

Li, Zheng

Article

The intertemporal connection between preschool delay of gratification and later academic performance in primary schools: Evidence from China

Journal of Applied Economics

Provided in Cooperation with:

University of CEMA, Buenos Aires

Suggested Citation: Li, Zheng (2022) : The intertemporal connection between preschool delay of gratification and later academic performance in primary schools: Evidence from China, Journal of Applied Economics, ISSN 1667-6726, Taylor & Francis, Abingdon, Vol. 25, Iss. 1, pp. 145-155, <https://doi.org/10.1080/15140326.2021.2013007>

This Version is available at:

<https://hdl.handle.net/10419/314156>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>



The intertemporal connection between preschool delay of gratification and later academic performance in primary schools: evidence from China

Zheng Li

To cite this article: Zheng Li (2022) The intertemporal connection between preschool delay of gratification and later academic performance in primary schools: evidence from China, Journal of Applied Economics, 25:1, 145-155, DOI: [10.1080/15140326.2021.2013007](https://doi.org/10.1080/15140326.2021.2013007)

To link to this article: <https://doi.org/10.1080/15140326.2021.2013007>



© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 03 Mar 2022.



[Submit your article to this journal](#)



Article views: 2235



[View related articles](#)




[View Crossmark data](#)



Citing articles: 2 [View citing articles](#)

The intertemporal connection between preschool delay of gratification and later academic performance in primary schools: evidence from China

Zheng Li 

School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi, PR China

ABSTRACT

A child's ability to resist temptation is an important non-cognitive skill and associated with lifetime benefits. Using a longitudinal dataset, this study links Chinese preschoolers' delay of gratification to their later scholastic performance during primary education. An empirical investigation is conducted to explore the potential relation between them. The results show that this personality trait, revealed at age 4–5 years by using the marshmallow experiment, has a long-lasting and positive contribution, even after accounting for students' cognitive performance and other non-cognitive skills measured at age 10–11 years. Our findings in a developing country context are supported by evidence from developed countries.

ARTICLE HISTORY

Received 26 February 2020
Accepted 28 November 2021

KEYWORDS

Delay of gratification; non-cognitive skills; schooling performance; ordered logit

1. Introduction

Human decision making often involves intertemporal trade-offs between costs and benefits occurring at different time points. Self-control is an important skill “altering one's own responses, especially to bring them into line with standards such as ideals, values, morals, and social expectations, and to support the attainment of long-term goals” (Baumeister, Vohs, & Tice, 2007, p. 351). Various terms have been used to describe this personality trait such as self-regulation, planning ability and use of self-instruction (Agbaria & Bdier, 2020). More specifically, a preschooler's ability of restraining her/his impulses for the sake of future (greater) reward is closely related to “delay of gratification”, a concept introduced by Mischel and his colleagues (e.g., Mischel, Ebbsen, & Zeiss, 1972; Mischel, Shoda, & Rodriguez, 1989; Shoda, Mischel, & Peake, 1990) using the famous marshmallow experiment.¹ In economic psychology, its discussion is about temporal discounting or time inconsistent preferences, and this ability plays an important role in overcoming present bias (see Frederick, Loewenstein, & O'Donoghue, 2002; Koch, Nafziger, & Nielsen, 2015 for overviews).

CONTACT Zheng Li  lzesse@hotmail.com; zheng_li@xjtu.edu.cn  School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, PR China

¹Children aged at around 4 years old were left alone with one marshmallow after the experimenter informed that they could have two marshmallows if they waited to eat the one marshmallow until she/he returned.

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Delay of gratification in children may lead to lifetime benefits (Duckworth, Tsukayama, & May, 2010; Moffitt et al., 2011; Oreopoulos, 2007). To understand its influence on educational outcomes is of particular importance (Koch et al., 2015), given the predictive power of academic achievement for future human capital formation and economic development (Mendez, 2015). The existing evidence on the connection between preschoolers' delay of gratification and their later scholastic performance has focused on developed countries (see Smithers et al., 2018 for an overview). In the literature, there is a dearth of empirical evidence on whether the similar link holds in a developing country setting, and it is this that has motivated our paper.

