The Effect of School Start Age and Readiness for School on Verbal Ability Acquisition

by

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Abstract

Older entrants are reported, in the literature, to attain more beneficial outcomes in school than the younger entrants. In this study, I analyze the effect of school starting age on the child's learning outcomes through the first two years of primary school in Turkey. I exploit my finding of linear natural maturation process to disentangle the school starting age effect from the age at testing and time in school effect. I use the sharp date of birth cutoff for school entrance as a source of exogenous variation in school starting age, to identify the older and younger entrants. I also incorporate a distinctive measure of mother's perceptions of children's readiness for school to account for potential heterogeneity in the effect of school starting age. I find that being older at school entrance have positive and significantly large effect on the verbal acquisition. Whereas, children who start school relatively young and rated to be not ready for formal education make the least progress. Results suggest that the move to an earlier date of birth cutoff rule for school admissions may be associated with lower learning outcomes, confirming parental concerns and decision of delayed entrance.

Keywords: Education, School start age, Readiness for school, Verbal ability, Education policy

Özet

Kaynaklar okula başlarken yaşça büyük olanların, okulda küçük olanlardan daha yararlı sonuçlar elde ettiklerini bildirilmektedir. Bu çalışmada, Türkiye'de ilköğretimin ilk iki yılı boyunca, çocuğun okula başlama yaşının öğrenme neticelerine etkisini inceledim. Okula başlama yaşının etkisini testin yapıldığı yaşın ve okulda geçirilen zamanın etkisinden soyutlamak için bulgum olan doğrusal doğal olgunlaşma sürecinden faydalandım. Yaşça büyük ve küçük okula başlayanları tespit etmek için, okula başlama yaşındaki dışsal değişim kaynağı olarak okula giriş için belirlenen doğum tarihindeki ayırma kuralını kullandım. Bunun yanı sıra, okula başlama yaşının etkisindeki potansiyel heterojeniteyi açıklamak adına annelerin algısına dayanan, çocukların okula hazır olma ölçeğini dahil ettim. Okula başlarken yaşça büyük olmanın sözel kabiliyet edinimi üzerinde olumlu ve anlamlı ölçüde büyük bir etkiye sahip olduğunu buldum. Nispeten okula başlarken yaşça küçük olanlar ve örgün eğitim için hazır olmayanlar az ilerleme göstermektedir. Sonuçlar, ebeveyn kaygılarını ve ebeveynlerin okula geç başlatma kararını onaylayan, okula giriş için doğum tarihindeki ayırma kuralının önceki bir tarihe çekilmesinin düşük öğrenme neticeleriyle ile ilişkili olabileceğini düşündürmektedir.

Anahtar Sözcükler: Eğitim, Okula başlama yaşı, Okula hazır olma, Sözel kabiliyet, Eğitim politikası

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1 Introduction

Over the last two decades the Turkish Education System has been transformed, with the most radical changes coming recently. A major emphasis has been on improving access to primary and secondary education to all. Persistent enrollment gaps by gender and by ethnicity are associated with poor economic outcomes and made educational reform a critical priority (Kırdar, 2009). While there is broad support for tackling these persistent educational and economic disparities, the particular reforms that have been implemented have been widely criticized as lacking comprehensibility and consistency. An initial major change increased the compulsory schooling from 5 to 8 years in 1997. This was followed by curriculum changes that attracted much criticism, and conflicting attempts at decentralization. In 2012 compulsory schooling was increased to 12 years, with a system popularly described as 4+4+4. In the same legislation, the primary school entrance age was lowered. As of academic year 2012-2013, it is compulsory for children reaching 66 months (5.5 years) of age by the end of September to enter primary school that September; Children between 60 and 66 month of age in September are eligible to begin primary school upon their parents' request. Previously, the rule applied to children who were at least 72 month of age by the end of December, corresponding to 69 months in September. Thus Turkey has moved to an earlier compulsory school starting age by a 3 month difference. The initial version of the legislation was designed to include 60-66 month of age group in compulsory schooling with the intention to set a viable cutoff rule. But, it was later excluded due to increasing public dispute and discontent(MoNE, 2012). This follows recent attempts to expand pre-primary education, which found mixed success. Overall, getting children into formal schooling at younger ages has been a priority.

This move to earlier school starting ages runs against the trend in some other jurisdictions. The rising trend of school entrance age across several states in the US is well documented (Deming and Dynarski, 2008). A growing academic litera-

ture, surveyed in the following section, has highlighted possible advantages of older school starting ages. The move to earlier school starting ages generated significant public debate, and compliance with the new regime has been incomplete. As the new compulsory schooling legislation came into effect in the 2012-2013 academic year, the enrollment rate of the 5 year olds rose by almost 8 percent. However, among 5 year olds who should have enrolled in first grade in 2012 according to the new legislation, fully 22 percent obtained medical reports from Ministry of Health indicating that they were not ready for school, and hence able to delay school entrance by one year (ERI, 2013b).

In this paper, I provide new evidence on the effect of school starting age on subsequent learning outcomes. To the best of my knowledge, it is the first evidence on this question particular to the Turkish context. I use data from a unique cohort study of child development in Turkey, the Study of Early Childhood Ecologies in Turkey (ECDET). The cohort followed by this study was subject to the pre-reform school entrance regime. I use the sharp cutoff in enrollment eligibility as a source of exogenous variation in school starting age. Children born in January started school relatively old, while students born just before them but on the other side of the cutoff, in December, started school relatively young. A key feature of ECDET is that it measures mothers' perceptions of children's readiness for school. This allows me to look for heterogeneity in the effect of starting school young by defining four subgroups in my sample. I contrast the subsequent outcomes of children who were young but perceived by parents as ready, with those who are young and perceived by parents to be unready as well as who are old and perceived by parents to be either ready or unready.

To preview my results, I find that students starting school young make less progress in verbal ability through the first year of school. Children rated unready for school by their mothers also make less progress in the first year of school. The group who are both chronologically young and rated as unready make the least

progress. Being an older entrant boosts the verbal ability acquisition roughly by 0.25 standard deviation for unready children and by 0.44 standard deviation for ready children . These differences are statistically significant.

