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Children's patience and school-track choices several years later: Linking experimental and field data ☆

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ABSTRACT

We present direct evidence on the link between children's patience and educational-track choices years later. Combining an incentivized patience measure of 493 primary-school children with their high-school track choices taken at least three years later at the end of middle school, we find that patience significantly predicts choosing an academic track. This relationship remains robust after controlling for a rich set of covariates, such as family background, school-class fixed effects, risk preferences, and cognitive abilities, and is not driven by sample attrition. Accounting for middle-school GPA as a potential mediating factor suggests a direct link between patience and educational-track choice.

1. Introduction

A key feature of many school systems around the world is tracking, which requires children to select one of several school tracks that differ in terms of their academic content, length, and future labor-market opportunities.[1] According to human capital investment theory (e.g., Mincer, 1958; Becker, 1964; Heckman et al., 2006), children's patience should play a decisive role in their school-track choice, since the additional investments in terms of time, effort, and foregone immediate earnings that are required when choosing an academic school track have to be set against discounted future gains. Yet, direct empirical evidence on the link between children's patience and their school-track choices is largely lacking. This is the research gap that we address in this paper.

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[1] Throughout the paper, "tracking" refers to between-school tracking where children are sorted into schools with a vocational or an academic focus. This form of tracking is prevalent in many countries: Among the 37 OECD countries that participated in the 2018 PISA test, three track children into different school types at the age of 10 years, four at age 11, three at age 12, three at age 14, and 10 at age 15 (OECD, 2020). See Betts (2011) for a discussion of within-school ability tracking that is present, for instance, in the US.

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To this end, we link incentivized intertemporal-choice data that we collected in a lab-in-the-field experiment with 493 primary-school children (grades two to five) in Northern Italy with administrative information about their school-track choices taken three to six years later (after middle school, i.e., after grade eight). The resulting dataset is characterized not only by low attrition, but also by its exceptional richness: It contains detailed individual-level information on children's family background, an incentivized measure of their risk preferences, cognitive abilities, and middle-school grade point average (GPA).[2] This combination of experimental, survey-based, and administrative information equips us with the rare opportunity to investigate how patience correlates with educational decisions years later, and how robust the relationship is to controlling for important background characteristics.

We find a strong and positive relationship between patience and school-track choice: Children who are one standard deviation more willing to invest into the future in the intertemporal-choice task conducted in primary school are 4.6 percentage points more likely to choose the highest educational track at the end of middle school. The fact that we measured children's patience years before they took school-track choices excludes the possibility that our finding suffers from reverse causation problems. We expose our main result to a series of robustness tests. First, to account for sample attrition (which is generally low in our data), we employ inverse-probability weighting and attrition bounding and show that our findings are unaffected by attrition. Second, we control for a host of important background characteristics, namely children's family background (migration background and proxied parental earnings), school-class fixed effects, an incentivized measure of children's risk-taking, and cognitive ability measured with Raven's test. The association between patience and the educational-track choice remains robust to adding these variables as controls, and to an analysis of unobservable selection based on Oster (2019). Third, we investigate the extent to which the relationship between patience and the educational-track choice is mediated by children's middle-school GPA. As expected, GPA is significantly correlated with children's patience, and with the probability to choose the academic track. Importantly, however, controlling for GPA leaves the significant association between patience and academic track choice intact, which suggests a direct link between the two variables. Finally, we provide suggestive evidence that the strong relationship between patience and later school-track choices is unlikely driven by children's impulsivity or school-related non-cognitive skills.

We contribute to the literature that investigates the relationship between economic preferences and field behavior. Among adults, incentivized patience measures have been shown to predict occupational choices, credit-card borrowing, or unhealthy consumption behavior (e.g., Khwaja et al., 2007; Chabris et al., 2008; Burks et al., 2009; Meier and Sprenger, 2010). Focusing on the field behavior of children and adolescents, previous studies report that more patient children and adolescents are less likely to drink alcohol or smoke, to receive disciplinary referrals, or to drop out from school (e.g., Castillo et al., 2011, 2018,2020; Sutter et al., 2013; Backes-Gellner et al., 2021). This literature has so far focused only on proxies for schooling decisions – like school misconduct, dropout, or achievement test scores (e.g., Bettinger and Slonim, 2007) –– but not directly on school-track choices as we do. We consider our focus on school-track choice particularly important for at least three reasons. First, school-track choices are a prototypical decision problem in which – according to human capital investment theory – rational agents set discounted future gains of additional schooling against its costs.[3] Second, many education systems entail between-school tracking (OECD, 2020), which implies that a large part of all children around the globe faces the choice between attending a more or less academic school track at some point in their educational career. Third, this choice has important repercussions for their subsequent educational paths, skill development, and labor-market success (e.g., Hanushek et al., 2017). Yet, the extent to which children's economic preferences are a potential driver of these decisions has hardly been studied before.

