

# The Effect of Preschool Education on Non-cognitive Skills of Middle School Students: Empirical Study Based on CEPS

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*Abstract.* Preschool education has been being seen as a crucial factor of individual cognitive skills, but it is yet clear regarding its effect on children's non-cognitive skills. Apart from cognitive skills, the "capabilities" in the human capital model should also include non-cognitive skills. Using the baseline data of the "China Education Panel Survey", this study explored the influence of preschool education experience on the non-cognitive skills of middle School students by using the method of propensity score matching. The results showed that children's chances of receiving preschool education has been affected by factors like the health status of the children before schooling, family economic status, and parents' education level. More importantly, preschool education had a statistically significant positive impact on the students' ability of curiosity, acceptance of new things and self-discipline, and showed a negative impact on negative emotionality.

*Best Evid Chin Edu* 2019; 3(1):287-303.

Doi: 10.15354/bece.19.ar1070

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**Keywords:** Preschool Education; Middle School Students; Non-cognitive Skills; Propensity Score Matching

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**Conflict of Interests:** None.

## Research Background and Problem

**P**RESCHOOL education, is of great significance to children's physical and mental health, habit formation and intellectual development, and has a foundational role in individual's lifelong development. In recent years, more and more attention has been paid to preschool education in China, and the gross enrollment rate of preschool education has increased from 35.9% in 2001 to 77.4% in 2016. The rapid progress of preschool education, on the one hand, benefits from the rapid growth of the social economy; on the other hand, the increasing realization of the economic and non-economic value of preschool education for children's overall growth. James J. Heckman, a Nobel Laureate in economy, has found that early childhood development interventions before formal elementary school are the highest-reward form of human capital investment, which is worth more than later investments in school education and on-the-job training (Heckman, 2006), and the economic benefits of universal preschool education is far greater than the traditional economic plan (Qiu & Liu, 2011). In terms of the specific impact of preschool education on children's development, it mainly focuses on the following two aspects: cognitive ability including in language, mathematics, and academic achievement; and non-cognitive ability such as sociability, self-confidence, motivation, etc.

Under the traditional human capital model, the word "ability" is always equated with cognitive ability, while the non-cognitive ability is usually ignored. However, in empirical studies, the cognitive ability from the controlled individuals only cannot explain the whole variety of individual outcomes. Therefore, Bowles proposed that "ability" in the human capital model should not be limited to "cognitive ability", but should also include "non-cognitive ability" (Bowles & Osborne, 2001). In recent decades, supporters of the new human capital theory headed by Heckman divided the "ability" in human capital into two parts: cognitive and non-cognitive abilities, emphasizing the important role of non-cognitive ability that is independent from cognitive ability (Heckman, 2007).

In studies over the past decade on non-cognitive ability, most of them have confirmed the important role of non-cognitive ability in individual's academic performance and income (Eren & Ozbeklik, 2013; Heckman & Rubinstein, 2001; Heineck & Anger, 2010; Scick & Steckel, 2015). Li et al. (2017) found that non-cognitive ability has a significant positive impact on students' academic performance. Le et al. (2017) used the data of the "Chinese Family Panel Survey" in 2012 and 2014, and according to "The Big Five-Factor Model of Personalities", showed that the non-cognitive ability has a substantial effect on the income of laborers, and its contribution was even higher than that of the core variable concerned by traditional human capital- education years. Huang and Xie (2017) found an explanatory effect of the non-cognitive ability on labor income difference that is independent from cognitive ability. Compared with cognitive ability, the non-cognitive ability has a greater impact on workers' income (Yu et al., 2017). The non-cognitive ability has also been found to improve individual's happiness and was

more conducive to a healthy and long life (Friedman et al., 2010; Kubzansky et al., 2009). In addition to the “instrumental” value of non-cognitive ability such as on an individual’s academic performance, income, and health, researchers start to realize its own value of the non-cognitive ability. For example, from an emotional perspective, if an individual rarely shows negative emotionality, then its immediate happiness will be relatively higher indicating the intrinsic value of the non-cognitive ability. In recent years, attention has been paid to the key competencies of students in China, and formulated the overall framework of “key competencies of Chinese students’ development”, emphasizing on the cultivation of comprehensive quality of students’ both cognitive and non-cognitive abilities.

