher expectations for the education levels achieved by their children. In addition, children of high SES also have higher expectations of their own education. That said, the high SES families exhibit different beliefs compared to low SES families both in terms of the belief in the value of human capital and in educational investment. Surprisingly, different from the literature, we do not find significant differences in parenting productivity between low- and high-SES families, which indicates that investment quantity matters more than quality in children's development at China's current development stage. Finally, the heterogeneous analysis shows that the SES effect is more prominent in rural areas than in urban areas, confirming the education resource constraint in less developed regions.

The findings in this paper contribute to a better understanding of the pattern of disparity in children's cognitive development in China and provide empirical evidence for efficient public policies that may reduce social and economic inequality. One of the policy implications drawn from our study is that the education of parents is extremely important to reduce intergenerational inequality and therefore overcome poverty trap generation by generation. Another lesson is that developing human capital is crucial, particularly in rural China at the current stage, where education resources and information are much more limited than in urban areas.

Due to data availability, our study only focuses on children between the ages of 10 and 15. As children's cognitive abilities form and disperse at the early stage of childhood (Cunha & Heckman, 2007), future studies may focus on younger children to obtain a complete picture of the SES impacts on children's cognitive abilities across ages. Furthermore, while we focus mainly on children's cognitive abilities, it has been shown that a single skill is insufficient to predict life achievements (Almlund et al., 2011; Heckman & Kautz, 2013). Further research might extend the attention to the impact on children's noncognitive skills, school achievement, and long-term labor market performance.

Funding

This research is supported by the China Center for the Economics of Human Development Project in 2019, the Fundamental Research Funds for the Central Universities, the Research Funds of Renmin University of China (Approval No. 21XNLG03) under the "Thematic Research Project on China's Income Distribution", National Natural Science Foundation of China (Grant No. 72273014), and Humanities and Social Science Foundation of Ministry of Education of China (Grant No. 22YJA790070).

Statements and Declarations

The authors declare no competing interest related to this paper. No new data were created for this study. Data used in this article are publicly available upon request from the Institute of Social Science Survey at Peking University. Ethical approval for the original data collection could be located at http://www.isss.pku.edu.cn/cfps.

Data availability

Data used in this paper are publicly available upon request. The link is http://www.isss.pku.edu.cn/cfps.

References

Aiyagari, S. R., Greenwood, J., & Seshadri, A. (2002). Efficient investment in children. *Journal of Economic Theory, 102*(2), 290–321.
Almlund, M., Duckworth, A. L., Heckman, J., & Kautz, T. (2011). Personality psychology and economics. In *Handbook of the Economics of Education* (Vol. 4, pp. 1–181). Elsevier,.
Anger, S., & Heineck, G. (2010). Do smart parents raise smart children? The intergenerational transmission of cognitive abilities. *Journal of Population Economics, 23*(3), 1105–1132.
Becker, G.S., 1981, A Treatise on the Family, Cambridge, MA: Harvard University Press.
Becker, G. S., & Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of Labor Economics, 4*, S1–S39.
Behrman, J. R., & Rosenzweig, M. R. (2002). Does increasing women's schooling raise the schooling of the next generation? *American Economic Review, 92*(1), 323–334.
Bingley, P., Christensen, K., & Jensen, V. M. (2009). Parental schooling and child development: Learning from twin parents. *The Danish National Centre for Social Research Working, Paper, 7*, 2009.
Björklund, A., Lindahl, M., & Plug, E. (2006). The origins of intergenerational associations: Lessons from Swedish adoption data. *The Quarterly Journal of Economics, 121*(3), 999–1028.
Black, S. E., & Devereux, P. J. (2011). Recent developments in intergenerational mobility. *Handbook of Labor Economics, 4*, 1487–1541.
Black, S. E., Devereux, P. J., & Salvanes, K. G. (2005). Why the apple doesn't fall far: Understanding intergenerational transmission of human capital. *American Economic Review, 95*(1), 437–449.
Black, S. E., Devereux, P. J., & Salvanes, K. G. (2009). Like Father, Like Son? A Note on the Intergenerational Transmission of IQ Scores. *Economics Letters, 105*(1), 138–140.
Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53*(1), 371–399.
Carneiro, P., & Heckman, J. J. (2002). The evidence on credit constraints in post-secondary schooling. *The Economic Journal, 112*(482), 705–734.
Carneiro, P., Meghir, C., & Parey, M. (2013). Maternal education, home environments, and the development of children and adolescents. *Journal of the European Economic Association, 11*(suppl_1), 123–160.