The rest of the paper proceeds as follows. In Section 2 I review the literature on school starting age and subsequent educational and economic outcomes. Section 3 deals with data. I consider in turn the institutional context from which my data are drawn; details of ECDET survey; and how key measures were constructed. Section 4 lays out my empirical strategy. Results are presented in Section 5 and Section 6 Concludes.

2 Literature Review

The relevant literature on the school starting age examines the effect on the academic performance throughout the formal schooling as well as later achievements, particularly in labor market outcomes. The literature further tries to analyze whether the effect of school start age is due to one's relative age to peers or absolute age at when introduced to formal education (Stipek, 2002). Studies of in-school test scores provide substantial evidence that the relatively older students outperform, on average, their younger peers with higher cognitive test scores and better non-cognitive skills (Puhani and Weber, 2008; Stipek and Byler, 2001; Fredriksson and Öckert 2006)[1]. Moreover, Some studies (McEwan and Shapiro, 2008; Elder and Lubotsky 2009; Bedard and Dhuey, 2006) suggest that this achievement gap between older and younger students persist in later grades, even though, it diminishes somewhat over time[2]. Elder and Lubotsky argue that the effect stems from endowment differences and skills accumulated in pre-schooling period.

Studies using short-term outcomes are constrained by the identity between school starting age, age at measurement and years in schooling.

$$Age\ at\ measurement = School\ start\ age + Time\ in\ school \tag{1}$$

Comparing test scores of children who are still in school, either in the same grade or at the same age fails to disentangle the effects of the remaining two. When the achievement score is measured in the same grade for younger and older entrants, the estimation result gives the combined effect of school starting age and

[1] This achievement gap among students with different birth month varies across grades, being roughly around 0.5 and 0.9 standard deviation for the reading and math scores in the kindergarten (Elder and Lubotsky, 2009) and 0.3 and 0.2 standard deviation in grade 4 and 8 (Bedard and Dhuey, 2006).

[2] Other countr-level studies, reporting positive outcomes on performances on late entrants include Black et al. (2011) for Norway, Fredriksson and Öckert (2006) for Sweden, McEwan and Shapiro (2008) for Chile, Puhani and Weber (2008) for Germany, Crawford et al. (2010) for England, Smith (2009) for Canada and Elder and Lubotsky (2009), Datar (2006)for the United States.

age at measurement. Yet, when they are measured at the same age, the estimated effect includes the impact of the additional time in school for younger entrant.

Considering this difficulty, Datar (2006) looks at the changes in test score of students in the US taking into account the variation both in the entrance age rules and month of births. Acknowledging that the age effect on the test score is linear, taking the differences of the scores over time yields solely the impact of school start age, eliminating the age effect. Therefore, Datar associates the difference in test score gains to differences in starting age that is independent of age at measurement. The paper finds that older entrants benefit more from a steeper test score trajectory in early grades.

The empirical evidence further suggests that the late entrance to formal schooling reduces the probability of grade retention and increases higher education participation(McEwan and Shapiro 2008; Crawford et al. 2010). Bedard and Dhuey (2006) find that enrolment to pre-university program and taking the exams for university admissions are lower for relatively young entrants in British Columbia and the US. Moreover, Puhani and Weber (2008), using administrative data from Germany, find that probability of attending the most academic educational track increases with later entrance. However, there are contradicting evidence on persistence of the effects of starting age on long-term outcomes. Fredriksson and Öckert (2006) find that the effect of delayed entrance leads to higher adult wages. On the contrary Dobkin and Ferreira (2010) and Black et al. (2011) find small negative or no significant effect of later school entrance on earnings. This is consistent with the idea that opportunity cost of one year experience in labor market fades away in later ages.

In this study, I adopt a similar methodological framework as used in Datar (2006), exploiting the identification of linear age effect on the verbal ability scores. Moreover, my study contributes to the existing literature by integrating a unique measure of school readiness. This measure captures the mother's perception on

how prepared the child is for the formal schooling. Therefore, its contribution is particularly important as it accounts for heterogeneity in the effect of school start age.

3 Data and Methodology

3.1 The ECDET Survey

The data used in this study are from the "Study of Early Childhood Ecologies in Turkey "(ECDET). ECDET is a longitudinal survey that studies children's developmental trajectories from early childhood, and identifies the social and environmental factors that influence those trajectories. Children were surveyed annually starting from 36-42 months of age till 7 years. The data collection was done through annual home visits since 2008 throughout the following five years. The survey examined a nationally representative sample of approximately one thousand children and their families from 19 different provinces in Turkey.

The subject of interest in my study is children who had finished at least the first year of formal schooling as of wave five interviews. Hence, I use measures of cognitive and non-cognitive skills of children that are collected in fourth and fifth wave. Moreover, the dataset provides detailed background information on household characteristics and socio-economic standing of the families.

The cohort I study in my analysis includes children who were born between January 2004 and October 2005, who started primary school in academic years 2009-10, 2010-11 or 2011-12. For my sample I observe vocabulary knowledge ability scores at each age starting from age 3.

The number of observations in my sample is 767. The number of children who are enrolled in a pre-primary education institute such as kindergarten or day care center is 9 in 2008. This number increases to 42 (%5) in year 2009. Moreover, the percentage of children who are enrolled in pre-primary education in academic year 2009-2010 is 36 which corresponds to age 5 for many children that participated in the survey. However, only 60 percent of these children started primary school the following year. Majority of the children (%63) in the sample started primary education during 2011-2012 academic year whereas, the percentage who had started school the previous academic year, 2010-2011, is 37. However, not all

of the children follow the rule of primary school entrance age. 92.2 percent of my sample complies with the cutoff rule as they enter the primary school upon their eligibility. 1.7 percent of the children in the sample started the primary school education one year earlier then they were supposed to. On the other hand, the percentage of students who delayed the entrance by one year is 6.1. Yet, my identification of the relative age of entrance does not depend on the non-compliance with the cutoff rule but on the month of age within the cohort of entrance.

The percentage of the children who are female is 45. The majority of the children uses Turkish (%98) as the primary language to communicate in the household, whereas Kurdish and Arabic (%2, combined) speakers constitute a fairly small proportion in the sample. On the other hand, the sample is evenly distributed between rural (%48) and urban (%52) settlement.

