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Being an only child and children's prosocial behaviors: evidence from rural China and the role of parenting styles

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Are only children little emperors and more selfish than children with siblings? Drawing on data from the National Children's Study of China, this research investigates the causal relationship between being an only child and the performance of prosocial behaviors. Results indicate that only children tend to show more prosocial tendencies than their counterparts with siblings, particularly with respect to trait-related, relational, and altruistic prosocial behaviors. In addition, the results are robust having accounted for potential biases due to endogeneity, sex selection preferences, and educational choices. Smaller children are also more sensitive to the status of being an only child. The investigation into why only children might exhibit more prosocial behavior suggests that only children perceive more positive parenting styles compared to their peers with siblings. The findings are consistent with the quantity-quality trade-off theory and present evidence about the formation of prosocial behaviors before the age of 15, challenging the stereotype that only children are more selfish than those with siblings.

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Introduction

The only children in China are usually doubted to be spoiled and become little emperors since the enforcement of the world's strictest one-child policy (OCP) in 1980. According to the OCP, couples can have only one child. The exception is that in some rural areas if a couple's first child was a girl, they could have a second child after approval (Yang, 2009). Although China abolished this OCP in 2015, a large proportion of Chinese families still decide to have only one child. Having no siblings leaves children with exclusive access to their families' material and non-material nurturing resources. Additionally, without siblings will lead to the absence of sibling interaction including competition and cooperation. Consequently, the skills formation and attitudes of only children may be affected. Some researchers state that the only children kind to be little emperors and selfish (Cameron et al., 2013; Liu, 2011). But the other side is also possible. The only children with exclusive access to their families' resources can learn from their parents more effectively and have more power to love others. As a result, they may become more prosocial. This study aimed to reexamine whether being an only child will lead to a reduction in a child's ability to develop prosocial behaviors using a large sample from a nationally representative survey.

Prosociality plays a vital role in the performance of employees in the labor market and the efficiency of organizations. Several studies have suggested that prosocial preferences and skills have a significant impact on people's performance in the workplace (Deming, 2017; Kosse and Tincani, 2020). Campos-Mercade et al. (2021) also found a strong correlation between prosocial and health behaviors during the COVID-19 pandemic. The results suggest that people with high prosocial abilities contribute greatly to society's efficiency. Accordingly, prosocial behavior should also be considered an important component of a child's human capital. Therefore, the low performance of prosocial behaviors should contradict the expectations of parents with only children and the theory of human capital accumulation.

Three potential benefits may arise from being an only child. Firstly, only children have more access to material educational resources and parenting styles conducive to their skill development than non-only children. Parents of only children have been shown to provide more patience and support to their children, thus improving their children's prosocial behavior (Carlo et al., 2011). Furthermore, by modeling and internalizing of prosocial values, parents of only children can shape children's prosocial values via specific positive parenting styles (Doepke and Zilibotti, 2017; van der Storm et al., 2022). Second, parents may favor one child over others in the case of multiple children, leading to a psychological imbalance in the other children, ultimately harming their physical and mental development. For example, parents with son preference may place less emphasis on their daughters (Barcellos et al., 2014; Lin et al., 2021). Finally, birth order may also matter because birth order may affect parents' investments, thus affecting children's outcomes (Lehmann et al., 2018). However, the effects of birth order on children's prosocial behaviors are mixed. Children who lose out on family investment games will turn to seek non-kin interactions to compensate for the loss of interactions within families (Salmon et al., 2016).

However, whether being an only child affects prosociality has not been conclusively determined. The "quantity-quality" trade-off theory (Q-Q theory) suggests that having siblings negatively impacts educational achievement (Falbo and Poston Jr., 1993; Rosenzweig and Zhang, 2009). It is unclear whether the Q-Q theory applies to the prosocial behaviors of Chinese children, which depend on social interactions between individuals. In some studies, researchers have concluded that siblings' interactions influence social skills, and singletons display significantly less

prosocial behavior than their non-only peers (Cameron et al., 2013; Li and Qiu, 2021). In contrast, Kadoya et al. (2018), He et al. (2021), and Carlsson et al. (2022) did not find that only children were less prosocial than non-only children. Zhao et al. (2013) and Zheng et al. (2022) even argued that only children exhibited some signs of success in prosocial behaviors.

Using the National Children's Study of China (NCSC), this study examined the relationship between being an only child and prosocial behaviors among rural children. The results suggested that being an only child significantly increased prosocial tendencies in children, particularly those related to traits, relationships, and altruism. Robustness tests demonstrated that the estimation results were robust to sex selection, son preferences, and selection into going to school. Mechanism analysis suggested that being an only child was associated with more positive parenting. In addition, being an only child helps to strengthen the positive effects of parenting styles and reduce negative parenting styles. Accordingly, the Q-Q theory continued to explain the formation of prosocial behaviors in children.

This study contributed to the literature in three aspects. First, this study examined how the prosocial behaviors of rural children were shaped before the age of 15. In contrast, previous studies mainly sampled college students or adults in urban areas. According to Eisenberg et al. (2005), basic prosocial behaviors remain stable after the age of 15 years. As with other non-cognitive skills, prosocial behaviors develop during childhood and have long-term effects on adult outcomes (Carlo et al., 2011). As a result, this paper provides a basis for understanding the formation of prosocial behaviors of children in rural China.

Second, this study sheds light on the role of parenting styles in explaining the differences between only children and non-only children. The NCSC provides information on parenting styles and parent-child relationships. Consequently, this study evaluates how the allocation of household resources impacts children's prosocial behaviors by the role of parenting styles. Given parents' ignorance of involvement in parenting practices in rural China (Yue et al., 2017), the findings were especially important to children's formation of prosocial behaviors in rural China.

Finally, the current study employs nationally representative microdata based on psychological data, thus providing representative evidence based on choices motivated by moral judgment. The previous research mainly relied on experiments based on monetary motivation data from special regions (Cameron et al., 2013; Li and Qiu, 2021). Hence, the current study provides new perspectives on the effects of being an only child on the development of children's prosociality.

Background

After 1949, China experienced burgeoning population growth, putting great pressure on the economy and society. The China's population increased from 541 million in 1954 to 672 million in 1979, representing a substantial increase of almost 25% in only ten years (National Bureau of Statistics, 2010). Rapid population growth placed great pressure on the country's economic and social development. To alleviate the pressure of rapid population growth, China's State Council began considering population control in 1962.

One-child policy (OCP) was informally introduced in 1973 and legally enforced in 1980 by the State Council. Then the National Family Planning Committee was established in March 1981 to coordinate family planning activities. The family planning departments of local governments were established to administer the local OCP. In 1982, the OCP became a basic national policy.

The OCP was enacted relatively smoothly in urban areas but faced fierce resistance in rural areas. In urban areas, abiding by the policy was linked to jobs primarily provided by governments or government-sponsored enterprises before 1998. Couples with more than one child would lose their jobs or access to social welfare immediately. Consequently, most urban residents have followed this policy. In contrast, farmers were not tied to any firms or enterprises. Furthermore, a typical rural couple believed that a son was essential in assisting with heavy farm work and providing care for them during their old age, especially when their first child was a girl. Therefore, the enforcement of one-child policies was initially difficult in rural areas. Some violent conflicts resulting in casualties even happened occasionally. The fierce opposition in rural areas prompted China to amend its OCP in 1984, allowing rural couples to have a second child under certain conditions.

Since 2001, the government has gradually relaxed requirements for the birth of two children in rural areas. Until 2011, all rural regions adopted a “double-only” policy that allowed couples who were only children to have a second child. In 2013, The double-only policy was proposed to urban residents.

In 2015, China ended its OCP with the full implementation of the two-child policy. The three-child policy was further announced in 2021. It is now possible to have more than three children without restrictions.

There have been many one-child births in China since the enactment of the policy in 1980. Based on the 1% Population Sample Survey of 2005, Ming (2008) found that 30% of youth aged 14–30 years in 2005 were only children. Moreover, the proportion of children born in 1976 was only 13.8%. The proportion increased to 24.8% in 1991. In addition, more than 70% of China’s only children lived in urban areas, and less than 30% lived in rural areas.

However, after the end of the OCP in 2015, only-child families continue to exist in China, and their scale continues to grow. In 2010, the birth rate in China was 11.93‰, but it decreased to only 6.77‰ by 2022 (National Bureau of Statistics, 2023). As the birth rate declines, there will be a substantial number of families with only one child.