Cheng, L., Liu, H., Zhang, Y., & Zhao, Z. (2018). The health implications of social pensions: Evidence from China's new rural pension scheme. *Journal of Comparative Economics, 46*(1), 53–77.
Conger, R. D., & Dogan, S. J. (2007). Social Class and Socialization in Families. In J. E. Grusec, & P. D. Hastings (Eds.), *Handbook of Socialization: Theory and Research* (pp. 433–460). The Guilford Press.
Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*, 175–199.
Contoyannis, P., & Li, J. (2011). The evolution of health outcomes from childhood to adolescence. *Journal of Health Economics, 30*, 11–32.
Cui, Y., Liu, H., & Zhao, L. (2019). Mother's education and child development: Evidence from the compulsory school reform in China. *Journal of Comparative Economics, 47*(3), 669–692.
Cunha, F., & Heckman, J. (2007). The technology of skill formation. *American Economic Review, 97*(2), 31–47.
Cunha, F., & Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources, 43*(4), 738–782.
Currie, J., & Almond, D. (2011). Human capital development before age five. *Handbook of Labor Economics* (pp. 1315–1486). Elsevier,.
Currie, J., & Thomas, D. (2001). Early test scores, socioeconomic status, school quality and future outcomes. *Research in Labor Economics, 20*, 103–132.
Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: evidence from the earned income tax credit. *American Economic Review, 102*, 1927–1956.
Doepke, M., Sorrenti, G., & Zilibotti, F. (2019). The economics of parenting. *Annual Review of Economics, 11*, 55–84.
Duncan, G. J., & Magnuson, K. A. (2005). Can family socioeconomic resources account for racial and ethnic test score gaps? *The Future of Children, 15*(1), 35–54.
Duncan, G. J., Yeung, W. J., Brooks-Gunn, J., & Smith, J. R. (1998). How much does childhood poverty affect the life chances of children? *American Sociological Review*, 406–423.
Ermisch, J. (2008). Origins of Social Immobility and Inequality: Parenting and Early Child Development. *National Institute Economic Review, 205*, 62–71.
Evans, W. N., & Garthwaite, C. L. (2014). Giving mom a break: The impact of higher EITC payments on maternal health. *American Economic Journal: Economic Policy, 6*(2), 258–290.
Falk, A., Kosse, F., Pinger, P., Schildberg-Hörisch, H., & Deckers, T. (2021). Socioeconomic status and inequalities in children's IQ and economic preferences. *Journal of Political Economy, 129*(9), 2504–2545.
Favara, M. (2017). Do dreams come true? Aspirations and educational attainments of Ethiopian boys and girls. *Journal of African Economies, 26*(5), 561–583.
Foley, K., Gallipoli, G., & Green, D. A. (2014). Ability, parental valuation of education, and the high school dropout decision. *Journal of Human Resources, 49*(4), 906–944.
Han, W. J., & Fox, L. E. (2011). Parental work schedules and children's cognitive trajectories. *Journal of Marriage and Family, 73*(5), 962–980.
Hart, B., & Risley, T.R., 1995, Meaningful differences in the everyday experience of young American children. Paul H Brookes Publishing.
Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science, 312*(5782), 1900–1902.
Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences, 104*(33), 13250–13255.
Heckman, J.J., & Kautz, T., 2013, Fostering and Measuring Skills: Interventions that Improve Character and Cognition. NBER Working Paper, (w19656).
Heckman, J. J., & Mosso, S. (2014). The economics of human development and social mobility. *Annual Review of Economics, 6*, 689–733.
Heckman, J. J., Stixrud, J., & Sergio Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics, 24*, 411–482.
Hernandez-Alava, M., & Popli, G. (2017). Children's development and parental input: evidence from the UK Millennium cohort study. *Demography, 54*(2), 485–511.
Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development, 74*(5), 1368–1378.
Holmlund, H., Lindahl, M., & Plug, E. (2011). The causal effect of parents' schooling on children's schooling: a comparison of estimation methods. *Journal of Economic Literature, 49*(3), 615–651.
Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology, 61*(4), 343–365.
Imbens, G. W., & Angrist, J. D. (1994). Identification and estimation of local average treatment effects. *Econometrica, 62*(2), 467–475.
Jacob, B. A., & Linkow, T. W. (2011). Educational expectations and attainment. *Whither Opportunity?: Rising Inequality, Schools, and Children's Life Chances*, 133.
Khanam, R., & Nghiem, S. (2016). Family income and child cognitive and non-cognitive development in Australia: does money matter? *Demography, 53*(3), 597–621.
Kottelenberg, M. J., & Lehrer, S. F. (2019). How skills and parental valuation of education influence human capital acquisition and early labor market return to human capital in Canada. *Journal of Labor Economics, 37*(S2), S735–S778.
Leight, J., & Liu, E. M. (2020). Maternal Education, Parental Investment, and Noncognitive Characteristics in Rural China. *Economic Development and Cultural Change, 69*(1), 213–251.
List, J. A., Pernaudet, J., & Suskind, D. L. (2021). Shifting Parental Beliefs about Child Development to Foster Parental Investments and Improve School Readiness Outcomes. *Nature Communication, 12*, 5765.
Liu, H., Chang, F., Corn, H., Zhang, Y., & Shi, Y. (2021). The impact of parental migration on non-cognitive abilities of left behind children in northwestern China. *Journal of Asian Economics, 72*, Article 101261.
Liu, T., Zhang, X., & Jiang, Y. (2020). Family socioeconomic status and the cognitive competence of very young children from migrant and non-migrant Chinese families: The mediating role of parenting self-efficacy and parental involvement. *Early Childhood Research Quarterly, 51*, 229–241.
Løken, K. V. (2010). Family income and children's education: using the norwegian oil boom as a natural experiment. *Labor Economics, 17*(1), 118–129.
Lundborg, P., Nilsson, A., & Rooth, D. O. (2014). Parental education and offspring outcomes: evidence from the Swedish compulsory School Reform. *American Economic Journal: Applied Economics, 6*(1), 253–278.
Mayer, S.E., 1997, What money can't buy: Family income and children's life chances. Cambridge and London: Harvard University Press.
McLoyd, V. C. (1990). The impact of economic hardship on black families and children: psychological distress, parenting and socioemotional development. *Child Development, 61*(2), 311–346.
Milligan, K., & Stabile, M. (2011). Do child tax benefits affect the well-being of children? Evidence from canadian child benefit expansions. *American Economic Journal: Economic Policy, 3*(3), 175–205.
Murayama, K., Pekrun, R., Suzuki, M., Marsh, H. W., & Lichtenfeld, S. (2016). Don't aim too high for your kids: Parental overaspiration undermines students' learning in mathematics. *Journal of Personality and Social Psychology, 111*(5), 766.
Parker, F. L., Boak, A. Y., Griffin, K. W., Ripple, C., & Peay, L. (1999). Parent-child relationship, home learning environment, and school readiness. *School Psychology Review, 28*(3), 413–425.
Pebley, A. R., & Sastry, N. (2004). Neighborhoods, Poverty, and Children's Well-being. In K. M. Neckerman (Ed.), *Social Inequality* (pp. 119–145). New York, NY: Russell Sage Foundation.
Phillipson, S., & Phillipson, S. N. (2017). Generalizability in the mediation effects of parental expectations on children's cognitive ability and self-concept. *Journal of Child and Family Studies, 26*(12), 3388–3400.
Plomin, R., Owen, M. J., & Mcguffin, P. (1994). The genetic basis of complex human behaviors. *Science, 264*(5166), 1733–1739.
Plug, E. (2004). Estimating the effect of mother's schooling on children's schooling using a sample of adoptees. *American Economic Review, 94*(1), 358–368.
Putnam, R. D. (2016). *Our Kids: The American Dream in Crisis*. Simon and Schuster,.
Reynolds, A. J., Temple, J. A., & Ou, S. R. (2010). Preschool education, educational attainment, and crime prevention: Contributions of cognitive and non-cognitive skills. *Children and Youth Services Review, 32*(8), 1054–1063.
Shi, X. (2022). Inequality of Opportunity in Earnings in Rural China. *Journal of Asian Economics*, Article 101498.