3.2 Institutional Context

Educational reforms in Turkey during the last two decades have focused on mainly providing access to primary and secondary education to all. This has crucial importance as there is clear disparity in school enrolment across gender, geographical regions and ethnic groups. The schooling rates are considerably high in the urban areas, especially in the western part of the country, whereas it remains as low as 42 percent for secondary education level in the eastern regions(MoNE, 2013). Moreover, the probability of non-enrolment in school is almost twice as high for ethnic Kurdish and Arabic children compare to ethnic Turks (Kırdar, 2009).

The priority areas of these reforms were on the female participation in the primary education. Immense progress has been recorded regarding the female enrolment rates at the primary level over the last ten years as a result of the several nation-wide campaigns and programs launched by the government together with private sector and non-governmental organizations (OECD, 2013b; UNDP, 2004; World Bank, 2012). Despite the promising gains, the gender disparity in attainment exists in the higher stages of education. Unlike most OECD countries where the schooling rate of girls surpasses the boys in the 15-19 year-old age group, the secondary school enrolment rates in Turkey is 6 percentage points higher for boys than for girls in 2011 which fell roughly from 15 percent in 2001(OECD, 2013a; World Bank, 2014). Hence, there is still room for improvement to close this gender gap in the educational attainment levels.

As far as quantitative records are concerned, recent progress in the enrolment rates are impressive. Yet, the quality of education in Turkey suffers greatly from a system with highly centralised governance structure that lacks motivating learning environment. Participation in the current education system where it is dominated by the multiple-choice examinations, outdated curriculum, under-equipped schools, especially in the rural areas, and poorly trained teachers with low incentives is argued to restrain the establishment of independent thinking and ambition

for scientific learning for students (UNDP, 2004). Consequently, 15-year-old students in Turkey fall behind their OECD counterparts as Turkey's performance in PISA assessment in mathematics, reading and science is significantly below the OECD average (OECD, 2014).

While the educational reforms undertaken to reverse the current situation have been in the core of the policy interventions, they are widely criticized for not being comprehensive and consistent. The major structural change was observed in 1997 when compulsory schooling increased from 5 to 8 years. Even though it aimed to increase the average years of schooling in Turkey, it was seen by others as an attempt to establish a more secular education system. In the following years, under the AKP rule, there have been several heavily criticized curriculum changes and conflicting decentralization attempts. The most recent reform legislation that was put in effect in 2012 and publicly be known as "4+4+4" increases the compulsory schooling to 12 years. Proponents of the reform claim that the new system is more progressive as it aims to increase the participation rates to upper secondary education through extending the period of compulsory schooling even more. But the opponents claim that it is secondary and not a well-thought reform and the main objective is to remove the obstacles against less secular vocational education.

Additional fundamental change that legislation introduced is to lower the primary school entrance age. Under the new legislation, as of academic year 2012-2013, it is compulsory for 66 month-olds to start primary school; while 60-66 month-olds will be considered eligible to enroll upon request of their parents. This policy change is highly relevant to Ministry of National Education(MoNE)'s priorities in recent years to expand the access to pre-primary education. Participation in early childhood education and care is compulsory only for 3-6 year-olds in special education(OECD, 2013b). Therefore, gross enrolment rate for pre-primary education remained to be less than 10 percent in early 2000s, although,

it gradually increased over time(World Bank, 2014). Since the 2008-2009 academic year, MoNE launched the Strengthening Pre-School Education Project in several provinces whose primary aim was to improve the attendance to day-care and preschool education for the target age group. However, progress in enrolment rate has been fairly low, and in fact, a decline in the rate is documented for the 60-72 month age group in pilot provinces(ERI, 2013a).

3.3 Construction of Measures

3.3.1 Turkish Receptive Language Abilities

Main outcome variable of interest in the analysis is the children's verbal ability which is measured by the Turkish Receptive Language Test (TRLT) in the dataset. TRLT is a test that was originally constructed by Berument and Guven (2010) and adopted in our analysis to estimate the vocabulary knowledge of children who are aged between 3-7.

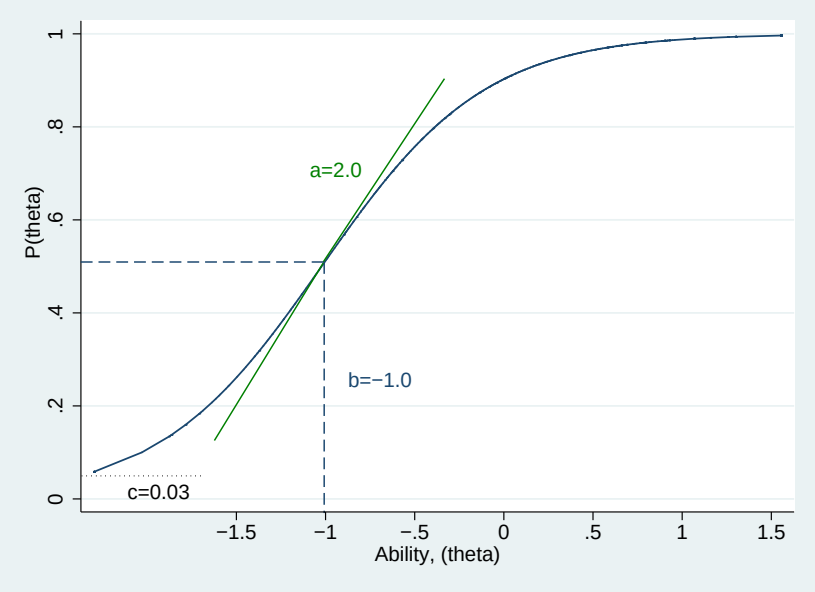
During the test, each participating child is asked to choose the picture, among 4 pictures shown, which represented the word said out loud by the interviewer. The test resembles the widely used Peabody Picture Vocabulary Test, PPVT (Dunn & Dunn, 1981). The item list used in the ECDET survey varies with the age of the children and consists of 159 items in total including two practice questions. Table 1 shows the number of items in the test by age levels. TRLT is an adaptive test. If the child's answers to two thirds of the items at any age level higher than child's age were incorrect, the test was terminated. The TRLT is conducted in each five waves, enabling me to compare the vocabulary knowledge across waves and with the introduction of the formal schooling.