Literature review. This study is related to the extensive literature on childhood skill formation and the effects of family size on the development of prosocial behaviors. First, it focuses on childhood skill formation. Cunha et al. (2006) and Almond et al. (2018) argued that there are critical periods for skill development. Investments during these periods allow certain skills to be acquired with little effort, whereas missing these periods will lead to more difficulty. Specifically, Cappelen et al. (2020) demonstrated that individuals’ prosocial preferences are rooted in childhood. Therefore, family investment in childhood affects individuals’ abilities throughout their lives. In addition to traditional material investments, family educational investments include parenting styles. As Cobb-Clark et al. (2019) argued, parenting styles rely on the parents’ time, patience, and cognitive resources. A higher-quality parenting style benefits the development of prosocial behavior in children (Carlo et al., 2011; Guo and Feng, 2017). Therefore, parenting styles play a crucial role in understanding differences in performance among children.

Second, this study relates to the relationship between family size and children’s prosocial behavior. Social character is an essential characteristic of prosocial behavior, making social interactions core determinants of prosocial behaviors (Kosse et al., 2020). However, there is a controversy between the quality of family investment and social interactions among siblings in the family, which will lead to inconsistent results. According to the

Q–Q theory, more siblings lead to lower investments thus lower educational attainment (Rosenzweig and Zhang, 2009). In addition, increasing the number of children decreases the quality of parenting, which depends on income, time, and attention (Cobb-Clark et al., 2019). With more children, parents may have less patience and time to spend with each child, and their responsiveness may suffer. As a result, having more children could negatively affect parenting. Thus, having more siblings may negatively affect children’s prosocial behaviors (Polit and Falbo, 1987).

However, some studies assert that social interactions between children were the primary factor in shaping social skills. Consequently, children with more siblings are significantly more prosocial as a result of the increased social interactions at home (Cameron et al., 2013; Li and Qiu, 2021; Sutter and Untertrifaller, 2020).

It is noted that there are two kinds of social interactions in the family: interactions with parents and interactions with siblings. The parent-child interactions reflect parenting styles. An increasing number of children increases social interactions between them but reduces parenting quality and will harm children’s prosocial behaviors. Having more children in a family increases social interactions with their siblings and thus equips them with prosocial skills. However, an increase in the number of children was associated with reduced parenting quality. Therefore, the prosocial outcomes of children are mixed effects of parenting styles and social interactions with siblings. Given the importance of parenting styles in forming children’s human capital (Doepke and Zilibotti, 2017), parenting styles may play a greater role in developing their prosociality. Accordingly, an increase in the number of children is possible to lead to a decline in children’s prosociality.

Despite the various benefits and drawbacks associated with being an only child, there remains no consensus regarding the impact of this status on children’s prosocial behaviors. On one hand, Cameron et al. (2013), and Li and Qiu (2021) provide significant evidence that being only children will be less prosocial than non-only peers. On the other hand, a body of studies challenges this viewpoint, presenting findings that only children are not inherently less prosocial (Carlsson et al., 2022; Chen and Goldsmith, 1991; Falbo, 1987; He et al., 2021; Kadoya et al., 2018; Zhao et al., 2013; Zheng et al., 2022). The contrasting outcomes of these studies highlight the complexity of the issue and suggest that the relationship between being an only child and prosocial behavior may not be straightforward, calling for further research to unravel the nuanced effects of family dynamics on child development.

Data and descriptive statistics

Data. A sample from the National Children’s Study of China (NCSC) is used in this study. The database was designed to explore the psychological characteristics of Chinese children and adolescents ranging in age from 9 to 15 years. The project was sponsored by the Chinese Ministry of Science and Technology and was executed by the State Key Laboratory of Cognitive Neuroscience and Learning at Beijing Normal University. Using an unequal probability sampling method, the database covered students aged 6–15 from 600 schools in 100 counties across 31 provinces. The database was finally completed in 2009.

NCSC takes the following advantages in studying children’s prosocial behaviors. First, it covers compulsory school students aged 9–15. Unlike previous research, the NCSC enables us to examine the relationship between children’s being an only child and their prosocial behavior during the time when their skills are developing. The age before 15 is also an essential period in developing children’s prosocial preferences.

Table 1 Questions for the different domains of prosocial behavior (PSB).

Domains of prosocial behavior	Questions
Rule-related prosocial behavior (Rules PSB)	I abide by the school's norms. I like to participate in various public interest activities inside and outside the school.
Trait-related prosocial behavior (Trait PSB)	I am willing to do favors for my classmates. I encourage others when they cannot do something. I tolerate classmates who make mistakes. I keep my promises.
Relational prosocial behavior (Relational PSB)	I cooperate well with my teammates when participating in school activities (e.g., playing football). I actively invite bystanders to join our games. I am willing to let my classmates borrow my possessions.
Altruistic prosocial behavior (Altruistic PSB)	I offer to help others when they are in need. I am happy to donate money to a disaster area. I help my classmates with their lessons or teach them how to play football.

Source: Questionnaires of the National Children's Study of China.

Second, NCSC provides prosocial behavior test scores based on psychological scales.

Currently, data on prosocial behavior can be obtained through two primary methods: experimental economics and the completion of surveys utilizing psychological scales. Experimental economics typically employs simulations of public goods investment, investment games, and dictator games to assess cooperation, trust, reciprocity, and altruism. These experiments often involve monetary or material incentives and are time-consuming, which generally results in limited sample sizes.

In contrast to experimental economics, the approach for acquiring psychological data entails having students complete psychological scales. These scales prompt students to assess their behavioral tendencies by reflecting on their personal experiences and opinions. The questions are designed to be comprehensible to an average student, allowing for self-assessment since they draw on individual experiences and viewpoints. This inclusivity ensures that the data encompasses all target students, making it representative of the students. Using this method, NCSC managed to collect data on the prosocial behaviors of approximately 23,521 students across 31 provinces in China.

There is a major difference between these two approaches in their motivation for making decisions. Experiments depend on monetary motivations or other material incentives to motivate the real preferences of participants. The psychological scale mainly relies on moral judgment. Different motivations might lead to different outcomes. To ensure the integrity of the survey, surveys were administered in controlled school settings to enhance privacy and mitigate external biases (Dong and Lin, 2011). Participants were assured of anonymity and voluntary participation, with instructions to omit personal identifiers on forms. Unique IDs were also adopted for questionnaires aiming to alleviate concerns over honesty and minimize experimenter demand effects.

Finally, the NCSC provides data related to family environments that can be used to study resource allocation within families by investigating the effects of parenting styles. Only children and non-only children may differ greatly in their family environments. The NCSC provides detailed information about parent-child relationships, which helps us understand how only children perform differently from non-only children regarding parent-child interactions.

Data cleaning. During data cleaning, students with urban Hukou¹ (8748 observations) were excluded, while children with rural Hukou (14,596 observations) were retained. Before 2013, the governments implemented different one-child policies for couples with rural Hukou and those with urban Hukou. Urban Hukou

couples are not allowed to have a second child unless their first child dies. Couples in rural Hukou, except for some provinces, can have a second child if their first child is a girl. Several rural regions even allowed couples to have two children. Consequently, most urban Hukou couples have only one child (about 76%). In contrast, most rural Hukou couples have more than one child (over 70%).

Left-behind children (3665 observations) with the absence of one or both parents are also excluded. Only children and non-only children face completely different family environments that play essential roles in forming the children's outcomes. But the absence of parents may lead to no parents' engagement in children's parenting practices. As a result, it is reasonable to eliminate the observations of left-behind children.

After excluding observations with missing values, we obtained a sample of 8732 observations.

Outcomes of interest. The dependent variables of this study are children's prosocial behaviors. Traditionally, prosocial behavior refers to voluntary actions that increase the welfare of others or improve relationships with others (Eisenberg et al., 2005). The NCSC surveyed four domains of prosocial behavior: rules-related prosocial behaviors (*Rules PSB*), traits-related prosocial behaviors (*Trait PSB*), relationships-related behaviors (*Relational PSB*), and traditional altruism (*Altruistic PSB*). As shown in Table 1, NCSC asked three questions for each domain of prosocial behaviors, and each dimension's score was calculated separately. The questions in Table 1 suggested that the children's choices relied on their moral judgment rather than monetary or other material motivations. Compared to prosocial preferences used in previous studies (Cameron et al., 2013; Li and Qiu, 2021), the definition of prosocial behaviors in the current study was different except for the *Relational PSB* and *Altruistic PSB*. Consequently, the NCSC provided a broader definition of prosocial behaviors in a different manner compared to previous economic analyses.