Using the education production function (Hanushek, 1979; Todd & Wolpin, 2003) as a theoretical framework, this study explores this intertemporal link established on a Chinese longitudinal dataset. The long-term role of preschool delay of gratification in shaping schooling performance is quantified, while accounting for individuals' cognitive skills, non-cognitive skills, studying behaviours, and parental inputs. A key finding is that Chinese children, aged at 4–5 years old, who delayed their gratification in the marshmallow experiment are more likely to be the top students in class during primary education, all else equal, which is in line with international evidence. The organisation of the remaining sections is as follows. First, we introduce the data used in this study. This is followed by the modelling framework. After the findings and discussion, we then draw some conclusions and suggestions.

2. Data

This study uses the China Family Panel Studies (CFPS) of the Institute of Social Science Survey (ISSS) at Peking University. The CFPS, a nationally representative survey of Chinese society, covers a variety of themes on Chinese society, economy, families, and individuals (Institute of Social Science Survey [ISSS], 2015). Its baseline survey was conducted in 2010, and, to date, there are three follow-up surveys (2012, 2014 and 2016) which are publicly available. The CFPS has three levels of survey. At the community level, it collects information on population structure, policies and social services. The family-level data include sociodemographic status, family interaction and relationships. At the individual level, different questionnaires are used for collecting individual attributes/behaviours/attitudes for adults and children/adolescent respectively. For detailed information related to its survey design, sample procedure, data collection, please refer to Xie and Hu (2014). For recent applications of CFPS in the field of economics, please refer to Hsieh and Qin (2018), Porto et al. (2019) and Zhang et al. (2020), among others.

Based on two CFPS waves (2010 and 2016),² the link between survey-based information on preschool delay of gratification and students' scholastic performance is established. Mischel's delay of gratification paradigm is useful for understanding between-individual heterogeneity in self-control abilities of preschoolers, however it may not be suitable for studying older age groups given that purposeful self-distraction would grow with age which makes delaying less difficult (Otto, 2013). Therefore, this study limits to those who (1)

²A reviewer suggested that using CFPS 2014 could explore the link of interest at an earlier point in time. The sample size would be substantially reduced if the 2014 data were used. Moreover, the 2014 survey did not conduct word recall and numerical series tests, which are important cognitive measures, also used as controls for robustness checks in this paper.

Table 1. Cognitive skills and non-cognitive skills assessed in this study.

Year	Cognitive skills	Non-cognitive skills
2010	Child's age to say complete sentences; Child's age to count from '1' to '10'	Delay of gratification
2016	Memory: Word recall test; Mathematics: Number series test	Conscientiousness, attention, self-esteem, self-efficacy

attended the marshmallow test at the age of 4–5 years old in CFPS 2010³ and (2) also reported the rank in class in the 2016 survey.⁴ Under the eligibility criteria, the study sample consists of 493 observations; and 51.9% of them delayed their gratification in the 2010 survey, while the distribution for the reported rank across the sample is 6.3% for bottom 25% in class, 8.3% for 51–75%, 27.4% for 26–50%, 27.8% for 11–25% and 30.2% for top 10%. Cognitive skills and non-cognitive skills are important to schooling performance and human capital accumulation (Cunha, Heckman, & Schennach, 2010; Heckman & Rubinstein, 2001; Kaufman, Reynolds, Liu, Kaufman, & McGrew, 2012). The former (abilities in reading, writing, reasoning and mathematics) are typically measured by using standardised tests; while the latter may be captured by observing behaviour or self-reported items (Kajonius & Carlander, 2017). The cognitive/non-cognitive skills assessed in this study are given in Table 1.

3. Modelling framework

In this study, the dependent variable is the student's overall rank in class in terms of five ordinal categories (bottom 25%, 51–75%, 25–50%, 11–25% and top 10%). Therefore, the ordered choice model is employed, with various thresholds being used to define the ranges of the categories on the underlying latent scale. The ordered choice model is capable of accommodating ordered outcomes with unequal distinctions among these preference scales. It has a wide range of applications with regard to discrete variables (ordinal categories) such as bank rating, investor belief and performance standard (see e.g., Bellotti, Matousek, & Stewart, 2011; Hoffman & Post, 2014; Li & Hensher, 2020). The standard ordered choice model is based on the following specification.