Table 1: Number of items in TRLT according to age levels

Age level	Number of Items
Basic level	9
Age 3	18
Age 4	15
Age 5	24
Age 6	15
Age 7	18
Age 8-9	17
Age 10-11	14
Age 12-13	27

The estimation of verbal ability is done through a three-parameter logistic item response theory model to obtain a more accurate result of the latent vocabulary ability. The method enables to calibrate the item characteristics on the

Figure 1: Item characterictic curve (ICC) of a logistic function



same scale where the assessment of the test is different for each wave. The IRT process exploits the assumption that a subject's probability of answering an item correctly depends on his or her ability as well as relevant item characteristics. A three parameter IRT logistic model (3PL-IRT) extracts a child's vocabulary ability (theta) on a continuous ability scale by making use of the dichotomously scored item responses and each item's difficulty, discriminating ability and guessing characteristics (Andreassen and Fletcher, 2007).

A specific relationship between the observed response and the latent ability is represented with an item characteristic curve (ICC) which constitutes the basis for the IRT models. Figure 1 presents an example of an ICC that is a logistic function.

The latent ability (theta) scale is given on the horizontal axis while each point on the vertical axis portrays an estimated probability of getting a correct answer from a person with the corresponding ability level. The difficulty of the items which is denoted with the parameter "b" determines the point of inflection of the logistic curve. It is the point on the horizontal axis where the probability of getting

a correct response for a dichotomous item is 50 percent. When the item difficulty increases, the ICC shifts farther to the right. The discriminating parameter (a) is a measure of how successful the item is in distinguishing among different ability levels at a particular point. It represents the slope of the line tangent to the curve at the difficulty level "b". As the discriminating parameter "a" increases, the logistic curve becomes steeper and maintains a higher success in narrowing the choice of likely ability level for the individual. On the contrary, an item with a low discriminating parameter that consequently has a flatter curve fails to provide useful information for detecting the ability level. The last parameter that 3PL-IRT utilize is the guessing parameter "c". It represents the probability of receiving a correct answer from an individual with very low ability. The "c" parameter corresponds to the low point of the curve on the horizontal axis and moves upwards with higher "c" levels.

Similar procedures are commonly used for scoring adaptive tests. The eventual receptive vocabulary ability scores I use in the analysis are standardized across all the individual time observations in the panel with mean zero and standard deviation one.

3.3.2 School Readiness

School readiness measure I use in analysis is a variable that captures the maternal perception on how ready the child is for the formal schooling at age 5. This measure was developed by Baydar et al. (2010). The original measure that consists of 106 questions with 7 sub-measures. It was modified to a shortlist of 15 items for ECDET survey, based on the factor analysis of the original 106 items. The items were asked to subjects both in wave 2 and 3 to attain the age 5 measurement of all children in the sample that have different date of birth and, hence, age at measurement. The short list includes questions such as "my child is able to write the first letter of his/her name, my child is curious about the content of the books" that are designed to identify the behavioral and motor skills as well as capacities of the child in terms of reading, writing and learning. The items were rated by mothers on a 5-point Likert scale to assess the child's early skill acquisition with regard to cognitive and attention competencies.

The school readiness measure is incorporated in the analysis through an indicator variable that is equal to 1 when the child has a raw school readiness score of at least 70 and , hence, classified to be ready. The threshold level (School Readiness Score=70) for the categorization is identified in accordance with the measure's sample distribution and its relation with parent-teacher conference visits. Table 2 presents the summary statistics for the indicator variable of school readiness by other background variables. The raw school readiness score exhibits a difference more than 2 standard deviation between children who are ready for school (m=59.76 , sd=9.23) and not ready for school (m=84.16 , sd=10.07).

Table 2: Summary statistics for school readiness

	Not ready for school (N=296)	Ready for school (N=471)	Pearson's X^2
School Readiness Score (RFS)			
Mean	59.76	84.16	
Standard deviation	9.23	10.07	
Gender			8.27
Female			
N	115	233	
Row %	33.1	66.9	
Male			
N	181	237	
Row %	43.2	56.8	
Primary Language			16.25
Turkish			
N	285	470	
Row %	37.8	62.25	
Kurdish			
N	10	0	
Row %	100.0	0.0	
Arabic			
N	1	1	
Row %	50.0	50.0	
Pre-primary education			4.68
Not enroled at age 5			
N	202	286	
Row %	41.4	58.6	
Enroled at age 5			
N	92	183	
Row %	33.5	66.5	

Figure 2: Distribution of School Readiness raw score

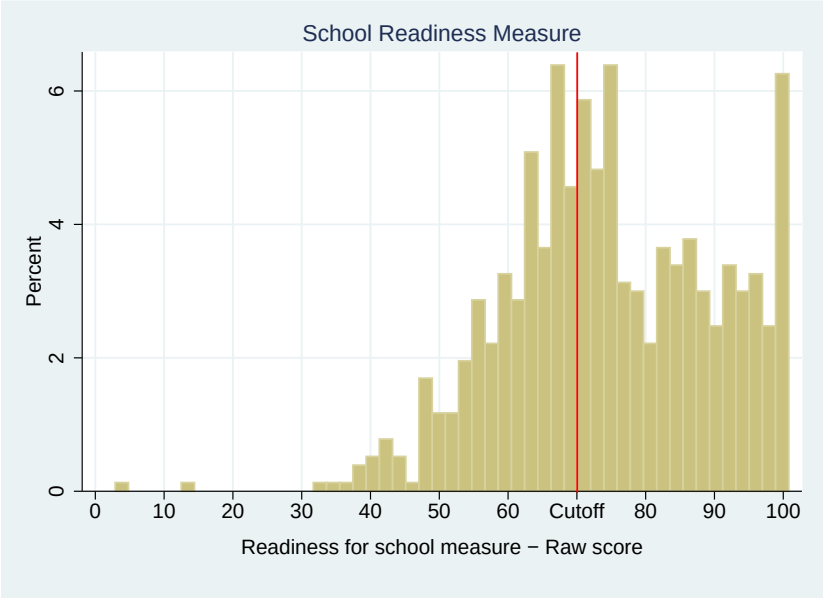
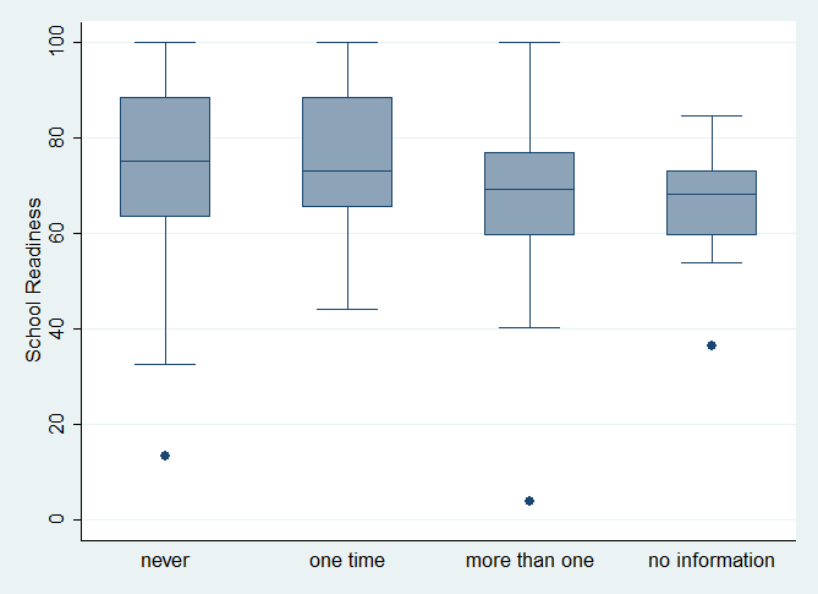