There are four items for each question: never, sometimes, often, and always, scoring 1–4. Children rated their tendencies when filling out the scales. Adding up all choice scores yielded the scores of each domain of prosocial behaviors. Adding four domains produced the scores of overall prosocial behaviors (*Overall PSB*). All the scores were standardized to 0 in estimation.

Concerns arise regarding potential measurement errors of self-reported prosocial behaviors, particularly attributable to respondent biases such as personal attitudes and a propensity for socially desirable responses, as delineated by Bertrand and Mullainathan (2001). The NCSC adopted rigorous protocols to ensure the integrity of survey data (Dong and Lin, 2011). Surveys took place in controlled settings, including classrooms and assembly halls, to

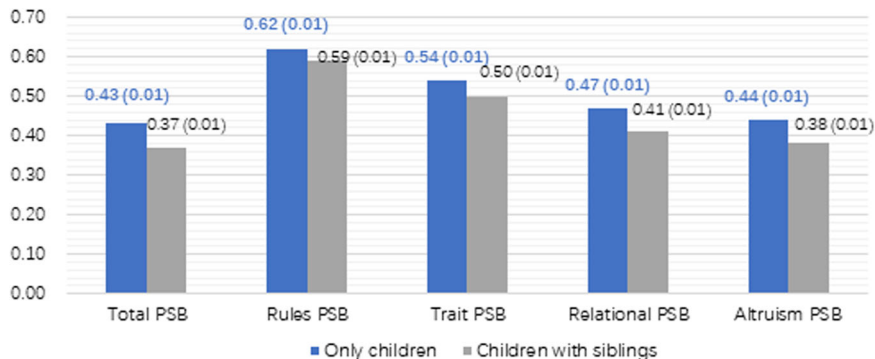


Fig. 1 Comparative proportions of high prosocial tendencies among only children and children with siblings. Note: A student is classified as having a high prosocial tendency if their cumulative score exceeds 36 across 12 evaluative questions. Furthermore, a student is considered to exhibit a high tendency towards specific domains of prosocial behavior if their score within that domain surpasses 9. The standard errors of *T* tests are shown in parentheses.

safeguard privacy and reduce external influences. Participants were assured of anonymity, and the voluntary nature of participation was highlighted, with explicit instructions to omit identifiable information on the survey forms. Utilizing unique identification numbers for each questionnaire further encouraged an environment conducive to honest responses. Consequently, it is anticipated that these measures will significantly mitigate the impact of measurement errors attributable to experimenter demand effects. This paper also employs instrument variable estimations to address the measurement errors, as discussed in subsection of Endogeneity problem of section Results.

Figure 1 presents a detailed visual analysis comparing the prosocial tendencies between students who are only children and those with siblings. To qualify as exhibiting high prosocial tendencies, a student must answer “often” or “always” across all survey questions, resulting in a composite score exceeding 36, based on a 12-question framework. Further, a pronounced inclination toward specific domains of prosocial behavior is indicated by a domain-specific score surpassing 9. As demonstrated in Fig. 1, the only children significantly outperform children with siblings in nearly all domains of prosocial tendencies.

Treatment variable: being an only child. The treatment variable is whether a student is an only child. Students are asked how many siblings they have. If a student answers 0 for the number of siblings, the variable takes the value of 1; otherwise, it takes the value of 0. As a result of this definition, 27.78% of the sample is only children. This percentage is close to Ming (2008) using the 1% Population Sample Survey of 2005.

Other control variables. Control variables include variables identifying characteristics of individuals, family backgrounds, schools, and regions. Individual characteristics include gender, age, ethnicity, migrant status, whether boarding at school or school stage (Grades 7–9). Family background variables include the father and mother’s education and whether annual family income is over 10 thousand RMB. School variables include student-teacher ratio, principal education, and school expenditure per student. The school stage is defined as grade 7 or above. The rule in China is that children must attend school for at least nine years, with the first six years in elementary school and the remaining three years in junior high school. In most cases, a typical student’s primary and junior secondary schools are different. Accordingly, the school stage was defined as one for those in grade 7 or above and 0 for others. Regional variables are county-fixed effect variables (0–1 variables).

Descriptive statistics of the major variables in this paper are shown in Table 2. Based on Table 2, only-child students perform better in all domains of prosocial behaviors. *T*-test results also support this argument. The results are in line with Fig. 1.

Table 2 also shows that, upon comparing the two groups of students, there are marked differences in the mean values of several variables. Specifically, the group consisting of only children is characterized by significantly lower mean values in critical dimensions such as age, the proportion of female students, the prevalence of boarding at school, and the student-to-teacher ratio. This observed divergence underscores the critical need to incorporate demographic and educational environmental factors when assessing the prosocial behaviors of these distinct student populations. The allowance for families in rural regions to have a second child if the first was a girl, a policy in place before 2012, may account for the observed lower proportion of females among only children. The diminished prevalence of students boarding at school among only children could be attributed to the less stringent enforcement of the OCP in remote areas, where boarding schools are more common. Furthermore, a reduced student-teacher ratio is indicative of only children attending higher-quality schools, suggesting that parents in economically advanced areas, who are more likely to have a single child, opt for superior educational institutions. Additionally, only children exhibit significantly elevated mean values in parental and principal education levels, school expenditure per student, and the proportion residing in urban areas, compared to their peers with siblings. Such factors may positively correlate with the prosociality of only children, indicating that their prosocial behaviors can be influenced by a myriad of factors. Notably, no significant differences were found between only children and non-only children in terms of age, grade level, and school size. The aim of this study is to elucidate the impact of being an only child on prosocial behaviors, taking into account the influence of individual, familial, school, and regional variables.

Results

Baseline results: OLS estimation. Initially, this paper employs ordinary least squares (OLS) regressions as a preliminary method to elucidate the relationship between being an only child and children’s prosocial behaviors. This step was intended to provide a baseline understanding, serving as a reference point for subsequent analyses using more sophisticated methodologies. As a result, we first estimate the following linear Equation.

$$prosoc = \alpha + \beta onlychild + \gamma X + \epsilon \tag{1}$$

Table 2 Descriptive statistics of major variables.

Variables	Only children (1)	Non-only children (2)	Diff: (1)-(2) (3)
Overall PSB (standardized)	0.114 (1.038)	-0.040 (0.984)	0.154*** (0.024)
Rule PSB (standardized)	0.073 (1.021)	-0.025 (0.992)	0.099*** (0.024)
Trait PSB (standardized)	0.083 (1.019)	-0.029 (0.992)	0.112*** (0.024)
Relational PSB (standardized)	0.123 (1.044)	-0.043 (0.981)	0.166*** (0.024)
Altruistic PSB (standardized)	0.096 (1.026)	-0.034 (0.989)	0.129*** (0.024)
Age	12.26 (1.780)	12.59 (1.740)	-0.321*** (0.043)
Female	0.343 (0.472)	0.517 (0.500)	-0.174*** (0.011)
Han	0.944 (0.223)	0.884 (0.306)	0.059*** (0.007)
Grades 7-9	0.463 (0.498)	0.489 (0.500)	-0.026** (0.011)
Migrant child	0.242 (0.422)	0.232 (0.428)	0.009 (0.010)
Boarding at school	0.186 (0.437)	0.257 (0.389)	-0.071*** (0.010)
Years of father education	8.753 (2.752)	8.198 (3.110)	0.555*** (0.066)
Years of mother education	8.147 (2.752)	6.942 (3.110)	1.206*** (0.074)
Annual family income over 10,000 RMB	0.535 (0.499)	0.369 (0.483)	0.167*** (0.012)
School size (logarithm)	6.788 (0.735)	6.730 (0.746)	0.058*** (0.019)
Student-teacher ratio	17.147 (5.801)	18.149 (5.933)	-1.002*** (0.144)
College education of school head	0.330 (0.465)	0.317 (0.461)	0.014 (0.011)
School expenditure per student (logarithm)	6.158 (0.938)	5.899 (0.917)	0.259*** (0.023)
Observations	2266	6466	8732

Standard errors are shown in parentheses. *** and ** represent significance levels of 1% and 5%, respectively.