With the attention paid to the non-cognitive ability, more discussion was raised on the cultivation of non-cognitive ability and its potential influence. Studies showed that the formation of non-cognitive ability needs several periods within a long developing period (Almlund et al., 2011), and the important period for the non-cognitive ability acquisition is the early childhood (Coneus & Laucht, 2014; Heckman, 2006). Moreover, abilities formed in different stages were closely related each other, and the development of one skill would help to acquire other skills during the next period (Borghans et al., 2008). Preschool stage is a sensitive period essential to cultivate children’s initiative, good personality, sense of responsibility, self-esteem, and self-control (Zhu, 2003; Shen, 1997), and to develop qualities such as curiosity, thirst for knowledge, imagination, and sociability as well (Pang et al., 2003). In particular, various game activities during the preschool period had an important impact on the cultivation of the non-intellectual abilities (Shen, 1997). Duncan et al. (2007) found in their empirical study that stable emotional characteristics cultivated in the early stage contribute to the development of children’s exploration ability later. A large number of empirical studies have confirmed that preschool education has a positive impact on the development of children’s cognitive and non-cognitive abilities (social skills, attention, etc.) (Nores & Barnett, 2010). The earlier the intervention would, the more beneficial would follow to the formation of both the cognitive and non-cognitive abilities. Besides, families and preschoolers might be more motivated to focus on the cognitive and non-cognitive development as it is too early to consider the competitive College Entrance Test during the preschool period.

Based on the analysis and consideration above regarding the education reality in China, we proposed that the acquisition of preschool education may possess an important role in the development of children’s non-cognitive abilities. However, it is yet known about the clear relationship between preschool education and the non-cognitive ability. In view of this, this study was designed to use the baseline data of China Education Panel Survey (CEPS) to observe the influence of preschool education on the development of the non-cognitive abilities in middle school students’ via Propensity Score Matching Method and, at the same time, to investigate the factors that affect the preschool education opportunities. As the prominent role of non-cognitive ability is increasingly recognized, it is particularly pivotal to explore the role of preschool education in developing the non-cognitive ability. First, it is important for public education policy makers in establishing capital investment, implementation and improvement of

the preschool education plan, popularization of preschool education, and promotion of human capital accumulation; second, it is crucial to provide with empirical evidence to the role of preschool education in the development of students' non-cognitive ability.

## **Literature Review**

Accumulating data have showed the contributing effects of preschool education on both cognitive and non-cognitive abilities. At the same time, some pieces of evidence have confirmed the significant role of preschool education in the improvement of children's non-cognitive ability. Reynolds (1995) investigated the impact of the Child-Parent Center Educational Program on children's cognitive and social development, and found that students in grades one to six who had received one or two years of preschool education had 0.34 standard difference higher in cognitive and social development than those who had not received the preschool education. Adaptability is another important characteristic for those who receive preschool education. Sammons (2010) found that preschool education has a long-term impact on children's "hyperactivity", "self-discipline" and "anti-social" behaviors. Furthermore, Sammons et al. (2014) used data from the UK and found that high-quality preschools (v.s. low-quality ones) had a significant impact on the non-cognitive ability (such as self-discipline) of 16-year-olds. Andersson et al. (1992) obtained similar results in a study carried out in Sweden that students who participated in the public childcare system were more independent and confident. Gormely et al. (2011) used the fixed effects regressions with propensity score matching examined the effect of the early childhood education on children's social-emotional outcomes in Tulsa, Oklahoma, and found that children participated in early childhood education programs showed lower timidity and higher concentration, and this effect was more significant on male children who came from the low-income families. Heckman (2006) indicated that the reason why the Perry Preschool Program in the United States could effectively improve the future success of participants was majorly due to its role in improving the non-cognitive ability. Chetty et al. (2010) found that high-quality education in K grade in the United States, had a significant impact on students' non-cognitive abilities such as autonomy and effort in the grades of 4 and 8, and could reduce students' destructive behaviors.