$$y^* = \beta'x_i + \varepsilon_i \quad (1)$$

The latent preference variable, y^* , is continuous, and its observed counterpart is y_i in discrete form shown in Equation (2):

$$\begin{aligned}
 y_i &= 0, \text{ if } y^* \leq \mu_0; \\
 &= 1, \text{ if } \mu_0 y^* \leq \mu_1; \\
 &= 2, \text{ if } \mu_1 y^* \leq \mu_2; \\
 &\dots \\
 &= J, \text{ if } y^* \mu_{J-1}
 \end{aligned} \quad (2)$$

³CFPS 2010 conducted the delay of gratification experiment as follows: The interviewer verbally informed the child that: "I can only give you one candy if you want it now. However, I can give you two if you wait until we complete the interview. Do you want it now or will you wait until we complete the interview?" The child then made a choice between two options.

⁴The absolute measure of performance is not available in the 2016 survey. The rank outcome is obtained across different schooling years, according to each sampled student's academic performance prior to the 2016 survey.

where β is the set of parameters of the explanatory variables x_i ; μ_j are the threshold parameters, estimated in conjunction with β based on maximum likelihood; ε_i are the disturbance or error term where a logistic distribution defines the ordered logit model. For detailed information on the ordered choice model, see Greene and Hensher (2010).

To conduct a meaningful statistical analysis, the theoretical justification for selecting candidate explanatory variables in the model is rather important. The education production function (Hanushek, 1979; Todd & Wolpin, 2003) presents a useful framework that relates schooling outcomes with (1) individual skills/abilities, (2) family inputs, (3) school characteristics and (4) peer effects. Given that the rank in class (from bottom group to top group) is the dependent variable, school characteristics (public school vs. private school and class size) are used as controls in this paper, along with the student's schooling year (n^{th} grade), age at test, age at school start and gender. Koch et al. (2015) detached peer effects from the function, and explained that they may also be decided by the family/school. Moreover, the NSFC survey has not collected information on peer effects. Therefore, this current study dropped this component.

The key hypothesis of this paper is that the delay of gratification ability of Chinese children may play a long-run and positive role in their formal schooling performance. Other non-cognitive skills considered in the empirical model are reported by the sampled students. These self-reported variables are associated with a 1–5 Likert-scale (from “strongly disagree” to “strongly agree”), and for each non-cognitive skill, two dummy variables are refined: “strongly agree” (=1) and “agree” (=1), while taking the value ‘0’ for other three levels (“neutral”, “disagree” and “strongly disagree”). Both dummy variables are included in the model simultaneously to test potential nonlinearity. The age (months) that the child was able to say complete sentences and to count from ‘1’ to ‘10’ and the results of standardised word recall and number series test are used to represent our sampled individuals’ cognitive skills at two different stages of development.

Family inputs typically consist of money and time investments on the child's education by the parents, and the available variables in this study include (a) monetary inputs: the child's kindergarten fee in the year of 2010 and primary education fee in the year of 2016, and (b) time-related inputs: whether read to the child every day (1,0) and the number of heart-to-heart conversations per month, as well as (c) indirect inputs: indirect inputs: mother and father's education. Several studying behaviours are also included in the main specification: non-weekend studying time (hours), weekend studying time (hours) and whether the student had cut formal class before (1,0). Table 2 summarises the descriptive statistics for the explanatory and control variables included in the empirical analysis presented in the following section.

4. Empirical results and discussion

A normalisation is needed so that a constant can be identified, in which the threshold parameter for between Level 0 and Level 1 equal to zero ($\mu(0)$) and estimate the parameters between Level 1 and 2 ($\mu(1)$), Level 2 and 3 ($\mu(2)$), and Level 3 and Level 4 ($\mu(3)$), which are the threshold values for the corresponding ranks in class, that is, $\text{value} < 0$: Bottom 25%; $0 < \text{value} < \mu(1)$: 51–75%; $\mu(1) < \text{value} < \mu(2)$: 25–50%; $\mu(2) < \text{value} < \mu(3)$: 11–25%; and $\text{value} > \mu(3)$: Top 10%. The specification with the full list of explanatory and control variables introduced in Section 3 is estimated,

Table 2. Descriptive statistics of the variables included in the main specification.