Table 3 Baseline results: OLS estimation.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruistic PSB
<i>onlychild</i>	0.110*** (0.031)	0.084*** (0.029)	0.096*** (0.030)	0.089*** (0.029)	0.095*** (0.030)
Observations	8732	8732	8732	8732	8732
R-squared	0.027	0.034	0.024	0.019	0.016

Standard errors clustered at the school level are shown in parentheses. *** represent significance levels of 1%. Other control variables, school location fixed effects, and county-fixed effects are omitted here.

$$onlychild = I[X'\lambda - v \geq 0] \tag{2}$$

where *prosoc* is a variable that represents prosocial behaviors, including rules compliance, traits of loyalty and tolerance, relations of cooperation and sharing, and altruism. *onlychild* is a binary variable that defines whether a student is an only child. *X* represents other control variables. ϵ and v are error terms, as usual. Whether a child is an only child is complicated, and it is defined by the indicator function of $I[\cdot]$.

Based on OLS, Table 3 presents the baseline results—one column for one dependent variable². Table 3 shows a significant and positive relationship between being an only child and prosocial behaviors. Compared to non-only children, only children exhibit significantly higher prosocial scores in terms of overall tendencies as well as four prosocial domains. On average, only children score about 0.1 standard deviations higher than the scores of non-only children.

The results of OLS contradict previous research (Cameron et al., 2013; Li and Qiu, 2021). Possibly, the contradiction relates to individuals' beliefs about monetary motives. Vohs et al. (2006) argued that money brings a self-sufficient orientation, and reminders of money decrease helpfulness. Conversely, Reed et al. (2016) found that moral identity was stable in motivating individuals' prosocial behaviors. In other words, students can be more prosocial when motivated by moral judgment.

It is a common belief that the only child is the little emperor in the family, claiming whatever resources are available and becoming self-centered (Zheng et al., 2022). According to the

estimates in this paper, this is not the case. Interactions between parents and children play a more critical role in building human capital.

Endogeneity problem. The major concern is the endogeneity of being an only child. The endogeneity stems from two sources. The first and most important source is the trade-off between parents' decision of the number of children and the children's performance. A parent may want to invest a sufficient amount of money, attention, and patience in their children. This may lead to parents having only one child. Parents can also transmit their preferences more effectively with only one child. In this case, only children have high prosocial tendencies. However, the opposite can also happen. A couple with low prosocial tendencies would prefer fewer children (Eriksson et al., 2020). In turn, being an only child negatively relates to parents' prosociality.

It is impossible to observe a parent's preferences and decisions in our data. Thus, omitted variables resulting from the selection problem will lead to biased estimation. In the first case, Eq. (1) overestimates the effect of being an only child. The second case, however, underestimates the effect.

The second source of endogeneity arises from the measurement errors associated with assessing prosocial behaviors. As delineated in Table 2, students who are only children benefit from more advantageous family environments, particularly in terms of higher parental education levels. This advantage may endow only-child students with enhanced cognitive abilities and social-cognitive skills, enabling them to respond to survey questions in a manner that aligns more closely with societal expectations and

Table 4 Results of PSM and 2SLS estimation.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruistic PSB
A. Propensity score matching method (kernel matching, bandwidth = 0.01)					
<i>onlychild</i>	0.099*** (0.030)	0.084*** (0.031)	0.083*** (0.028)	0.088*** (0.027)	0.077*** (0.024)
Observations	8733	8733	8733	8733	8733
B. IV based on heteroskedasticity of the error term					
<i>onlychild</i>	0.584*** (0.217)	0.159 (0.210)	0.572** (0.226)	0.588** (0.209)	0.609*** (0.228)
Observations	8732	8732	8732	8732	8732
F statistics	131.327	131.327	131.327	131.327	131.327
C. IV based on the ratio of only children at the county level					
<i>onlychild</i>	0.682*** (0.161)	0.184 (0.146)	0.621*** (0.144)	0.620*** (0.145)	0.431*** (0.155)
Observations	8733	8733	8733	8733	8733
F statistics	220.106	220.106	220.106	220.106	220.106

Note: Standard errors of IV estimation are clustered to the school level. The standard errors of PSM are obtained by bootstraps of 200 times. *** and ** represent significance levels of 1% and 5%, respectively. Other control variables, school location fixed effects, and county-fixed effects are omitted here.

norms. Such a scenario could lead to an overestimation of the positive impacts associated with being an only child on prosocial behaviors.

A conventional approach to mitigating the issue of endogeneity is to use instrumental variables that influence whether a child is an only child, without directly affecting their social preferences. A plausible instrumental variable in the context of only children is the intensity of enforcement of the OCP. An effective strategy is to leverage the variation in penalties for exceeding birth quotas across different regions (Ebenstein, 2010). Nonetheless, limited by the information in the NCSC, this study is unable to incorporate the necessary information to distinguish between provinces. Consequently, the application of this method is not feasible in the current research.

This paper employs three distinct strategies to address the potential endogeneity problem. The initial strategy involves the application of the Propensity Score Matching (PSM) method, predicated on the assumption of selection based on observable characteristics (selection on observables). The remaining strategies involve the use of two instrumental variables, both of which are derived from data provided by the NCSC. The first instrumental variable exploits the heterogeneity in the error terms associated with the decision to have an only child. The second instrumental variable is based on the calculated ratio of only children in the sample prior to the child’s birth. These methodologies are designed to robustly estimate the impacts of being an only child, controlling for underlying biases.

The PSM was introduced by Rosenbaum and Rubin (1983). The basic idea of PSM is to match the treatment group (the only children) with the control group (the non-only children) based on the propensity score (predicted probabilities of being only children).

By definition, the average treatment of being an only child is

$$ATT = E[psb_{1i} - psb_{0i} | only_i = 1] \tag{3}$$

Here, the psb_{1i} is prosocial behaviors of individual i when he is an only child. psb_{0i} is prosocial behaviors of individual i when he is not an only child. The question is that in our sample, we can only observe one of the child’s states. The solution is to construct the only child’s counterfactual fact, that is, the prosocial behaviors of his matched children. Based on the propensity score matching, the average treatment is

$$\alpha_{ATT}^{PSM} = E_{P(X)|board=1} \{ E[psb_1 | only = 1, P(X)] - E[psb_0 | only = 1, P(X)] \} \tag{4}$$

Here, the $P(X)$ is the estimated propensity score of a person being an only child.

The results of propensity score matching method are shown in panel A of Table 4. Generally speaking, the PSM follows three steps. First, we need to decide on the common support based on different matching approaches. This paper only considers the usual kernel matching and the bandwidth is set as 0.01. Second, test the balances of the treatment group and control group to see if these two groups are comparable (see Table A2 and Fig. A1 in Appendix)³. Finally, calculate the average treatment. From Table 4 we can see that, the results of PSM are quite close to the OLS estimation. The PSM results suggest that after considering the selection of observables, the results are robust.

The second strategy is predicated on the heteroskedasticity identification strategy outlined by Klein and Vella (2009). The PSM is less effective when selection relies on unobservables. Under these circumstances, instrument variable estimation becomes significantly more appropriate. However, due to data limitations, a perfect external instrument variable for identifying the status of being an only child is unavailable. An internal instrument variable serves as a viable alternative. Chen et al. (2018) successfully applied this approach in their analysis of informal job search methods. Following Chen et al. (2018), and Klein and Vella (2009), decision Eq. (2) exhibits multiplicative heteroskedasticity, as delineated in Eq. (5) as follows.

$$v = S(X'\theta)v^* \tag{5}$$

Where the v^* is a homoskedastic error term. The v^* is independent of X but depends on the error term ϵ in Eq. (1). Function $S(\cdot)$ captures the heteroskedasticity in the error term v . Equations (1) and (5) implies that⁴

$$E(onlychild|X) = Pr[onlychild = 1|X] = F \left[\frac{X'\lambda}{S(X'\theta)} \right] \tag{6}$$

The $F(\cdot)$ is the probability function for v^* and the predicted $\widehat{F}(\cdot)$ is a valid IV for only-child decisions. Obviously, the $\widehat{F}(\cdot)$ is associated with the endogenous decision of the only child by definition. At the same time, the $\widehat{F}(\cdot)$ is uncorrelated to the error term in Eq. (1) because it is a nonlinear function of exogenous variables of X ($E(\epsilon|X) = 0$).