However, in China, few studies did the same observation. Several studies focused on the impact of preschool education on children's cognitive development, but most of them were small sample and did not examine the long-term impact. Peng et al. (2011) investigated 182 children from three rural elementary schools in Sichuan Province and found that children with kindergarten learning were more likely to be praised by their peers and less likely to be downgraded than the comparisons. Rao et al. (2012) observed 370 rural children in Guizhou Province and showed that children who had attended kindergarten or preschool classes were significantly better than those who had not in reading and mathematics. Liu et al. (2013) studied 1,360 children in Beijing and Shanxi Province and found that one-year preschool education had a significant effect on the mathematical learning and language development, reaching 0.61 and 0.33 standard deviations, respectively. Li et al. (2016) investigated the influence of preschool educa-

tion on children's language, mathematics, and social cognition ability and found a significant relation between them. Chen and Liu (2017) used a sample of 5,177 students from the Program of International Student Assessment (PISA) Shanghai 2012 data and Propensity Score Matching and OLS estimation methods, they found that preschool education had a significant positive impact on the mathematics, reading and scientific literacy for 15-year-old students, and the academic achievements in those who received more than one-year preschool education were higher than those who received only one-year preschool education. Gong et al. (2016) used assessed the long-term impact of preschool education on the development of rural children with the age over 10 on the basis of the "Chinese Family Panel Survey" (CFPS) data through fixed-effects model, OLS estimation method, and Propensity Score Matching, and found that preschool education had a substantial impact on the social and emotional skills, which were displayed as preschool attendees in a rural area tended to have 1.32–1.53 more friends and an 11%–17% higher chance to be a school leader than the non-attendees.

The above-mentioned studies focused on the influence of preschool education on students' cognitive abilities such as mathematics, language, and reading, but rarely explored its effect on the non-cognitive ability. However, the impact of preschool education on children's development is a multi-dimensional, multi-level and multi-faceted complex system, and researchers and decision-makers should pay more attention to its impact on children's non-cognitive development. This study evaluated the effect of preschool education from a new perspective and empirically tested the influence of preschool education on the development of the non-cognitive ability of middle school students with a nationwide sample.

## **Data**

This study used data from the China Education Panel Study (CEPS) baseline survey for the 2013-2014 academic year. The survey was designed and implemented by the National Survey Research Center at Renmin University of China. The middle school (7th graders) and high school (9th graders) students were the objects, and multi-stage probability proportional to size (PPS) sampling method was used. After four sampling stages, the county (district), school, class, student/parent/teacher/main subject teacher/school leadership and other four sampling units were extracted. In the baseline survey, a total of 28 counties, 4 schools from each county, and 4 classes from each school were selected, and a total of 19,487 seventh- and ninth-graders from 112 schools and 438 classes were sampled including 18,034 sample booklets with complete information on the preschool experience.

## **Variables**

### **Outcome Variables**

The outcome variable of this study was the non-cognitive ability. At present, there is no unified standard for the definition and measurement of non-cognitive ability. It is generally believed that the non-cognitive ability is not a representative of a single ability,