Figure 3: Box plot for School readiness vs. Problems faced in school

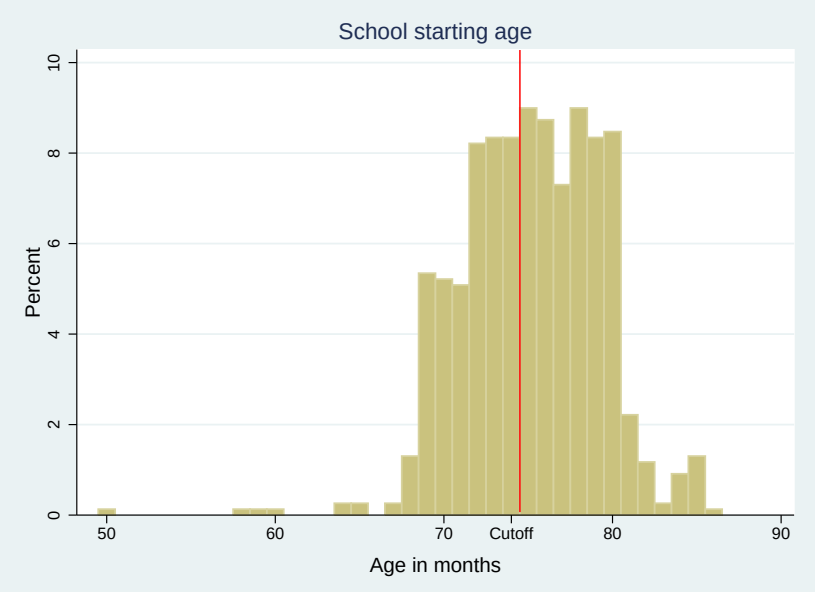


3.3.3 School Entrance Age

The key explanatory variable in my analysis is the indicator variable of child's relative, age-wise maturity within the grade enrolled which is computed by the month of birth and the school entrance cutoff rule. I assign each children in my sample to appropriate states of old and young according to their school entrance age in months. My sample from the ECDET survey are not affected by the "4+4+4" reform since the new legislation became effective in the academic year 2012-13. Hence, during the period of data collection, children were expected to start school when they were 6 years old in the calender year which corresponds to the academic year of 2011-2012 for the majority of the sample. In Turkey, academic year starts in mid-September and the cutoff date for school entrance eligibility is at the beginning of the year. If the cutoff rule is followed, the expected age range of the entrants varies from 80 months to 69 months. Hence, it is observed that children born in December start primary education a year earlier than children born in January. However, It is not unusual to delay entrance to formal schooling in the rural parts of the country and for the children that are born later in the year. In fact, I observe late and early starters in my sample as the range of school start age is wider, from 86 months of age to 50 months of age. When constructing the variable, I identify children who were at most 74 months old the at the entrance, i.e. born in the second half of the year as well as early starters, to be relatively "young", whereas the opposite to be relatively old and mature.

Table 3 exhibits the compliance rates to school entrance cutoff rule for the sample. Compliance with school starting rule are high for the children who are born in the first half of the year, whereas greater irregularities with regard to on time enrolment are evident for the second half. This intensification of the non-compliers predominantly in the group of "expected young" students suggests that the concerns regarding to in-school achievement and performance along with

Figure 4: Distribution of school starting age



school adaptation are present for the families with relatively young children. Moreover, the self-evident high non-compliance rates is mostly derived by the effortless act of the parents which is mainly due to the inability to practice the cutoff rule strictly by the school administrations and local authorities. Even though, some countries requires a formal notification from the health and school specialist and/or an approval by the local government to issue an exception, there exists a more flexible system in Turkey that enables the judgment or the decision to be made by the parents with no consultation. Overall, as it is visible in the Table 3, compliance rates are considerably lower for children born in December than for those born in January.

Table 3: Compliance rates by month of birth

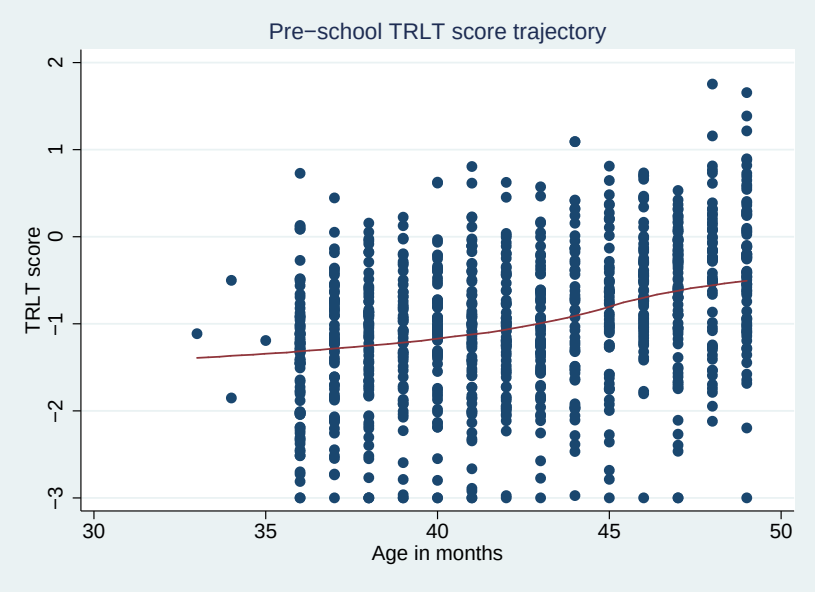
	Early	On time	Late	N
January	3.2	96.8	0.0	93
February	3.6	96.4	0.0	56
March	0.0	100	0.0	61
April	3.1	96.9	0.0	64
May	2.8	97.2	0.0	71
June	0.0	98.5	1.5	67
July	1.4	97.2	1.4	72
August	0.0	86.7	13.4	75
September	1.7	88.1	10.2	59
October	2.1	89.1	8.5	47
November	2.0	78.4	19.6	51
December	0.0	70.6	29.4	51
Total Sample	1.7	92.2	6.1	767