Following Millimet and Tchernis (2013), and Chen et al. (2018), we assume that the v^* is normally distributed and $S(\cdot) = \exp(Z'\theta)$. Where the Z is a subset of variables in X that produces heteroskedasticities in Eq. (5). Specifically, in this paper, the Z includes age, gender (female), Han ethnicity, and years of education of the father and mother. This specification allows us to flexibly use different sets of variables in the mean and variance equations. A maximum likelihood method can be used to

Table 5 Estimation results of new PSB indicators (0-1 variable).

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruism PSB
A. OLS					
<i>onlychild</i>	0.053** (0.014)	0.024 (0.014)	0.053*** (0.014)	0.038*** (0.013)	0.038*** (0.014)
Observations	8732	8732	8732	8732	8732
R-squared	0.022	0.023	0.017	0.013	0.011
B. 2SLS					
<i>onlychild</i>	0.244*** (0.093)	0.101 (0.094)	0.257** (0.106)	0.258** (0.107)	0.220** (0.110)
Observations	8732	8732	8732	8732	8732
R-squared	131.327	131.327	131.327	131.327	131.327

Standard errors at the cluster to school level are shown in parentheses. *** and ** represent significance levels of 1% and 5%, respectively. The IV in panel B is based on the ratio of only children calculated by Eqs. (6) and (7). Other control variables, school location fixed effects, and county-fixed effects are omitted here.

estimate the parameters of λ and θ .

$$\ln(L) = \sum_i \left[\ln \Phi \left(\frac{X_i' \lambda}{\exp(X_i' \theta)} \right) \right]^{onlychild_i} \left[\ln \left(1 - \Phi \left(\frac{X_i' \lambda}{\exp(X_i' \theta)} \right) \right) \right]^{(1-onlychild_i)} \tag{7}$$

Where the $\Phi(\cdot)$ is the standard normal distribution function.

Once we have the estimated parameters of $\hat{\lambda}$ and $\hat{\theta}$, we can further obtain the predicted variables of $\widehat{F(\cdot)}$. Then we can use the $\widehat{F(\cdot)}$ as IV for being an only child to estimate Eq. (1) using 2SLS.

Panel A in Table 4 presents the results of the second stage of the estimation using $\widehat{F(\cdot)}$ as IV of being an only child. The excluded F statistics indicate that the IV for only children is not weak. The coefficients of being an only child are still significant on Overall PSB, Trait PSB, Relational PSB, and Altruism PSB, and their magnitude increases four times over OLS estimates. According to Table 4, the scores of prosocial behaviors for only-child students will be 0.6 standard deviations higher than their counterparts. It is a relatively large number since the average difference is only 0.15 standard deviation.

IV results suggest that OLS estimates underestimate the effects of being an only child. Parents' preferences and choices may be negatively related to being an only child. It is possible that parents with high prosocial preferences wishing for more siblings to support their children. Only-child parents may be more selfish on average than Only-child parents may be more selfish on average than parents with more children (Eriksson et al., 2020). Consequently, being an only child is negatively associated with parental prosociality. The analysis may also account for the potential of measurement error, which could be inversely correlated with the status of being an only child. For instance, it is conceivable that only children might intentionally rate their prosocial behaviors lower. This deliberate underestimation could distort the assessment of prosocial tendencies among only children, complicating the evaluation of how being an only child influences such behaviors.

The final strategy of this paper resorts to an instrumental variable based on ratio only children in the county prior to the birth year of the child under study. The preceding instrumental variable, derived from the heteroskedasticity of the error term, is fundamentally driven by technical considerations. Its economic relevance and implications might be met with skepticism by some scholars. Consequently, we construct a second instrumental variable based on the ratio of only children at the county level. This ratio is calculated according to Eq. (8), as follows:

$$ratio_{age,j} = \frac{N_{onlychild_{age+1,j}}}{N_{child_{age+1,j}}}, age = 9, 10, 11, 12, 13, 14 \tag{8}$$

Here, *ratio* is the constructed instrumental variable. $N_{onlychild_{age+1,j}}$ is the number of only-child students in county *j* who are one year

born before the student. $N_{child_{age+1,j}}$ is the number of all students in county *j* who are one year older than the student.

Limited by data, the maximum age of students is 15. If a student's age is 15, *ratio* is redefined according to Eq. (9).

$$iv = \frac{(N_{onlychild_{15,j}} - onlychild)}{(N_{child_{15,j}} - 1)} \tag{9}$$

Here, *onlychild* is the students' status of being an only child. Equation (9) indicates that the instrumental variable for a person's being an only child aged 15 is the percentage of only-child students of the same age.

Equations (8) and (9) indicate that whether a child is an only child depends on the policy and local traditions of the previous year. Fertility decisions and preferences will be influenced by local traditions and policies. They are also exogenous to an individual's parents' fertility decisions and a child's outcomes. In this regard, the IV is a plausible instrument variable to mitigate the endogenous problem⁵.

Table 4 presents the second-stage estimation results in panel B. According to panel B of Table 4, being an only child significantly increases students' prosocial behaviors. Additionally, estimated coefficients are significantly greater than OLS estimates, suggesting that OLS underestimates the effects of being an only child.

Utilizing different instrumental variables across two panels yielded consistent outcomes, underscoring the regression models' Robustness. This implies that results robustly link being an only child to students' prosocial behavior, with OLS estimates serving as conservative approximations of this effect. However, the instrumental variables are not flawless, and county-level averaging could add noise. Considering these limitations, the analysis will primarily focus on OLS results in the following discussions.

Robustness and heterogeneity

Problem with the definition of the dependent variables. The definition of the dependent variable may also affect the estimation results. As discussed in previous sections, standardized scores of prosocial behaviors are the dependent variables. The dependent variable in this study can also be defined as high prosocial behavior tendencies. Figure 1 presents this definition. Students with a high prosocial tendency will score one if they answer "often" or "always." Therefore, they will have a total score of more than 36 (12 questions). Otherwise, the high prosocial tendency value is 0. The value will also equal one if a particular domain of prosocial behavior exceeds 9. Otherwise, it is 0. Consequently, five indicators are defined, and Eq. (1) estimates how being an only child impacts them.

Table 5 presents the results of the OLS and the second stage using the IV based on the ratio of only children calculated by Eqs. (6) and (7). In Table 5, being an only child has a significant positive impact on the probability of students having higher

Table 6 Results of sex selection and son preference.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruistic PSB
A. Sex selection test					
<i>A.1. Male sample with higher-order males as control group</i>					
<i>onlychild</i>	0.074* (0.038)	0.060 (0.038)	0.062 (0.039)	0.053 (0.038)	0.075** (0.038)
Observations	3512	3512	3512	3512	3512
R-squared	0.027	0.021	0.018	0.027	0.021
<i>A.2. Male sample of with first-order males as control group</i>					
<i>onlychild</i>	0.072* (0.044)	0.090** (0.043)	0.048 (0.044)	0.074* (0.043)	0.033 (0.045)
Observations	2523	2523	2523	2523	2523
R-squared	0.021	0.017	0.018	0.022	0.014
<i>A.3. Coefficient tests ($H_0 : \beta_{onlychild_{highorder}} = \beta_{onlychild_{firstorder}}$)</i>					
χ^2 statistics	0.05	0.26	0.18	0.17	1.03
B. Son preference test					
<i>B.1. Females with high orders as control group</i>					
<i>onlychild</i>	0.188*** (0.051)	0.167*** (0.048)	0.174*** (0.049)	0.147*** (0.048)	0.146*** (0.049)
Observations	2353	2353	2353	2353	2353
R-squared	0.039	0.033	0.031	0.034	0.024
<i>B.1.1 Coefficient tests ($H_0 : \beta_{onlychild_{daughterhighorder}} = \beta_{onlychild_{sonhighorder}}$)</i>					
χ^2 statistics	3.87**	3.20	3.75*	2.59	1.47
<i>B.2. Female sample with the first-order as control group</i>					
<i>onlychild</i>	0.083* (0.050)	0.024 (0.048)	0.095* (0.049)	0.076 (0.048)	0.086* (0.049)
Observations	2472	2472	2472	2472	2472
R-squared	0.030	0.022	0.030	0.024	0.025
<i>B.2.1 Coefficients test ($H_0 : \beta_{onlychild_{daughterfirstorder}} = \beta_{onlychild_{sonfirstorder}}$)</i>					
χ^2 statistics	0.03	1.12	0.57	0.00	0.73
C. Results of IV estimation: female sample with high orders as control group					
<i>onlychild</i>	0.611* (0.337)	0.160 (0.326)	0.336 (0.362)	0.570** (0.325)	0.598* (0.356)
Observations	2385	2385	2385	2385	2385
F statistics	46.985	46.985	46.985	46.985	46.985

Standard errors clustered to school level are shown in parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. Other control variables, school location fixed effects, and county-fixed effects are omitted here. The IV in panel C is based on the ratio of only children calculated by Eqs. (6) and (7). Other results are derived from OLS estimations based on Eq. (1).

prosocial behavior scores. An only child is more likely to have high prosocial tendencies by about 3–5 percent, especially when it comes to traits, relationships, and altruism. 2SLS of Table 5 indicates robust significant relationships, which is roughly consistent with Table 4. Note that there is no robust relationship between being an only child and Rule PSB. Rule PSB differs from the other three PSB types due to its rule-based nature. It may therefore be more influenced by external factors than whether being an only child.