but a combination of multiple abilities. In western, the concept of “non-cognitive skills” was defined as those that are different from calculation, reading or reciting and can be measured by personality traits. For example, curiosity, attention, grit, self-control, social-emotional ability, self-discipline, motivation, self-esteem, sociability, time preference and so on (Borghans et al, 2008; Duckworth & Yeager, 2015; Gutman & Schoon, 2013). In China, Yan (1988) divided “non-intelligence factors” into three levels: (1) in the broad sense, they refer to all psychological factors other than intelligence factors; (2) in the narrow sense, they mainly include motivation, interest, emotion, intention, character and other psychological factors; (3) specific non-intellectual factors, including achievement motivation, thirst for knowledge, and enthusiasm for learning; self-esteem, self-confidence, and competitiveness; sense of responsibility, obligation and honor; Self-control, tenacity and independence. In the past two decades, the “big five personalities” measurement method developed by personality psychology has gradually been recognized and applied to measure the non-cognitive abilities that include extraversion, openness, emotional stability, agreeableness, and conscientiousness. Since no uniform measurement index exists, empirical researchers often reconstruct the proxy index of the non-cognitive ability according to specific questionnaire index and the characteristics of the “big five personalities”.

### **Openness**

According to the four related questions in the questionnaire, they can express opinions clearly, respond quickly, learn new knowledge swiftly, and be curiosity about new things (1 = completely disagree to 4 = completely agree). Through factor analysis, this study found that these four items naturally stayed together to form one factor value ( $\alpha = 0.72$ ). Combined with the “big five grid” model, we define this factor value as “openness”, and set it up as a measure of non-cognitive ability to keep consistent with the method used by Li et al. (2017).

### **Negative Emotionality**

The CEPS questionnaire asked students if they felt dispirited, depressed, unhappy, listless, or sad in the past seven days, using a five-point scoring system (1 = never to 5 = always) to measure the frequency of these feelings. Factor analysis showed that these five measures had a high similarity and could be naturally aggregated into one factor value ( $\alpha = 0.85$ ). Combined with the negative emotionality in the temperament type of children, we define this factor value as “negative emotionality”. The higher the factor score is, the stronger the negative emotionality would be.

### **Self-Discipline**

According to the CEPS questionnaire, whether students often skip classes or late, a factor value ( $\alpha = 0.69$ ) was obtained by factor analysis. Referring to the research idea of Cawley et al. (2001) that took truancy, lateness and other behaviors as proxy variables of “self-discipline”, our study reversed scores of the above-mentioned factor value (1 =

completely agree to 4 = completely disagree) and defined it as “self-discipline”. The higher the factor score is, the stronger the self-discipline would be.

## **Sociality**

We took the number of students’ self-reported good friends as a social indicator. In previous studies, the number of friends has been used as a proxy indicator of social communication skills. For example, Gong et al. (2016) used “the number of good friends they have” and “whether they are class cadres” as proxy indicators of non-cognitive social skills. Some western studies also took the number of good friends as the proxy variable of social communication (Kingery et al., 2011; Pettit et al., 2011). In addition, studies have shown that people who have more friends as childhood had better social and emotional well-being in adolescence and adulthood. Kingery et al. (2011) found that students who had more friends showed reduced loneliness and increased self-esteem. Wentzel et al. (2004) found a positive correlation between the number of friends and various adaptive indicators. Above-mentioned studies indicated that the larger the number of friends, the stronger the transitional adaptability from one stage of development to the next. In addition, our study added a reflection of the quality of friends that was composed of friends’ academic performance, effort, educational expectations and discipline.<sup>1</sup>

## **Independent Variables**

The key independent variable of our study is preschool education experience. The CEPS questionnaire asks a student whether he or she has attended preschool or a one year preschool class before grade 1 after the age of 3, and we construct a binary variable (yes = 1, no = 0) based on the student’s answer whether he or she has received preschool education (79.8%).<sup>2</sup>

## **Control Variables**

On the basis of the literature reviewed above, this study controlled for the other factors that may affect both preschool education acquisition and the non-cognitive ability of middle school students, including:

- At the personal level, gender (female = 1, male = 0) and grade are used (nine grade = 1, grade 7 = 0), nationality (Han = 1, minority = 0), household registration (agricultural as the reference), one-child (one-child = 1, non-only child = 0), birth weight (low birth weight or birth weight less than 2.5 kg = 1, normal birth weight = 0), illness before elementary school (severe illness = 1, not severe = 0), and other variables.
- At the family level, two variables are included: the years of education of the parent; the subjective evaluation of the family economic status before the children enters elementary school, including “family economic status is medium” and “family economic status is rich” two binary variables, taking “family economic status is difficult” as the reference.<sup>3</sup>