4 Empirical Framework

As discussed in the earlier section, one of the drawbacks of the literature is its weakness to disentangle to effect of school starting age from the age at measurement effect. Comparing the ability scores of children at the same grade results in estimation of combined effect of these two. Nevertheless, I am able to track the progress of individual characteristics and outcomes across time with the help of the available longitudinal survey. The ECDET survey provides an opportunity to break up the entrance effect from age effect.

I organize the data by child and by year of schooling, rather than time or age. Cognitive measure k, for child i through school year s is denoted by y_{is}^k. I expect that the growth in a cognitive measure, $\triangle y_{i1}^k$, from the start of school year to beginning of the next reflects a natural maturation process with age, the gains of schooling and shocks. My examination of the prior-to-school data on TRLT score (Figure 5) and the prior literature (Datar, 2006) suggest that the maturation process is linear, which is imposed in the following analysis. However, I allow it to be heterogeneous, reflecting latent ability in measure k. Likewise, the impact of schooling is heterogeneous. Investigating the nature of this heterogeneity is my primary objective.

Figure 5: Pre-school maturation process



I assume that conditional on individual specific maturation rate, the shocks are independent over time. Thus for growth of cognitive measure k, for child i through the first year of school I adopt the following form:

$$\triangle y_{i1}^k = \alpha_i^k + \theta_{i,1}^k + \beta_1 y_{i,0}^k + e_{1,i} \tag{2}$$

where α_i^k captures the natural maturation and $\theta_{i,1}^k$ captures the gains of schooling.

For the second year of school I have similarly the following form:

$$\triangle y_{i2}^k = \alpha_i^k + \theta_{i,2}^k + \beta_2 y_{i,1}^k + e_{2,i} \tag{3}$$

Verbal ability scores (TRLT) is the outcome of interest included in the model as a cognitive measure.

Furthermore, I model latent propensity for growth in cognitive measure k as a function of background variables:

$$\alpha_i^k = Z_i\gamma_k + u_i \tag{4}$$

where the background variables Z_i include maternal vocabulary ability (ACEP), the child's level on TRLT at age 4, up to 2 years before the start of school and inhibitory control at age 4.

The maternal vocabulary test has a similar implementation procedure as TRLT. The mothers participated in the survey were asked to select the synonym of a word that was read out loud to them, among given 4 alternatives. The test consisted of 24 items which were classified to be words that are not common in everyday usage. Moreover, participants were given the option to declare that they did not know a particular words meaning. The maternal vocabulary ability score used in the analysis is composed of the total number of synonyms that are correctly identified.

In addition to verbal ability scores of child and the mother, I include the inhibitory control measure at age 4 in the background variables in order to control for impulsivity of the children. Inhibitory control is one of a subset of cognitive abilities labeled as executive functions that regulates the cognitive processes. The variable is measured through recording the response times of the child in a simple head to toes test in which they are instructed to do the opposite of the given command. The test proceeds as the child asked to touch his/her head when the interviewer says toe and vice versa. A higher score is associated with the higher ability of the child to use inhibition to suppress a prevailing response.

My model investigates the heterogeneity in $\theta_{i,s}^k$ and in particular the impact of starting school young, and of readiness for school. Therefore, the specification is:

$$\theta_{i,s}^k = \theta_{0,s}^k + \theta_{1,s}^k YNG_i + \theta_{2,s}^k READY_i + \theta_{3,s}^k YNG_i \times READY_i \tag{5}$$

where $YNG_i = 1$ if the child starts school young and 0 otherwise; and $READY_i = 1$ if the child was ready for school at $s = 0$ and 0 otherwise.

During the period of the ECDET visits, in Turkey, children were supposed to start school in the mid-September of the calendar year they turned 6. Thus children born in August started school at 73 months of age. Children born in January started at 80 months of age and children born in December at 69 months of age. I define YNG as 69 to 74 months of age at school start (born July through December). In fact some children start school early and some are held back. This reflects parental choices and so a potential endogeneity problem. In 4, I provide some evidence that deviations of school starting age from the official rule are determined by parental perceptions of school readiness. I address this by instrumenting the actual school age with the age the child should have started school. However, to be correlated with $e_{s,i}$ the parents must anticipate future shocks to specific developmental trajectories when they make the decision. The greater concern is that it is rather correlated with variation in the latent trait (α_i^j) that are not captured by the proxies, Z_i.