Variables	Description	Mean or percentage of "yes" for dummy variables	Standard deviation
Non-cognitive/Cognitive skills of children			
Delay of gratification (1,0)	Whether the child delayed his/her gratification in the 2010 marshmallow experiment	51.9%	-
Age to speak (months)	Child's age to say complete sentences e.g., "I want to eat"?	20.32	7.55
Age to count (months)	Child's age able to count from 1 to 10	34.92	10.45
Memory (points)	Word recall score tested in the 2016 survey	8.20	3.72
Mathematics (points)	Number series score tested in the 2016 survey	5.88	1.62
Conscientiousness: (1,0)	"Agree" for "I respect the school rules"	67.1%	-
Strong conscientiousness (1,0)	"Strongly agree" for "I respect the school rules"	23.1%	-
Attention	"Agree" for "I Concentrate during class"	59.6%	-
Strong attention	"Strongly agree" for "I Concentrate during class"	11.0%	-
Low self-esteem (1,0)	"Agree" for "I regard myself as a failure"	3.4%	-
Extremely low self-esteem (1,0)	"Strongly agree" for "I regard myself as a failure"	1.0%	-
Self-efficacy	"Agree" for "I am able to do things as well as most other people"	78.1%	-
Strong self-efficacy	"Strongly agree" for "I am able to do things as well as most other people"	15.6%	-
Family inputs			
Kindergarten miscellaneous fee (CNY: Chinese Yuan)	Collected in the 2010 survey	800.32	1538.69
Primary education miscellaneous fee (CNY)	Collected in the 2016 survey	161.90	398.24
Parents read to the child every day (1,0)	Collected in the 2010 survey	11.2%	-
Heart-to-heart conversation with the child (times/month)	Collected in the 2016 survey	2.79	5.12
Mother with a tertiary education (1,0)	Parental education	4.9%	-
Father with a tertiary education (1,0)	Parental education	5.7%	-
Children's studying behaviours in primary schools			
Weekdays studying time (hours)	Collected in the 2016 survey	8.17	4.29
Weekend studying time (hours)	Collected in the 2016 survey	3.30	2.63
Cut class (1,0)	Whether the student had cut formal class before	2.0%	-
Control variables			
Male (1,0)	Gender being male	55.6%	-
Age at test (years)	Age of the student when attending the 2016 survey	10.60	0.57
Grade (years)	Years of primary schooling	4.23	0.93
Age at school start (years)	The age to start primary schooling	6.40	0.79
Class size (students)	The number of students in class	45.33	19.17
Public school (1,0)	Whether it is a public school	90.8%	-

which is the empirical model in this study. As a robustness check, an alternative specification is also estimated, and the comparison of two models (Model 1: Full specification vs. Model 2: Without other non-cognitive/cognitive skills) suggests that the core parameter estimate of this study, namely preschool delay of gratification, is robust to alternative specifications (see [Table 3](#)).

The empirical model suggests that preschool delay of gratification may play a long-run role in later schooling performance. Other significant skills include two types of cognitive functioning: word memory and mathematics in terms of dummy variables,⁵ as well as conscientiousness (the tendency to be hardworking, responsible and organised, Smithers et al., 2018), attention (the awareness of focusing on certain aspects of the environment, Smithers et al., 2018) and low self-esteem (the global appraisal of the self in terms of a feeling of worthlessness, Axelsson & Ejlerstsson, 2002). Relative to directly using the point estimates in Table 3, a more informative way is to use the partial effects. For a continuous variable, a partial or marginal effect represents the influence on the choice probability of a particular outcome of one-unit change in an explanatory variable. For

Table 3. The ordered logit modelling results.