Problem of sex selection. The sex selection is the elephant in the room. Sex selection happens when a couple thirsts for a son. The couple may abort the child if they discover prenatally that the child is a girl (using an ultrasound). According to Scharping (2003), the abortion rate per 100 live births was 35.7 in 1999. Chen et al. (2013) found that rural China has widespread prenatal sex determination and sex-selective abortion practices, especially in second and higher-order pregnancies.

There should be sex selection in the sample of this study. The proportion of female students of second order and third order are only 44.78% and 39.29%, respectively. The uncommon ratios suggest that there are substantial son preferences and sex selection problems in rural China.

What this study concerns is whether sex selection affects the estimates of being an only child. Research has found that multiple-child families are more likely to engage in sex selection, especially when previous births are girls (Chen et al., 2013). This implies that students from multiple-child families may also be less prosocial than other families because of fewer parent-child interactions. Consequently, the estimated effect will be biased upwards.

We can consider subsample estimations to test whether the sex selection will affect the estimation indirectly. Given that prenatal sex selection usually happens in second and higher-order pregnancies, this study estimates two subsamples with first-order sons and high-order sons as control groups, respectively. In both subsamples, the treatment group is only children. If sex selection leads to estimation bias, we will expect that the coefficients of the subsample with high-order sons as control groups will be significantly larger.

The results of estimating these two subsamples are presented in panel A of Table 6. Table 6 also provides χ^2 statistics testing whether the coefficients of the *onlychild* are equal (see panel C in Table 6). From panel A in Table 6, we can see that the coefficients are quite similar. The results of χ^2 statistics suggest that we cannot reject the null hypothesis that the coefficients of being an only child are equal. The results suggest that the sex selection problem may not be important in affecting the estimation bias.

It is to be noted that the sex selection problem is just one possibility of omitted variable problems discussed in the previous section. An IV identification will help to solve this problem. As shown in Table 4, the OLS estimates underestimate the effects of being an only child.

Problem of son preferences. The common problem of son preferences may also lead to estimation bias. Parents with son preference will allocate more material and time resources to sons at the expense of girls (Lin et al., 2021). As a result, the son preference may lead to an upward bias.

To test whether there were son preferences, this paper estimated two subsamples with different control groups, including first-order daughters and higher-order daughters. And then,

Table 7 Results by grades.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruism PSB
A. Grades 4-6					
<i>onlychild</i>	0.118*** (0.038)	0.094** (0.037)	0.085** (0.038)	0.102** (0.036)	0.117*** (0.038)
R-squared	0.038	0.051	0.021	0.025	0.021
Observations	4520	4520	4520	4520	4520
B. Grades 7-9					
<i>onlychild</i>	0.082** (0.037)	0.063 (0.035)	0.094** (0.036)	0.074** (0.032)	0.073** (0.035)
R-squared	0.021	0.025	0.021	0.012	0.014
Observations	4212	4212	4212	4212	4212
C. Coefficients test ($H_0 : \beta_{onlychild_{grades4-6}} = \beta_{onlychild_{grades7-9}}$)					
χ^2 statistics	0.52	0.36	0.03	0.67	1.22

Standard errors clustered to school level are shown in parentheses. *** and ** represent significance levels of 1% and 5%, respectively. The results are derived from OLS estimations using Eq. (1). Other control variables, school location fixed effects, and county-fixed effects are omitted here.

we tested the coefficients using sons of the same birth orders as control groups in panel A. If there is no son preference, there should be no significant differences between the coefficients of samples using sons and daughters with the same birth order as control groups.

The results of samples of girls are presented in panel B of Table 6. The results showed that except for *Relational PSB* and *Altruistic PSB*, the coefficients of being an only child are significantly higher when using the high-order girls as the control group. Obviously, there are significant son preference problems against higher-order daughters, and it will lead to upward bias in OLS estimation.

The son preference is also some kind of omitted variable and can be solved by the IV estimation proposed in the previous section. Panel C in Table 6 provides the result of IV estimations with the IV constructed based on the heteroskedasticity of the error term of Eq. (1). From panel B.4, we can see that being an only child had some significant effects on *Overall PSB*, *Relational PSB*, and *Altruistic PSB*. Additionally, the results were quite similar to that in Table 4. The results suggested that even though high-order girls were harmed by son preference and sex selection, the effects of being an only child are still robust.

Problem of selection into going to school. Selection bias due to school attendance and dropout rates may skew the findings, particularly in remote areas for grades 7–9. Ministry of Education statistics from 2005 reveal dropout rates for elementary and junior middle schools at 0.45% and 2.62%, respectively, with 98.42% of elementary students progressing to junior middle schools (Ministry of Education, 2006). Consequently, around 4.59% did not complete their compulsory education in 2005. With the development in rural China, it is conceivable that the student dropout rate decreased in 2009. Nonetheless, the reported statistics do not differentiate between rural and urban students. Given the significant gap between rural and urban settings, it is plausible to assume that dropout rates among rural students would be comparatively higher.

Attrition may inadvertently lead to an underestimation of the impacts of being an only child. Drawing from the theoretical framework posited by Doepke and Zilibotti (2017), parental investment is influenced by motives of altruism and paternalism. It is conceivable that parents of dropout students might exhibit lower levels of altruism, manifesting in a diminished propensity to invest in their children’s education, thereby precipitating an early termination of their schooling. Conversely, students who remain in school likely benefit from a more prosocial parental disposition, a trait they are inclined to inherit.

Constrained by data limitations, our analysis could not encompass students outside the school system. Acknowledging

that dropout rates predominantly occur in junior middle schools, we categorized the sample into two subgroups: grades 4–6, representing elementary students, and grades 7–9, corresponding to junior middle school students. The findings, as detailed in Table 7, remain robust across these subgroups, with notably higher effects observed in the grades 4–6 cohort. This suggests that younger students may be more influenced by their family environments, thereby magnifying the observed effects. However, a test of the coefficient differences between these subgroups indicated no statistically significant disparity. Consequently, the decision to attend school appears to have a negligible impact on the study’s outcomes. Based on the evidence presented in Table 7, any selection bias related to school attendance is likely to result in an underestimation of the unique impacts attributable to being an only child.

Age patterns. This study differentiates itself from prior works, like those by Cameron et al. (2013) and Li and Qiu (2021), by concentrating on school-aged children and adolescents. Such a focus brings to light unique findings, particularly around how age influences the effects of being an only child on prosocial behaviors. To investigate this, the study categorizes participants into three age groups: 9–10, 11–13, and 14–15 years old, with outcomes presented in Table 8. The analysis indicates that younger children are more influenced by being an only child, though these effects lack statistical significance. This highlights the importance of age in understanding the dynamics of being an only child and its effect on prosocial behavior.

Mechanism

As discussed in prior sections, the differences between only children and those with siblings are predominantly influenced by parent-child interactions, or more specifically, the parenting styles. Economics has highlighted that parenting styles are important family investments determining the distribution of families’ financial, time, patience, and cognitive resources (such as attention) (Cobb-Clark et al., 2019; Doepke and Zilibotti, 2017). This perspective underscores the crucial role of the quality and nature of interactions within the household, especially how parents distribute emotional, financial, and educational support among their children. Research further indicates that parenting styles affect children’s cognitive and non-cognitive skills, with parental behaviors transmitting values, traits, and preferences (such as altruism and risk aversion) (Doepke and Zilibotti, 2017; Guo and Feng, 2017).