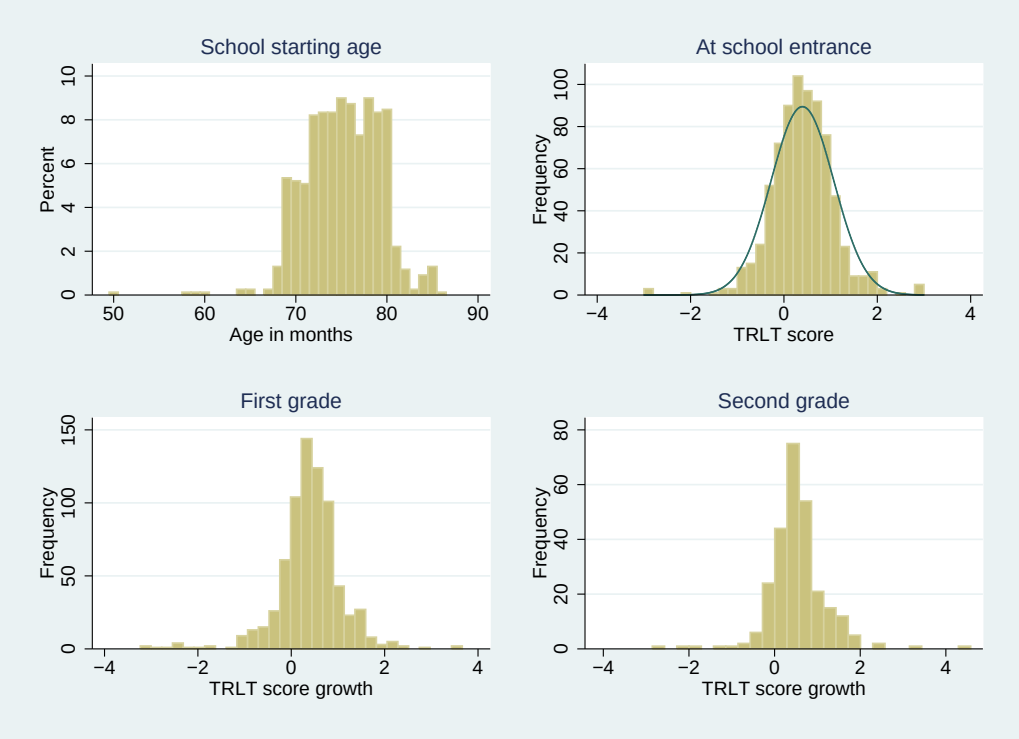
Table 4: Compliance rate, readiness for school and gender - Row percentages

	Early starter	On time	Late starter
Not ready for school (N=296)	1.4	90.2	8.4
Ready for school (N=471)	1.9	93.4	4.7
Female (N=348)	2.6	90.5	6.9
Male (N=419)	0.9	93.6	5.5

Readiness for school is constructed by mothers perception, whose method of measurement is described in previous section thoroughly. The measure is converted into an indicator variable (READY) for the values of raw score above and equal 70.

Putting this all together the model consists of :

Figure 6: Distribution of key variables - School starting age and TRLT score (level & growth rate)



$$\begin{aligned} \triangle y_{i1}^k = Z_i\gamma^k + \theta_{0,1}^k + \theta_{1,1}^k YNG_i + \theta_{2,1}^k READY_i \\ + \theta_{3,1}^k YNG_i \times READY_i + \beta_1 y_{i,0}^k + e_{1,i} \end{aligned} \tag{6}$$

and for the second year of school

$$\begin{aligned} \triangle y_{i2}^k = Z_i\gamma_k + \theta_{0,2}^k + \theta_{1,2}^k YNG_i + \theta_{2,2}^k READY_i \\ + \theta_{3,2}^k YNG_i \times READY_i + \beta_2 y_{i,1}^k + e_{2,i} \end{aligned} \tag{7}$$

I estimate these models by Ordinary Least Squares (OLS) regression and by Instrumental Variable (IV) Estimation method where actual school starting age is instrumented by the regulated school starting age.

5 Results

The results for the Turkish Receptive Language Test scores are reported in Table 6 to Table 9. In column 1 of Table 6, I present the Ordinary Least Squares (OLS) estimates of the equation of interest for first grade TRLT score growth. The "YNG" variable which is an indicator variable of being relatively young within the cohort classifies the children who were at most 74 months old at the primary school entrance, corresponding to being born in the second half of the calender year if the school entrance rule is followed. The OLS estimates suggest that age at school entrance has a large positive effect on verbal ability progress. Being older in the first grade is associated with high verbal ability acquisition, by 0.6 standard deviation despite of not being ready for formal schooling. However, this progress is one forth standard deviation smaller for the young compare to the old when the child also is rated to be not ready for school.

Table 7 highlights the differences in verbal ability acquisition among the four subgroups categorized through age and school readiness measure. The significant difference of being young in first grade is especially pronounced for children who are also classified to be ready, being -0.44 standard deviation. This suggests that the delayed entrance of ready children is more likely to result in higher verbal ability progress due to longer time spent in maturation process. Being ready for school, on the other hand leads a higher progress by 0.27 and 0.09 standard deviation in the verbal ability acquisition within the old group and young group respectively. However, school readiness is statistically significant (at 1 % level) only when the child is relatively old. Consequently, I find that the group that has the most beneficial outcome from the stimulating environment of education is the old and ready for school.

The results for OLS estimates of grade 2 TRLT score progress are exhibited in Table8 in its first column. This model is based on the sample of students who completed the grade 2 by the time of wave 5 visits, which is considerably smaller in

size than the first grade sample. Therefore, the observed variation in the entrance age attained through variation in month of birth is relatively lower. Although it is statistically insignificant, the adverse effect of being young relaxed for grade 2 progress. For both ready and not ready for school subgroups, the difference by relative age is insignificant. Yet, school readiness remains to be a significant determinant of (at 10 % level) only for relatively young children in grade 2 (Table 9), unlike in grade 1.

To account a possible endogeneity problem, I estimate the model through the Instrumental Variable (IV) Estimation method .The IV estimates where the indicator variable for expected relative age is used to instrument for actual relative age are presented in second columns in Table 6 and Table 8. The results for first grade verbal score progress do no differ from the OLS estimates. Whereas, the IV estimation results for grade 2 progress varies notably in magnitude compare to column 1 in Table 8. Note that the significance of effects across subgroups remains to be same as in OLS estimates (Table 6) both for grade 1 and 2. Nevertheless, I conclude that the smaller sample size have a great influence on the deviation of the IV estimate results for grade 2.