Variables	Model 1		Model 2	
	Parameter	Standard error	Parameter	Standard error
<i>Constant</i>	2.364	1.734	4.1272***	1.588
<i>Non-cognitive/Cognitive skills of children</i>				
Delayed gratification (1,0)	0.4769***	0.172	0.4152**	0.168
Age to speak (months)	0.0002	0.002	-	
Age to count (months)	0.66D-04	0.000	-	
Word recall score >6 (1,0)	0.3722**	0.184	-	
number series score >9 (1,0)	0.3908**	0.185	-	
Conscientiousness (1,0)	0.7686***	0.200	-	
Strong conscientiousness (1,0)	1.5060***	0.324	-	
Attention (1,0)	0.7038**	0.306	-	
Strong attention (1,0)	0.5584	0.345	-	
Low self-esteem (1,0)	-0.0829	0.458	-	
Extremely low self-esteem (1,0)	-1.7194	1.065	-	
Self-efficacy (1,0)	0.3047	0.389	-	
Strong self-efficacy (1,0)	0.5341	0.438	-	
<i>Family inputs</i>				
Kindergarten fee (CNY)	-0.91D-04	0.59D-04	-0.97D-04*	0.59D-04
Primary education fee (CNY)	0.0002	0.000	0.0003	0.000
Parents read to the child every day (1,0)	0.0985	0.269	0.1901	0.268
Heart-to-heart conversation (times/month)	0.0005	0.001	0.0003	0.001
Mother with a tertiary education (1,0)	0.5009	0.432	0.7086*	0.429
Father with a tertiary education (1,0)	0.6947*	0.413	0.6206	0.412
<i>Children's studying behaviours in primary schools</i>				
Weekdays studying time (hours)	0.0029**	0.001	0.0024*	0.001
Weekend studying time (hours)	-0.0014	0.001	-0.0012	0.001
Cut class (1,0)	-1.4623**	0.633	-1.4173**	0.604
<i>Threshold parameters</i>				
Mu(1)	1.0425***	0.11	0.9707***	0.103
Mu(2)	2.6860***	0.096	2.4956***	0.091
Mu(3)	4.0021***	0.112	3.7206***	0.106
<i>Controls</i>				
Sample size (N)	Yes		Yes	
Log-likelihood	-669.098		-697.058	
Akaike information criterion (AIC)/N	2.844		2.909	

***, **, *: Significance at 1%, 5%, 10% level

⁵The maximum possible score is 10 for the word memory test and 15 for the number series test. Within this sample, the mean score is 5.88 for the former and 8.20 for the latter. These two dummy variables may imply "good memory" (31.8% of the sample) and "good mathematics" (31.0%).

a dummy variable, the partial effects are the derivatives of the choice probabilities given a change in the level of the dummy variable from '0' to '1'. Table 4 presents the identified important partial effects on the response probabilities.

We found a strong correlation between preschool delay of gratification and scholastic performance during primary education. When facing a choice between (1) immediately obtaining one gift or (2) obtaining two gifts after the interview, children who chose the second option would have a higher chance of being the top-10% students in class (+9.41%). Moreover, its raised likelihood of being among the best performed group is much higher than for being among the second best group (1.28%). This self-control ability is associated with the reduced likelihood of becoming normal students (−6.42% for being ranked among 26–50% and −2.99% for being ranked among 51–75%, as well as the chance of being the worst performed students (−2.14%). The corresponding partial effects estimated from Model 2 which controls for other non-cognitive and cognitive skills are: −0.0221(0.009), −0.0267(0.011), −0.0520(0.021), 0.0154(0.008) and 0.0853(0.035) respectively for the response probabilities from “bottom 25%” to “top 10%”, similar to what are reported in Table 4, which would, to some extent, support the robustness of our empirical findings on the intertemporal link of interest.

In addition to individuals' non-cognitive skills, cognitive abilities and studying behaviours, we found that parental education is positively related to their offerings' schooling outcomes. This connection is referred to as intergenerational schooling associations (Holmlund, Lindahl, & Plug, 2011; Pronzato, 2012; Fleury & Gilles, 2018 for an overview). According to Cunha and Heckman's (2007) life-cycle model of learning, parental schooling may add children's initial ability endowment, which would, in turn, has a positive contribution to their learning productivity. In China, Magnani and Zhu (2015) and Dong, Luo, Zhang, Liu, and Bai (2019) found some empirical evidence on the intergenerational transmission of schooling. These findings highlight the long-run benefits of education improvement, which is associated with compound gains in economic and social returns.