This study seeks to determine whether the status of being an only child correlates with a higher prevalence of positive parenting styles and a lower incidence of negative ones. Positive parenting styles include authoritative parenting, value

affirmation, and instrumental help, all of which necessitate considerable parental investment in terms of effort, time, patience, and attention. To assess authoritative parenting, this research analyzes children’s responses to a set of sixteen questions, with each question containing five items. These inquiries are designed to capture the children’s perceptions of their parents’

encouragement, warmth, patience, involvement, and effort. In contrast, authoritarian parenting, characterized by a lack of patience despite evident efforts, is evaluated through the children’s responses to twelve 5-item questions. These questions center on perceptions of physical punishment, irrational behaviors, and verbal abuse by parents. Meanwhile, permissive parenting, often marked by a failure to attend to children’s needs, is assessed through scores calculated from children’s perceptions of parental neglect. Additionally, value affirmation is delineated and measured through two 5-item questions that explore children’s perceptions of their parents’ beliefs in their capabilities and recognition of their accomplishments. Instrumental help is assessed by three 5-item questions that reflect parents’ attentiveness to and provision of assistance for their children’s needs. Aggregating responses to these questions yields scores for each parenting style and related variables. Subsequently, all variables are standardized to a mean of 1 and a standard deviation of 0.

We first estimate the effects of being an only child adjust for parenting variables, then analyze them as dependent variables and assess the impact of being an only child on them. Considering potential biases, such as the influence of being an only child on parenting or the tendency of inherently skilled parents to have fewer children, instrumental variable estimation is employed to clarify the relationship between being an only child and parenting practices. The instrument variable is the ratio of only children defined by Eqs. (6) and (7).

Table 9 presents the results. Panel A of Table 9 shows that when parenting styles are taken as control variables, the effects of being an only child decrease significantly. When parenting practices are evaluated as dependent variables (panel B), being an only child is positively associated with positive parenting and negatively associated with negative parenting. The findings presented in Table 9 indicate that only children are recipients of

Table 8 Age patterns of effects of being an only child.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruism PSB
A. Ages of 9 and 10					
<i>onlychild</i>	0.163** (0.065)	0.150** (0.060)	0.108* (0.066)	0.165*** (0.064)	0.125* (0.066)
Observations	1425	1425	1425	1425	1425
R-squared	0.052	0.061	0.031	0.033	0.034
B. Ages of 11, 12 and 13					
<i>onlychild</i>	0.075** (0.038)	0.044 (0.037)	0.061 (0.038)	0.070* (0.038)	0.077** (0.039)
Observations	4363	4363	4363	4363	4363
R-squared	0.039	0.050	0.026	0.028	0.020
C. ages of 14 and 15					
<i>onlychild</i>	0.105** (0.050)	0.084* (0.051)	0.129** (0.052)	0.062 (0.045)	0.081* (0.048)
Observations	2945	2945	2945	2945	2945
R-squared	0.017	0.019	0.023	0.013	0.013

Note: Standard errors clustered to school level are shown in parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The results are derived from OLS estimations using Eq. (1). Other control variables, school location fixed effects, and county-fixed effects are omitted here.

Table 9 Results of the mechanism analysis.

Variables	Overall PSB	Rule PSB	Trait PSB	Relational PSB	Altruism PSB
A. Parenting Practices as Control Variables					
<i>onlychild</i>	0.049** (0.023)	0.034 (0.025)	0.046* (0.024)	0.040* (0.023)	0.044* (0.024)
Observations	8718	8718	8718	8718	8718
R-squared	0.279	0.200	0.199	0.185	0.196
B. Parenting Practices as Dependent Variables					
Dependent variables	Authoritative	Authoritarian	Permissive	Value affirmation	Instrumental help
B.1 Whole sample (OLS)					
<i>onlychild</i>	0.078*** (0.024)	−0.049* (0.027)	−0.037 (0.027)	0.107*** (0.026)	0.077*** (0.025)
Observations	8737	8737	8737	8738	8738
R-squared	0.020	0.026	0.058	0.015	0.015
B.1 Whole sample (IV)					
<i>onlychild</i>	0.222 (0.138)	−0.323** (0.152)	−0.474*** (0.135)	0.404*** (0.131)	0.370*** (0.136)
Observations	8728	8727	8729	8729	8729
F statistics	219.924	219.963	220.264	220.094	220.094
C. Mediation effects of parenting styles					
C.1 Mediation effects of authoritative parenting style					
<i>onlychild</i>	0.067*** (0.024)	0.053** (0.026)	0.061** (0.025)	0.055** (0.024)	0.058** (0.025)
<i>authoritative</i>	0.481*** (0.013)	0.385*** (0.014)	0.424*** (0.013)	0.385*** (0.013)	0.429*** (0.013)
<i>onlychild×authoritative</i>	0.047** (0.023)	0.034 (0.024)	0.040* (0.023)	0.065*** (0.024)	0.018 (0.024)
Observations	8728	8728	8728	8728	8728
R-squared	0.260	0.172	0.193	0.172	0.187
C.2 Mediation effects of authoritarian parenting style					
<i>onlychild</i>	0.098*** (0.029)	0.076*** (0.028)	0.087*** (0.029)	0.080*** (0.027)	0.087*** (0.029)
<i>authoritarian</i>	−0.140*** (0.016)	−0.146*** (0.016)	−0.140*** (0.017)	−0.090*** (0.016)	−0.098*** (0.017)
<i>onlychild×authoritarian</i>	−0.065** (0.026)	−0.047* (0.026)	−0.049* (0.025)	−0.058** (0.026)	−0.066** (0.026)
Observations	8727	8727	8727	8727	8727
R-squared	0.045	0.050	0.039	0.029	0.026

Standard errors clustered to school level are shown in parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The IV in panel B.1 is based on the ratio of only children calculated by Eqs. (6) and (7). Other results are derived from OLS estimations using Eq. (1). Other control variables, school location fixed effects, and county-fixed effects are omitted here.

more constructive parenting styles compared to their peers with siblings.

Note that parenting styles may not be only determined by family size but also affected by other family characteristics and parents' personalities. Accordingly, it is worth studying how the effects of being an only child were affected by parents' parenting practices. This study will interact the authoritative and authoritarian with the variable of *onlychild* separately and estimate the following Equation separately.

$$\text{prosoc} = \alpha + \beta\text{onlychild} + \pi_1\text{parenting} + \pi_2\text{onlychild} \times \text{parenting} + \gamma X + \varepsilon \quad (10)$$

Where the *parenting* represents the authoritative parenting style and authoritarian parenting style, respectively. Considering there may be multicollinearity because the authoritative parenting style and the authoritarian parenting style are highly correlated, this study will estimate the mediation effects separately. The results are shown in panel C of Table 9.

Panel C of Table 9 reveals distinct medication effects between positive and negative parenting styles. Specifically, an authoritative parenting style amplifies the impact of being an only child, whereas the authoritarian style tends to mitigate these effects. This differentiation in parenting styles provides an empirical basis for the Quality-Quantity (Q-Q) theory, which posits a trade-off between the number of children and their quality.

Discussion

Drawing on data from the National Children's Study of China, this paper seeks to assess the impact of being an only child on the development of prosocial behaviors in students aged 9 to 15 years. The results suggest that only children exhibit more prosocial tendencies than their peers with siblings, particularly in terms of trait-related, relational, and altruistic behaviors. The results contradict the findings of Cameron et al. (2013) and Li and Qiu (2021) but support the argument proposed by Zhao et al. (2013) and Zheng et al. (2022). Among these, Cameron et al. (2013) present the most influential judgment, suggesting that an only child behaves like a "little emperor" and is more selfish than a child with siblings. This paper offers a contrasting viewpoint, providing evidence that parent-child interactions (parenting styles) are more crucial in shaping children's prosocial behaviors.

The differences between the findings of this paper and those of previous seminal studies can be attributed to three aspects. Firstly, the national representativeness of this paper and previous studies differs significantly. This paper uses a nationwide dataset, whereas Cameron et al. (2013) and Li and Qiu (2021) conducted their studies through experiments with adults in Beijing and Wuhan, respectively. Differences in dataset generalizability may lead to varying results. Therefore, future research should focus on studies utilizing nationally representative samples of adults. Secondly, this paper focuses on school-age children in rural China, whereas previous studies have primarily focused on adults in urban China. Adults may exhibit different prosocial behaviors compared to children. Kettner and Waichman (2016) provide evidence suggesting that older adults show greater prosociality than younger adults. Eisenberg and Mussen (1989) note that prosocial behaviors increase with age due to the development of sociocognitive skills. Finally, this paper employs scale-based measures to assess prosocial behaviors based on moral judgment, while Cameron et al. (2013) and Li and Qiu (2021) adopt experimental methods based on monetary incentives. Consequently, discrepancies in findings may reflect differences in measurement methods to a certain extent.