- At the regional level. A region of the average level of teaching education to a certain extent reflects the local social and economic development. To observe the influence of regional social, economic and cultural level on preschool education and the development of the cognitive ability, we selected students in the county level with average education years as a regional social, economic and cultural development level proxy variable.<sup>4</sup>

## Method

First, we used descriptive statistical methods to analyze whether there were differences between students with or without preschool education in terms of individual characteristics and family background, so as to understand whether the basic characteristics of both groups matched. On this basis, the logit method was used to investigate the factors that affect the preschool attending.

Second, in order to accurately evaluate the influence of preschool education on children's non-cognitive ability, we adopted the OLS estimation and the Propensity Score Matching (PSM) methods. Conventional OLS estimation roughly assumes that the observed value of the treatment group is the influence after receiving preschool education, which will lead to biases of the estimation results. It is not a natural process if receive preschool education or not or how long preschool education lasts, but generally is influenced by factors such as students' individual characteristics and family socio-economic background. So it is impossible to observe the outcomes of the same individual in the two states of both preschool and non-preschool education at the same time. Selective bias is a problem we need to take care of in order to accurately estimate the effect of preschool education on the non-cognitive ability. Compared with OLS, PSM can match the background of both groups more effectively and reduce the selective bias. Therefore, our study was based on the estimation of PSM.

PSM was first proposed by Rosenbaum and Rubin, and has been increasingly recognized and widely used in recent years. The basic feature of PSM is its good match of the control group with the treatment group to balance the data of the probability (propensity score). It degrades the multidimensional standard of both groups into one dimension to greatly improve the matching degree and guarantee the comparability of both groups, and to get a better estimation of the intervention effect of the treatment group. The net effect of preschool education on the non-cognitive ability of middle school students was recorded as Average Treatment Effect on the Treatment group (ATT) in the PSM model, and the model was as follows,

$$ATT = E \{E [Y_{1i} - Y_{0i} | D_i = 1, p(X_i)]\}$$

where  $Y_{1i}$  and  $Y_{0i}$  represent the scores of the non-cognitive ability of individual student in preschool and non-preschool education, respectively.  $D_i$  is the processing variable, which represents the dummy variable of whether students receive preschool education. If student  $i$  receives preschool education,  $D_i = 1$ ; otherwise,  $D_i = 0$ .  $P(X_i)$  is the propensity score value, which represents the conditional probability of student  $i$  receiving pre-

school education under the control of sample characteristic covariate X. PSM is generally divided into four steps: (1) select appropriate covariates. Based on the previous research experience, we selected a group of variables that have an influence on both preschool education participation and children's non-cognitive abilities (see Control Variables above); (2), calculate propensity scores. The propensity score was calculated by logit regression; (3), match samples according to propensity scores. In this study, the nearest neighbor matching method is used, and the radius matching and kernel matching methods were used to test the robustness of the estimated results; (4) by comparing the estimation results of various matching methods, the net effect of preschool education on the non-cognitive ability of middle school students is obtained.

## Results

### Descriptive Picture

**Table 1** shows significant differences between preschool attendees and non-attendees in terms of individual and family background. Specifically, among the samples receiving preschool education, non-agricultural households account for 43.5% of the total sample, which was significantly higher than the proportion of non-rural households in the group without preschool education (30.2%). In addition, compared with non-preschool attendees, the proportions of individuals with low birth weight and serious illness before elementary school were much lower in students who received preschool education, and the proportion of only children was higher. From the point of family economic background, the parents of preschool attendees have more years of education, with a difference of 1.27 years than the non-attendees, and the proportion of moderate and rich family in the preschool attendees was significantly higher than the comparisons. Finally, there was a significant difference in the average length of education (~0.68 yrs). In sum, obvious difference exists in individual characteristics and family background between preschool attendees and non-attendees.