Our setting is particularly well-suited for studying how patience is related to schooling decisions, the relationship modeled in human-capital investment theory (e.g., Mincer, 1958; Becker, 1964): Unlike most other countries, children in Italy are free to choose their school track regardless of their grades (see Section 2 for details). This allows us to directly test the link between patience and schooling decisions, net of regulatory restrictions based on previous educational performance (which itself is affected by patience; e.g., Hanushek et al., 2022). Thus, our setting facilitates assessing the importance that schooling decisions play in explaining the well-documented relationship between patience, overall educational achievement, and related life outcomes (e.g., Golsteyn et al., 2014).

Our paper also relates to studies showing that hypothetical, non-incentivized measures of patience predict educational outcomes. Closest to our study, Golsteyn et al. (2014) show that more patient individuals are more likely to attend the science track in upper secondary school in Sweden, and have more favorable lifetime outcomes. Interestingly, they show that the relationship between patience and long-run outcomes operates through early human capital investments. Besides relying on an incentivized patience measure as opposed to a hypothetical one, our study differs from Golsteyn et al. (2014) in terms of the institutional context. The fact that high-school track choice is *not* restricted by past educational performance in the setting that we study makes it likely that children's patience has a direct effect on school-track choice. In line with human-capital investment theory, we in fact find that patience has explanatory power for academic track choice that is independent of children's GPA. Relatedly, Cadena and Keys (2015) use data from the National Longitudinal Survey of Youth (NLSY) and show that respondents aged between 15 and 27 years who are perceived as restless by the interviewer (which is their proxy for impatience) exhibit worse educational and labor-market outcomes as young adults. Furthermore, Figlio et al. (2019) and Hanushek et al. (2022) show that a society's level of patience measured in international surveys (Hofstede et al., 2010; Falk et al., 2018) is closely linked to student performance in the PISA test. We also relate to the famous psychological studies on the "marshmallow test". In this literature, initial results have shown that the decision of four-year-olds not to eat one marshmallow now, but to wait to receive a second one later, predicts educational success and other favorable life outcomes years later (e.g., Mischel et al., 1972, 1989; Shoda et al., 1990). More recently, these findings have been challenged for different reasons. First, Watts et al.'s (2018) conceptual replication of the classic study by Shoda et al. (1990) finds much smaller and often insignificant relationships between children's delay of gratification and later life outcomes. In contrast, Falk et al. (2020b) provide evidence for the validity of the Shoda et al. (1990) study by showing that Watts et al. (2018) results are biased toward zero due to censoring of the delay of gratification measure, and due to controlling for endogenous variables. Second, Benjamin et al. (2020) show that

[2] In our setting, middle-school GPA refers to the middle-school final grade which is a measure of overall school performance at the end of middle school (see Section 3.2 for details).

[3] In contrast, the relationship between patience and the decision to drop out from school is arguable more indirect, since dropping out is hard to reconcile with an ex-ante rational human-capital investment plan in which discounted future returns to schooling are set against immediate costs.

delay of gratification measured at preschool age alone does not predict participants' financial and human capital in their late 40s, but a measure that also includes self-regulation at later ages does. Independent of this ongoing scientific debate, Castillo et al. (2020) show that economic time preferences (measured in incentivized decision problems) are a distinct contributing factor to educational outcomes over and above children's behavior in the marshmallow task, which demonstrates that studying the relationship between experimental measures of time preferences and educational outcomes as we do is an important complement to the psychological literature.

Furthermore, our paper contributes to the education-economics literature on educational tracking. Several studies investigate how (the timing of) between-school tracking affects students' educational outcomes or labor-market success (e.g., Hanushek and Woessmann, 2006; Pekkarinen et al., 2009; Pekkala Kerr et al., 2013; Piopiunik, 2014; Dustmann et al., 2017). While the results are somewhat mixed, they tend to find that earlier tracking increases inequality in these outcomes. A smaller strand within this literature investigates individual determinants of children's school-track choices, and finds that relatively older children in a class, those from more advantaged family backgrounds, or those receiving high-intensity mentoring are more likely to choose a more academic school track (e.g., Dustmann, 2004; Mühlenweg and Puhani, 2010; Falk et al., 2020a). Yet, school-track choices turn out to be largely unaffected by teachers' gender, class size, or stated risk preferences of parents[4] (Wölfel and Heineck, 2012; Argaw and Puhani, 2018; Puhani, 2018). To the best of our knowledge, this literature has not yet studied the relationship between incentivized measures of children's patience and their school-track choices.

The rest of the paper is structured as follows. Section 2 introduces the institutional background on the education system in Northern Italy. Section 3 presents our data. Section 4 presents our results, and Section 5 concludes.