5. Conclusions

Using two waves of the CFPS study, this paper investigates the intertemporal connection between Chinese children's self-control abilities and their schooling outcomes within the theoretical framework of the education production function. The model outputs in this study demonstrate the long-run associations between Chinese preschoolers' gratification delay at age 4–5 years and their academic outcomes at age 10–11 years. In the USA, Shoda et al. (1990) found that the ability to delay gratification at the age of four years old is positively correlated with the Standardized Aptitude Test (SAT) results; Watts, Duncan, and Quan (2018) also found that this ability predicted a gain in schooling achievement at age 15. According to the cross-country findings of Pearce et al. (2016), Children in Australia (6–7 years) and in the UK (5 years) with low self-regulation are more likely to deliver worse academic outcomes at 7–9 years old. Another Australian study (Sawyer et al., 2015) found that the ability of self-regulation in early childhood positively correlates with formal schooling performance. These evidence from developed countries would strength the credibility of our conclusion, that is, preschool self-control may be a predictor of academic achievement for Chinese primary school students.

Table 4. Important partial effects for the empirical model (Model 1).

Variables	Rank in class: Bottom 25%			Rank in class: 51–75%			Rank in class: 26–50%			Rank in class: 11–25%			Rank in class: Top 10%		
	Partial effect	Standard error		Partial effect	Standard error		Partial effect	Standard error		Partial effect	Standard error		Partial effect	Standard error	
Delayed gratification (1,0)	–0.0214	0.008		–0.0299	0.011		–0.0642	0.023		0.0215	0.010		0.0941	0.034	
Word recall score >6 (1,0)	–0.01548	0.007		–0.0221	0.011		–0.0514	0.025		0.0129	0.007		0.0762	0.039	
number series score >9 (1,0)	–0.01620	0.007		–0.02317	0.011		–0.0540	0.026		0.0133	0.007		0.0801	0.039	
Conscientiousness (1,0)	–0.0368	0.011		–0.050	0.014		–0.0997	0.024		0.0392	0.014		0.1473	0.038	
Strong conscientiousness (1,0)	–0.0418	0.007		–0.0636	0.010		–0.1947	0.035		–0.0478	0.036		0.3477	0.077	
Attention (1,0)	–0.0347	0.017		–0.0469	0.022		–0.0903	0.036		0.0394	0.022		0.13252	0.055	
Strong attention (1,0)	–0.0217	0.012		–0.0315	0.018		–0.0777	0.048		0.0131	0.008		0.1178	0.076	
Low self-esteem (1,0)	0.0038	0.021		0.0050	0.029		0.0112	0.062		–0.0040	0.025		–0.0162	0.090	
Extremely low self-esteem (1,0)	0.1641	0.176		0.1463	0.085		0.0745	0.089		–0.1714	0.111		–0.2135	0.068	
Mother with a tertiary education (1,0)	–0.0181	0.013		–0.0267	0.019		–0.0704	0.061		0.0062	0.011		0.1089	0.101	
Father with a tertiary education (1,0)	–0.0235	0.011		–0.0351	0.017		–0.0970	0.056		0.0010	0.018		0.1545	0.100	
Weekdays studying time (hours)	–0.0001	0.000		–0.0002	0.000		–0.0004	0.000		0.0001	0.000		0.0006	0.000	
Cut class (1,0)	0.1250	0.089		0.1242	0.058		0.0905	0.033		–0.1439	0.073		–0.1958	0.051	

However, children's delay of gratification outcomes could be influenced by the trustworthiness of the experimenter (Michaelson & Munakata, 2016), environmental reliability (Kidd, Palmeri, & Aslin, 2013) and children's emotions (Shimoni, Asbe, Eyal, & Berger, 2016). The marshmallow experiment might be associated with measurement error (Cunha et al., 2010) for example the ability to exercise self-control. Such information is not available and hence cannot be separated from observed outcomes, which is a major limitation to this current study.

Besides its contribution to educational success, other returns to this non-cognitive skill are substantial such as health, social functioning and wealth, according to some longer-term follow-up studies (Golsteyn, Grönqvist, & Lindahl, 2014; Moffitt et al., 2011). This important ability is malleable and can be improved (Drobtz, Maercker, Spiess, Wagner, & Forstmeier, 2012; Piquero, Jennings, & Farrington, 2010). However, there is no evidence supporting that one type of intervention is always superior to another (Smithers et al., 2018). When designing interventions, it is imperative to investigate the potential effects of genetic factors and environmental factors on its malleability (Koch et al., 2015).

Acknowledgments

The author is indebted to one reviewer who provided exceptional and insightful comments and advice.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was funded by the Young Talent Support Plan, Xi'an Jiaotong University (grant number 0002019060).