### *Factors Affecting Individual's Acceptance of Preschool Education*

On the basis of above-mentioned descriptive analysis, we found significant differences between the two groups in terms of individual characteristics and family background. In order to observe the factors that influence individual acceptance of preschool education, we used logit regression analysis method to analyze the specific factors affecting individual acceptance of preschool education, and the estimation results are shown in **Table 2**. Since most independent variables in the model are discrete variables, the table presents both odds ratio and the original non-standardized coefficient of the model.

**Table 2** shows that factors such as gender, ethnic group, grade, individual health status, family economic status and years of education of parents all had significant influences on individual's acceptance of preschool education. Specifically, only-child families were more likely (22.9%) to receive preschool education than non-only children. Seventh-graders were 12% more likely than ninth-graders to receive preschool education, which may be related to the development of preschool education. Students in

**Table 1. Sample Characteristics.**

Variables	Overall Sample	Preschool Attendees	Preschool Non-attendees	t-test
Preschool Attendance	0.798	1	0	-
Female	0.485	0.490	0.470	0.020*
Han Ethnicity	0.910	0.924	0.857	0.067***
Grade 9	0.473	0.464	0.505	-0.041***
Non-Agricultural Household	0.409	0.435	0.302	0.133***
Low Birth Weight	0.322	0.295	0.433	-0.138***
Had Major Illness before Entering Elementary School	0.091	0.083	0.126	-0.043***
The Only Child	0.434	0.468	0.300	0.168***
Parent's Education	10.767	11.082	9.793	1.273***
Family Economy Medium	0.731	0.749	0.652	0.097***
Family Economic Affluence	0.056	0.060	0.041	0.019***
Average Number of Years of Education in the County	9.485	9.481	8.938	0.543***

Note: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . The value in the table is the mean value of each variable. Since most of the result variables are standardized factor score values, the mean value of the result variables is not shown here.

poor physical condition before elementary school were significantly less likely (25.7%) to receive preschool education than those in good physical condition. In comparison, students came from families with economic difficulties had a 43.3% of preschool education acceptance, but those from family with good economic status had a 63.1% of the preschool education acceptance, this is mainly because of poor families are unable to afford the high cost of preschool education. In addition, the level of local education level had a statistically significant impact on students' access to preschool education. Therefore, the analysis confirmed that students in a better position were more likely to receive preschool education. Moreover, the family's economic status is the most significant factor influencing students to receive preschool education.

### ***Influence of Preschool Education on Non-Cognitive Ability of Middle School Students***

We first used the OLS regression method to estimate whether preschool education had a significant impact on students' non-cognitive ability after controlling other confounding factors. Then, the PSM method was used for further analysis. The results are shown in **Table 3**.

The PSM results showed that a stable and significant relationship exists between preschool education and students' non-cognitive abilities such as thinking openness, negative emotionality, and self-discipline and friend quality. After controlling the

**Table 2. Influencing Factors of Preschool Education: Logit Regression Results.**

Variables	Preschool Attendance	
	Coef	Odds Ratio
Female	0.082* (0.039)	1.086
Grade 9	-0.128*** (0.039)	0.880
Han Ethnicity	0.195** (0.065)	1.217
Non-Agricultural Household	0.033 (0.469)	1.034
Low Birth Weight	-0.291*** (0.041)	0.743
Had Major Illness before Entering Elementary School	-0.131* (0.062)	0.872
The Only Child	0.206*** (0.046)	1.229
Parent's Education	0.064*** (0.012)	1.070
Family Economy Medium	0.355*** (0.043)	1.433
Family Economic Affluence	0.487*** (0.112)	1.631
Average Number of Years of Education in the County	0.198*** (0.017)	1.219
N	18,034	
<i>Note: *p&lt;0.05, **p&lt;0.01, ***p&lt;0.001.</i>		