Smith, J. R., & Brooks-Gunn, J. (1997). Correlates and Consequences of Harsh Discipline for Young Children. *Archives of Pediatrics and Adolescent Medicine, 151*, 777–786.
Solon, G. (1999). Intergenerational mobility in the labor market. *Handbook of Labor Economics* (pp. 1761–1800). Elsevier,.
Sutin, A. R., Luchetti, M., Stephan, Y., Robins, R. W., & Terracciano, A. (2017). Parental educational attainment and adult offspring personality: An intergenerational life span approach to the origin of adult personality traits. *Journal of Personality and Social Psychology, 113*(1), 144.
Wang, W., Dong, Y., Liu, X., Bai, Y., & Zhang, L. (2020). The effect of parents' education on the academic and non-cognitive outcomes of their children: Evidence from China. *Children and Youth Services Review, 117*, Article 105307.
Xie, Y. (2012). *The User's Guide of the China Family Panel Studies (2010)*. Beijing: Institute of Social Science Survey, Peking University,.
Xie, Y., & Zhou, X. (2014). Income inequality in today's China. *Proceedings of the National Academy of Sciences, 111*(19), 6928.
Xu, H., & Xie, Y. (2015). The causal effects of rural-to-urban migration on children's well-being in China. *European Sociological Review, 31*(4), 502–519.
Yamamoto, Y., & Holloway, S. D. (2010). Parental expectations and children's academic performance in sociocultural context. *Educational Psychology Review, 22*(3), 189–214.
Yamauchi, C. (2010). Parental Investment in Children: Deferential Pathways of Parental Education and Mental Health. *Economic Record, 86*, 210–226.
Yeung, W. J., Linver, M. R., & Brooks-Gunn, J. (2002). How money matters for young children's development: parental investment and family processes. *Child Development, 73*, 1861–1879.
Zhang, Y. (2021). The role of socioeconomic status and parental investment in adolescent outcomes. *Children and Youth Services Review, 129*, Article 106186.
Zhong, J., Gao, J., Wang, T., He, Y., Liu, C., & Luo, R. (2020). Interrelationships of parental belief, parental investments, and child development: A cross-sectional study in rural China. *Children and Youth Services Review, 118*, Article 105423.
Zhou, L., Jiang, B., & Wang, J. (2020). Do cash transfers have impacts on student Academic, cognitive, and enrollment outcomes? Evidence from rural China. *Children and Youth Services Review, 116*, Article 105158.