Table 5: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
School starting age in months	75.18	4.10	50	86	767
TRLT* score (at school entrance)	0.40	0.67	-2.999	2.999	754
TRLT score gain in grade 1	0.40	0.70	-3.234	3.662	724
TRLT score (grade 1)	0.80	0.73	-2.999	2.999	734
TRLT score gain in grade 2	0.54	0.69	-2.745	4.58	267
Mother's vocabulary knowledge	8.26	4.97	0	23	767
TRLT score at age 4	-0.18	0.84	-2.999	2.999	758
Female (0,1)	0.45	0.50	0	1	767
Pre-primary education (age 3) (0,1)	0.01	0.11	0	1	767
Pre-primary education (age 4) (0,1)	0.06	0.23	0	1	767
Pre-primary education (age 5) (0,1)	0.36	0.48	0	1	763
Urban (0,1)	0.52	0.50	0	1	767
Household size	5.07	1.92	1	17	764
Number of kids in the household	2.368	1.266	1	10	767
Mother's years of completed education	5.907	3.483	0	15	767
Father's years of completed education	7.395	3.237	0	15	764
Mother's working status at wave 5	0.173	0.379	0	1	767
Father's working status at wave 5	0.943	0.232	0	1	753
Socio-economic level	-0.015	0.966	-2.282	3.715	717
Born in second half (0,1)	0.432	0.496	0	1	767
Ready for school (0,1)	0.614	0.487	0	1	767

*TRLT, Turkish receptive language test

Table 6: Determinants of verbal ability acquisition in first grade

	(1) OLS	(2) IV
Intercept	0.573***	0.583***
	(0.146)	(0.128)
YNG	-0.250**	-0.279***
	(0.115)	(0.098)
READY	0.277***	0.259***
	(0.088)	(0.070)
YNG*READY	-0.185*	-0.143
	(0.097)	(0.094)
Mother's vocabulary Knowledge	0.006	0.007
	(0.008)	(0.008)
TRLT score at age 4	0.144***	0.144***
	(0.036)	(0.031)
TRLT score at school entrance	-0.638***	-0.640***
	(0.081)	(0.075)
Age 4 inhibitory control	0.004	0.004
	(0.004)	(0.004)
N	712	712
R^2	0.291	0.291

* p < .1, ** p < .05, *** p < .01
Standard errors in parentheses
All standard errors are clustered at the province level

Table 7: Test of significance for first grade estimates - "Young" and "Ready for school"

	OLS				IV			
	Estimate	Std. errors	t-stat	p-value	Estimate	Std. errors	t-stat	p-value
Test of significance for "Young"								
Subgroup - ready	-0.436	0.085	-5.14	0.000	-0.422	0.086	-4.93	0.000
Subgroup - not ready	-0.250	0.115	-2.18	0.043	-0.279	0.098	-2.86	0.004
Test of significance for "Ready"								
Subgroup - young	0.092	0.056	1.65	0.117	0.116	0.078	1.49	0.136
Subgroup - old	0.277	0.088	3.15	0.006	0.259	0.070	3.68	0.000

Table 8: Determinants of verbal ability acquisition in second grade

	(1) OLS	(2) IV
Intercept	0.667***	0.753**
	(0.146)	(0.340)
YNG	-0.161	-0.245
	(0.136)	(0.432)
READY	-0.063	-0.059
	(0.202)	(0.421)
YNG*READY	0.215	0.207
	(0.225)	(0.455)
Mother's vocabulary Knowledge	0.007	0.006
	(0.008)	(0.007)
TRLT score at age 4	0.213**	0.214**
	(0.087)	(0.084)
TRLT score at grade 1	-0.582***	-0.581***
	(0.167)	(0.161)
Age 4 inhibitory control	0.018**	0.018***
	(0.007)	(0.007)
N	266	266
R^2	0.210	0.210

* p < .1, ** p < .05, *** p < .01
Standard errors in parentheses
All standard errors are clustered at the province level

Table 9: Test of significance for second grade estimates - "Young" and "Ready for school"

	OLS				IV			
	Estimate	Std. errors	t-stat	p-value	Estimate	Std. errors	t-stat	p-value
Test of significance for "Young"								
Subgroup - ready	0.054	0.159	0.34	0.738	-0.037	0.172	-0.22	0.827
Subgroup - not ready	-0.161	0.136	-1.18	0.252	-0.245	0.432	-0.57	0.570
Test of significance for "Ready"								
Subgroup - young	0.152	0.084	1.81	0.087	0.147	0.079	1.86	0.063
Subgroup - old	-0.063	0.202	-0.31	0.760	-0.059	0.422	-0.14	0.888

6 Conclusion

One component of recent reforms to the Turkish educational system was to lower the school admission age. This reform aimed to get children into formal schooling earlier in the hope of diminishing existing gender, ethnic, and socioeconomic differentials in educational progress and outcomes. However, confusion between early childhood education and early schooling lies in the core of this reform. In fact, this reform has been much resisted by parents, and parents reservations are supported by an academic literature that suggests that later school starting ages are advantageous in terms of subsequent skill acquisition and educational outcomes.

In this paper I studied the effect of school starting age on the acquisition of verbal ability through the first two years of primary school in Turkey. To my knowledge, this is the first study of the effects of school starting age on educational progress in Turkey, and as such, it is particularly relevant to the current policy debate. My data are drawn from the pre-reform period and I use the sharp date of birth cutoff for school entrance as source of exogenous variation in school starting ages. I exploit the fact that the natural age maturation process for verbal ability is linear – which I document in my data - to break the identity between school starting age, time in school and age at testing. This linearity means that I can isolate an effect of school starting age on growth in verbal ability through the school year.

An important and unique feature of my data is the availability of sophisticated measure of school readiness. This allowed me to investigate whether chronological age per se matters, or just school effects, as well as to study interactions between the two. The latter is an exploration of heterogeneity: whether, for example, the effect of school starting age on subsequent acquisition of verbal ability varies with measured school readiness.

My findings are that students starting school young make less progress in

verbal ability through the first year of primary school, as do students with lower measured school readiness. Student who are both chronologically young and with lower measured readiness make the least progress of all.

This means that the move to earlier school starting ages may have some negative effects on learning outcomes, and parents are right to be concerned with this. As secondary result, I also show that in my data parents appear to be responding appropriately. Children with younger nominal school starting ages are more likely to be held back, as are children who are rated unready.

My results lend support to concerns about the recent Turkish reform to school starting age and encourage further research and reflection on this important policy issue.

In subsequent research, I plan to extend my analysis in a number of ways. First, I intend to add a second learning measure, based on mathematical ability. It is important to know whether the negative effects of early starting are specific to the acquisition of verbal ability or more general. Second, I would like to investigate additional moderators of the school starting age effect, including the nature of the households and communities that children come from.

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