personal and family factors, the thinking openness in students who had received preschool education were 0.04-0.05 standard deviations higher than those who had not received preschool education, that is, students who have received preschool education were better than those who had not received preschool education in terms of curiosity and ability to accept new things. Regarding the negative emotionality, students who have received preschool education showed less negative emotions such as depression, sadness and unhappiness indicating that in terms of emotional regulation, students who had received preschool education were stronger than those who had not received preschool education. In addition, on self-discipline, students who had received preschool education rarely ran away from school and late when compared with those who had not received preschool education. Finally, in terms of the quality of friends, students who had received preschool education showed better performance. Among the friends they mentioned, most were students who learnt hard, achieved outstanding results and per-

**Table 3. Influence of Preschool Education on Non-cognitive Ability of Students.**

Outcome Variable	OLS	PSM		
		Nearest Neighborhood Matching	Radius Matching	Kernel Matching
Openness	0.036** (0.015)	0.042** (0.019)	0.036** (0.017)	0.045*** (0.017)
Negative Emotion	-0.071*** (0.017)	-0.071*** (0.022)	-0.073*** (0.020)	-0.071*** (0.019)
Self-Discipline	0.028* (0.014)	0.011 (0.019)	0.032* (0.017)	0.034* (0.017)
Number of Good Friends	0.547 <sup>+</sup> (0.279)	0.278 (0.344)	0.149 (0.307)	0.198 (0.301)
Quality of Friends	0.151*** (0.037)	0.176*** (0.052)	0.197*** (0.047)	0.206*** (0.046)

Note: <sup>+</sup> $p < 0.1$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . Other control variables are included in both OLS and PSM estimates. In PSM estimation, the nearest neighbor matching ( $K=4$ ), radius matching (caliper= 0.01), kernel matching and other matching methods were adopted. The standardized mean differences of almost all variables after matching were less than 10%, and the standardized mean differences of most variables were significantly reduced. ATT was reported in the table.

formed well. In addition to preschool education, parents' education level and the status of family economy were also important factors affecting these non-cognitive abilities.<sup>5</sup>

Chinese scholars have analyzed the important role of preschool education in cultivating children's curiosity from the theoretical point, but no corresponding empirical study was conducted. Our study demonstrated that preschool education has a significant positive effect on the development of students' curiosity that provides an empirical evidence for the theoretical analysis mentioned above. In addition, this study found that preschool education has a significant positive impact on the self-discipline of middle school students, which is consistent with the conclusion of Sammons (2010). Different from Gong et al. (2016), they found that preschool experience had no significant effect on the number of students' friends, which may be related to the differences in the samples used in the two studies, Gong et al took rural students as the research objects, whereas this study covered students from both urban and rural areas, and this variable was given priority, and therefore may exist a certain difference. Although the conclusions were inconsistent in terms of the number of friends, our study found that the students who received preschool education were more likely to have good academic performance, learn hard and perform well with their best friends, which supplemented the study of Gong et al. These two studies verified the significant influence of preschool

education on the development of the non-cognitive ability of elementary and middle school students from different aspects.

### ***Matching Effect Analysis***

The propensity score matching method was used to satisfy two basic assumptions: (1) equalization of covariate distribution in the post-match treatment and control groups; (2) the propensity scores of both treatment and control groups with common support areas. Our study focused on the balance of variables that also affect the preschool enrollment and the non-cognitive abilities of children. The balanced variables include parents' educational attainment, family economic status before elementary school, household registration, and only-child family. The balance test found that these variables matched well and standardized mean differences were less than 5%. Meanwhile, the standard mean difference of the other control variables was less than 10%. According to the distribution map of propensity scores between the treatment and the control groups, there were overlapping areas of propensity scores between the preschool attendees and non-attendees indicating that the matching reduced the initial difference of characteristic variables between both groups.