Notes on contributor

Dr. Zheng Li is Professor of Economics at the School of Economics and Finance, Xi'an Jiaotong University, and Honorary Professor of ITLS at the University of Sydney Business School. His research focuses on applied economics, transport/logistics management and risk/uncertainty analysis. As of Nov. 2021, he has published nearly 50 papers in the world-renowned journals, and his Google Scholar h-index is 19 and i10-index being 26.

ORCID

Zheng Li  <http://orcid.org/0000-0002-2912-2103>

Availability of data and material

The data is publicly available: <http://dx.doi.org/10.18170/DVN/45LCSO>

References

- Agbaria, Q., & Bdier, D. (2020). The Agbariaole of self-control, social support and (positive and negative affects) in reducing test anxiety among Arab teenagers in Israel. *Child Indicators Research*, 13(3), 1023–1041.
- Axelsson, L., & Ejlertsson, G. (2002). Self-reported health, self-esteem and social support among young unemployed people: A population-based study. *International Journal of Social Welfare*, 11(2), 111–119.
- Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. *Current Directions in Psychological Science*, 16(6), 351–355.
- Bellotti, T., Matousek, R., & Stewart, C. (2011). A note comparing support vector machines and ordered choice models' predictions of international banks' rating. *Decision Support Systems*, 51(3), 682–687.
- Cunha, F., Heckman, J. J., & Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3), 883–931.
- Cunha, F., & Heckman, J. (2007). The technology of skill formation. *American Economic Review*, 97(2), 31–47.
- Dong, Y., Luo, R., Zhang, L., Liu, C., & Bai, Y. (2019). Intergenerational transmission of education: The case of rural China. *China Economic Review*, 53, 311–323.
- Drobtetz, R., Maercker, A., Spiess, K., Wagner, G. G., & Forstmeier, S. (2012). A household study of self-regulation in children: Intergenerational links and maternal antecedents. *Swiss Journal of Psychology*, 71(4), 215–226.
- Duckworth, A. L., Tsukayama, E., & May, H. (2010). Establishing causality using longitudinal hierarchical linear modeling: An illustration predicting achievement from self-control. *Social Psychological and Personality Science*, 1(4), 311–317.
- Fleury, N., & Gilles, F. (2018). The intergenerational transmission of education. A meta-regression analysis. *Education Economics*, 26(6), 557–573.
- Frederick, S., Loewenstein, G., & O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40(2), 351–401.
- Golsteyn, B. H. H., Grönqvist, H., & Lindahl, L. (2014). Adolescent time preferences predict lifetime outcomes. *The Economic Journal*, 124(580), 739–761.
- Greene, W., & Hensher, D. A. (2010). *Modeling ordered choices: A primer*. Cambridge: Cambridge University Press.
- Hanushek, E. A. (1979). Conceptual and empirical issues in the estimation of the educational production functions. *Journal of Human Recourses*, 14(3), 351–388.
- Heckman, J. J., & Rubinstein, Y. (2001). The importance of non-cognitive skills: Lessons from the GED testing program. *American Economic Review*, 91(2), 145–149.
- Hoffman, A. O. I., & Post, T. (2014). Self-attribution bias in consumer financial decision-making: How investment returns affect individuals' belief in skill. *Journal of Behavioral and Experimental Economics*, 52, 23–28.
- Holmlund, H., Lindahl, M., & Plug, E. (2011). The causal effect of parents' schooling on children's schooling: A comparison of estimation methods. *Journal of Economic Literature*, 49(3), 615–651.
- Hsieh, C., & Qin, X. (2018). Depression hurts, depression costs: The medical spending attributable to depression and depressive symptoms in China. *Health Economics*, 27(3), 525–544.
- Institute of Social Science Survey (ISSS). 2015. China family panel studies (CFPS). Peking University Open Research Data, Peking University. <http://dx.doi.org/10.18170/DVN/45LCSO>.
- Kajonius, P. J., & Carlander, A. (2017). Who gets ahead in life? Personality traits and childhood background in economic success. *Journal of Economic Psychology*, 59, 164–170.
- Kaufman, S. B., Reynolds, M. R., Liu, X., Kaufman, A. S., & McGrew, K. S. (2012). Are cognitive g and academic achievement g one and the same g? An exploration on the Woodcock–Johnson and Kaufman tests. *Intelligence*, 40(2), 123–138.
- Kidd, C., Palmeri, H., & Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*, 126(1), 109–114.