One of the most important findings of this paper is that only children benefit from more positive parenting styles. Mechanism

analysis suggests that only children outperform their peers with siblings because they receive more from parenting styles conducive to the development of prosocial behaviors. Specifically, we find that families of only children offer more value affirmation, and instrumental help, and fewer authoritarian parenting to their children. This finding aligns with our predictions, the Quantity-Quality (Q-Q) theory, and the human capital investment theory suggested by Cobb-Clark et al. (2019). Moreover, this finding is particularly practical and has significant policy implications. Families can adopt more conducive parenting strategies to enhance their children's prosocial behaviors.

A striking finding is that the prosocial behavior scores of high-order female students are significantly lower compared to both high-order male students and only children. These results indicate a pronounced preference for sons over daughters in rural China. Despite its shortcomings, our findings reveal that the OCP confers significant benefits to girls in rural China. The findings underscore the importance of focusing on parenting practices for girls with siblings in rural China.

There are four major limitations of this paper. First, the methods employed to address the endogeneity of being an only child are not beyond question. Owing to limitations within the NCSC, we address the issue of endogeneity through the propensity score matching method, instrumental estimation based on the heterogeneity of error terms associated with being an only child, and instrumental variable estimation based on the ratio of only children at the county level prior to the birth year of the child. However, these methods may not entirely eliminate doubts regarding the issue of endogeneity. Future research should endeavor to identify a compelling instrument for being an only child. Second, constrained by NCSC data, this study does not cover the effects on preschool children and those over 15. It is conceivable that the effects of being an only child differ from our findings. Consequently, generalizing the findings of our study should be approached with caution. Thirdly, this investigation relies on scale-based measurements to assess prosocial behaviors, which significantly depend on the children's moral judgment. Future research should endeavor to amalgamate scale-based assessments with experimental methodologies that are predicated upon material motivations. This integrated approach promises to enhance the robustness and validity of findings. Finally, the current study is limited to examining children in rural China, thereby excluding those from urban areas. In urban areas, the government enforces the One-Child Policy (OCP) with greater strictness, whereas in rural areas, exceptions are made that allow couples to have a second child under specific conditions. This dichotomy complicates the identification of a direct causal link between being an only child and the manifestation of prosocial behaviors. Nevertheless, the examination of only children in urban China remains a vital area of interest. Future research should endeavor to clarify the causal relationships concerning the status of being an only child and the prosocial behaviors of children across both urban and rural settings.

Conclusion

With the end of its one-child policy (OCP) in 2015, China's demographic landscape has been significantly shaped by the rise of only children, who are increasingly becoming integral to the societal and economic framework. This study investigates how being an only child influences prosocial behavior, utilizing a comprehensive national micro-database. The analysis shows that being an only child markedly enhances prosocial behaviors, including trait-related, relational, and altruistic aspects. Through meticulous robustness checks that account for endogeneity and variations in defining dependent variables, the study's findings

stand firm. Additionally, it explores the influence of factors like sex selection and school attendance, concluding that these do not detract from the core finding: a positive correlation between being an only child and prosocial behavior. This research not only clarifies the ongoing debate but also hints at the broader implications of fostering prosocial behavior in only children for the future societal and economic health of China.

Mechanism estimation indicates that only-child families are more inclined toward adopting constructive parenting strategies. These families predominantly adopt authoritative parenting techniques, actively recognize and affirm their child's worth, and extend instrumental help, distinguishing them from families with more than one child. The presence of positive parenting styles is associated with amplifying the advantages of being an only child, while the detrimental effects of authoritarian parenting tend to mitigate these advantages. This illustrates the critical influence of parenting style in shaping the experiences and outcomes of only children, highlighting the nuanced ways in which family structure and parental approaches can impact child development.

This paper underscores significant policy implications, advocating for the promotion of democratic and supportive parenting practices, especially in rural areas. The study finds that only children exhibit higher prosocial behavior, largely attributed to more positive parenting. Contrasting this, Yue et al. (2017) observed that such parenting practices are infrequently adopted in rural Chinese families. To foster children's prosocial behaviors, it is essential to implement multifaceted strategies. Firstly, local governments, communities, and schools should enhance opportunities and training for parental involvement in child-rearing. Secondly, in light of limited parental engagement in parenting practices, it is crucial for schools and communities to facilitate social interactions among peers, providing platforms for children to develop and exhibit prosocial behaviors. This approach not only aims to improve individual child outcomes but also seeks to strengthen the well-being of individuals, communities, and society.

Data availability

The data is confidential, and the authors do not possess the authority to distribute it. Data cleaning and processing are exclusively conducted on designated computers located within the China Basic Education Quality Monitoring Collaborative Innovation Center at Beijing Normal University.

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Notes

- 1 Chinese population registration distinguish between urban and rural Hukou. In rural China, children born into rural families are registered as rural Hukou. Children born in urban families are born with urban Hukou. A person with rural Hukou can convert to urban Hukou by working for state-owned enterprises, buying an urban house, graduating from college, joining the army, joining a cadre, and moving to an urban household. This is the so-called "conversion of agricultural Hukou to non-agricultural Hukou" (*Nong Zhuan Fei*).
- 2 We additionally conduct OLS regressions treating the responses to each question as the dependent variables. The findings from this analysis are presented in Table A1. Table A1 shows that akin to the observations in Table 3, the majority of individual behaviors exhibit a positive correlation with the status of being an only child.
- 3 Table A2 shows that post-matching, the treatment and control groups exhibit remarkable similarity, indicating that PSM effectively mitigates the initial differences between these groups. Furthermore, Figure A1 illustrates a significant overlap in the propensity scores of only children and non-only children across a broad range. This overlap signifies the presence of common support between the treatment and control groups, suggesting that the PSM method has successfully identified comparable subjects within both groups for the analysis.

4 Following Chen et al. (2018), the

$$E(\text{onlychild}|X) = 1 \times \Pr[\text{onlychild} = 1|X] + 0 \times \Pr[\text{onlychild} = 0|X] \\ = \Pr[\text{onlychild} = 1|X] = \Pr[v \leq x_i \lambda] = \Pr[S(X'\theta) v^* \leq x_i \lambda] = \Pr\left[v^* \leq \frac{x_i \lambda}{S(X'\theta)}\right] \\ = F\left[\frac{x_i \lambda}{S(X'\theta)}\right].$$

- 5 Concerns arise that averaging at the county level might introduce noise, potentially affecting both fertility decisions and children's outcomes. Gormley & Matsa (2014) argue that when unobserved group heterogeneity is correlated with regressors, the instrumental variable based on the mean of the group violates the exclusion restriction, thus rendering the ratio of only children an implausible instrumental variable. Nevertheless, a fixed effect estimator, controlling for group fixed effects, may prove effective. Importantly, in this study, the ratio of only children, as detailed in Eq. (6), is calculated based on the demographic composition one year prior to the subject child's birth, not within the same age group. This calculation method ensures a precise measurement of the prevalence of being an only child in the county just before the subject child's birth year. Additionally, by controlling for county-fixed effects, our analysis addresses county-fixed heterogeneity. As a result, the ratio of only children in our study, through this meticulous definition and adjustment, meets the exclusion restriction criteria, permitting its use as an instrumental variable for identifying an only child status.

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Author contributions

Yunsen Li: conceptualization, methodology, writing—original draft, writing—reviewing and editing, funding acquisition. Yunlu Li: writing—editing, data curation, software. Gang Chen: investigation, validation, methodology. Jing Yang: investigation, resources.

Competing interests

The author(s) declare no competing interests.

Ethical approval

This is secondary data analysis. The Beijing Normal University provides the data from the National Children's Study of China (NCSC). No human beings or animals were involved in this article. The secondary data used was de-identified data. The dataset has been stripped of all identifying information and there is no way it could be linked back to the subjects from whom it was originally collected.

Informed consent

This article does not contain any studies with human participants performed by any of the authors. Consent for publication
All authors read and approved the final manuscript.

Additional information

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