## **Conclusions and Suggestions**

Given the prominent role of the non-cognitive ability in personal growth and development, it is increasingly recognized that "ability" in the human capital model includes not only cognitive ability, but also the non-cognitive ability. It has become the latest trend of world education practice to try new teaching methods to develop children's non-cognitive abilities in social emotion, curiosity, and thirst for knowledge, self-discipline, and initiative. In this context, it is particularly important to explore the role of preschool education in the development of children's non-cognitive ability. Based on the national sample of the 2013-2014 baseline data of the CEPS, this study empirically investigated the effect of preschool education on the non-cognitive ability of middle school students in China using the propensity score matching method, and attempted to answer the following questions: What factors affect the access to preschool education? Does preschool education affect the non-cognitive ability of the middle school students? The main research conclusions are:

First, there is inequality in access to preschool education. Our study found that students' physical condition before elementary school, family economic condition, parents' years of education and local economic level all possess role in affecting students' access to preschool education. In comparison with students from poor families, students from middle and wealthy families are 43.3% and 63.1% more likely to receive preschool education.

Second, preschool education has a significant impact on the non-cognitive ability of middle school students. We found that students who have received preschool education had a strong curiosity and ability to accept new things, less negative emotions, better self-discipline, and less truancy and lateness. In addition, in terms of the quality of friends, students with preschool education had more good friends who are more like-

ly to get good academic and other school performance. Therefore, preschool education can improve the non-cognitive ability of human capital and play a positive role in promoting individual's future development.

Based on these findings, we strongly suggest that the government should continue to pay attention to and invest in the preschool education. Meanwhile, because children from poor families with poor health are significantly less likely to receive preschool education, so the government's financial expenditure on preschool education should incline to vulnerable children to guarantee the right of the disadvantaged children to receive preschool education.

We need to point out the limitations that our study has. First, the two methods we used in this study are non-experimental ones. Although the PSM method can reduce the selective bias to some extent, it only controls the influence of observable variables. If there is an unobservable endogenous variable, so "hidden bias" cannot be avoided. Second, we observed a number of non-cognitive indicators such as self-discipline, negative emotionality, and thinking openness, but most of these indicators are self-reported measures. So they were more subjective. With the development of measurement technology, more objective indicators can be investigated in the future. Finally, future studies can observe the impact of preschool education with different types and quality on the development of children's non-cognitive ability.

**Note:**

1. *The CEPS questionnaire asks the following questions: "do some of the good friends mentioned above have the following situations: good academic performance, hard study, and want to go to college", then the answer is "no such" (1) "one or two" (2) and "many such" (3) Another related question is: "good friend mentioned above have the following situation: skipping classes, truant, kip, in violation of the rules being criticized, disposition and fight back and learned", because the behavior such as skipping classes and grades excellent performance, such as is on the contrary, to facilitate research, do the reverse score here, answer "no such assignment 3," answer "one or two" assignment 2, answer "many of these" assignment 1. On this basis, the index of "friend quality" ( $\alpha = 0.80$ ) was synthesized by principal component analysis.*
2. *The preschool education here is mainly for children aged 3-6, but not limited to this. In the CEPS survey, no matter how old a child is enrolled in kindergarten or pre-school, or how many preschools he or she has received, the figure is better than the three-year gross enrollment rate reported by the national statistics.*
3. *During the survey, the hospital asked parents and students for subjective evaluation of the economic status of the family before elementary school. We give priority to the parents' questionnaire data, and then use the students' questionnaire data when the parents do not answer, and finally generate derived variables that reflect the family economic status of students before they enter elementary school.*

4. *Based on the data of the sixth national census, the CEPS project works out the average years of schooling in the samples' districts and counties.*
5. *Limited by space, other control variables from the results of omission.*

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*Received: 22 July 2019*

*Revised: 10 August 2019*

*Accepted: 15 September 2019*

*The Chinese version of this article has been published in Edu Econom 2018; 34(4):37-45. The English version has been authorized for being publication in BECE by the author(s) and the Chinese journal.*

龚欣, 李贞义. 学前教育经历对初中生非认知能力的影响: 基于 CEPS 的实证研究. *教育与经济*, 2018; 34(4): 37-45.