- Koch, A., Nafziger, J., & Nielsen, H. S. (2015). Behavioral economics of education. *Journal of Economic Behavior & Organization*, 115, 3–17.
- Li, Z., & Hensher, D. A. (2020). Performance contributors of bus rapid transit systems: An ordered choice approach. *Economic Analysis and Policy*, 67, 154–161.
- Magnani, E., & Zhu, R. (2015). Social mobility and inequality in urban China: Understanding the role of intergenerational transmission of education. *Applied Economics*, 47(43), 4590–4606.
- Mendez, I. (2015). The effect of the intergenerational transmission of noncognitive skills on student performance. *Economics of Education Review*, 46, 78–97.
- Michaelson, L. E., & Munakata, Y. (2016). Trust matters: Seeing how an adult treats another person influences preschoolers' willingness to delay gratification. *Developmental Science*, 19(6), 1011–1019.
- Mischel, W., Ebbsen, E. B., & Zeiss, A. R. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of Personality and Social Psychology*, 21(2), 204–218.
- Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science*, 244 (4907), 933–938.
- Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., & Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences*, 108(7), 2693–2698.
- Oreopoulos, P. (2007). Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling. *Journal of Public Economics*, 97(11–12), 2213–2229.
- Otto, A. (2013). Saving in childhood and adolescence: Insights from developmental psychology. *Economics of Education Review*, 33, 8–18.
- Pearce, A., Sawyer, A. C. P., Chittleborough, C. R., Mittinty, M. N., Law, C., & Lynch, J. W. (2016). Do early life cognitive ability and self-regulation skills explain socio-economic inequalities in academic achievement? An effect decomposition analysis in UK and Australian cohorts. *Social Science & Medicine*, 165, 108–118.
- Piquero, A. R., Jennings, W. G., & Farrington, D. P. (2010). Self-Control interventions for children under age 10 for improving self-control and delinquency and problem behaviors. *Campbell Systematic Reviews*, 2010, 2.
- Porto, N., Huang, Y., & Xiao, J. (2019). Credit card adoption and usage in china: urban–rural comparisons. *Singapore Economic Review*, 60(1), 41–56.
- Pronzato, C. (2012). An examination of paternal and maternal intergenerational transmission of schooling. *Journal of Population Economics*, 25(2), 591–608.
- Sawyer, A., Chittleborough, C., Mittinty, M., Miller-Lewis, L., Sawyer, M., Sullivan, T., & Lynch, J. (2015). Are trajectories of self-regulation abilities from ages 2–3 to 6–7 associated with academic achievement in the early school years? *Child: Care, Health and Development*, 41(5), 744–754.
- Shimoni, E., Asbe, M., Eyal, T., & Berger, A. (2016). Too proud to regulate: The differential effect of pride versus joy on children's ability to delay gratification. *Journal of Experimental Child Psychology*, 141, 275–282.
- Shoda, Y., Mischel, W., & Peake, P. K. (1990). Predicting adolescent cognitive and self-regulatory competencies from preschool delay of gratification: Identifying diagnostic conditions. *Developmental Psychology*, 26(6), 978–986.
- Smithers, L. G., Sawyer, A. C. P., Chittleborough, C. R., Davies, N. M., Smith, G. D., & Lynch, J. W. (2018). A systematic review and meta-analysis of effects of early life non-cognitive skills on academic, psychosocial, cognitive and health outcomes. *Nature Human Behaviour*, 2(11), 867–880.
- Todd, P., & Wolpin, K. (2003). On the specification and estimation of the production function for cognitive achievement. *The Economic Journal*, 113(485), 3–33.
- Watts, T. W., Duncan, G. J., & Quan, H. (2018). Revisiting the Marshmallow test: A conceptual replication investigating links between early delay of gratification and later outcomes. *Psychological Science*, 29(7), 1159–1177.
- Xie, Y., & Hu, J. (2014). An Introduction to the China Family Panel Studies (CFPS). *Chinese Sociological Review*, 47(1), 3–29.
- Zhang, M., Zhou, G., & Fan, G. (2020). Political control and economic inequality: Evidence from Chinese Cities. *China Economic Review*, 61, 101272.