2. Institutional background

The Italian school system comprises ten years of compulsory schooling, starting at the age of six years with primary school (see Appendix Figure A1 for a graphical illustration). After five years of primary school, all children attend a comprehensive three-year middle school from which they graduate with an exit exam. Assignment of children to primary and middle schools is based on the children's place of residence in the schools' catchment areas and thus, unless changing residence, children from one primary school go to the same middle school. Only after graduating from middle school, children can choose between different high-school tracks (of which the first two years are still mandatory, although high schools last for longer).

There are three possible high-school tracks. Children may choose a vocational track or one of two academic tracks: generic high schools with various focus areas (such as sciences, languages, or arts) or technical schools specializing in specific fields of study (e.g., economics and business, technology). Both types of high schools take five years and lead to the statutory exit exam that is required for university admission. The vocational track is usually organized as a dual apprenticeship that combines formal schooling with in-company training. Its duration is three or four years (depending on the program) and it is oriented towards practical subjects enabling students to enter the labor market upon completion (Autonome Provinz Bozen-Südtirol, 2020a).[5] Overall, about 65 % of children choose an academic track (35 % a generic high school and 30 % a technical school) and 35 % the vocational track (Autonome Provinz Bozen-Südtirol, 2020b).

The high-school track choice we study represents a prototypical intertemporal decision problem in which time preferences should theoretically play a crucial role: Children must decide whether to receive a lower payment stream earlier by choosing the vocational track, or a higher payment stream later by choosing an academic track. Those who opt for a vocational track in the form of a dual apprenticeship receive an apprenticeship allowance right at the start of their apprenticeship.[6] Those who choose the academic track do not receive an income until they enter the labor market after graduation, i.e., no earlier than five years after choosing their high-school track. More than 50 % of graduates enter the labor market even later because they take up university studies after graduation (ISTAT University Indicators; http://dati.istat.it/). The longer training periods of the academic tracks are set against their substantial labor-market returns: In South Tyrol, an academic degree is associated with an average increase in available net income of 18.1 % compared with a compulsory school degree (after 10 years of schooling), whereas a professional qualification is associated with an average increase in available net income of 6.6 % only (Autonome Provinz Bozen-Südtirol, 2020c).[7] Beyond these economic opportunity costs and benefits of the academic track, academic track choice may also entail non-monetary costs (e.g., effort costs of studying) and benefits (e.g., increased physical and mental health; see Kamhöfer et al., 2019).

Two distinctive features of the Italian school system are particularly noteworthy in the context of our study: First, the school system is comprehensive until the end of middle school, which makes the high-school track choice the first key educational decision that children take. Second, access to different high-school tracks is unrestricted and independent from school grades. This implies that children's educational careers are not determined by past performance but largely depend on their high-school track choices that we study as the dependent variable in this paper. The middle-school GPA merely constitutes a guideline for children and their parents as to whether they are well suited for the academic track in terms of their educational performance (which is similar to, e.g., non-binding secondary school-track recommendations in several states in Germany; see Bach and Fischer, 2020).

3. Data

3.1. Experimental data

Patience measure. We elicited children's patience in an incentivized choice experiment using a simple investment task (similar to the convex time budget method of Andreoni and Sprenger, 2012a). Children were endowed with 5 tokens and had to decide how many tokens to consume immediately (by exchanging them into small presents), and how many tokens to invest in the future. Each invested token was doubled and the respective presents were

[4] In Section 5, we discuss the extent to which parental preferences may affect children's school track choices in our setting.

[5] Note that, in exceptional cases, students in vocational schools have the possibility to extend their studies to a five-year program including the same exit exam as in the academic track in order to receive admission to university.

[6] Apprenticeship pay is relatively low and varies greatly across different professions. For example, a first-year apprentice in hairdressing earns 423 € gross per month, while a first-year apprentice in hospitality earns 903 € (see Arbeitsförderungsinstitut, 2021a). Average gross earnings in South Tyrol are 2.064 € per month (Arbeitsförderungsinstitut, 2021b).

[7] OECD (2022) presents similar figures for Italy as a whole. The returns to education in Italy are in the middle range compared to other European countries (Luongo et al., 2010), with estimated causal returns for an additional year of schooling ranging from 6 % to 8 % (Brunello et al., 2000; Fiaschi and Gabbriellini, 2013).

Table 1
Descriptive statistics.

	Whole sample			Known track choice		Unknown track choice		
	Mean (1)	SD (2)	N (3)	Mean (4)	N (5)	Mean (6)	N (7)	p-value (two-sided) (8)
Experimental patience measure								
Tokens invested in future	2.245	1.657	493	2.305	449	1.636	44	0.011
Covariates								
Exact age	8.917	1.145	493	8.938	449	8.698	44	0.185
Female (=1)	0.448	0.498	493	0.457	449	0.364	44	0.237
Migration background (=1)	0.152	0.360	493	0.127	449	0.409	44	0.000
Experimental risk measure	2.360	1.176	491	2.351	447	2.455	44	0.579
Alternative patience measure	1.412	0.979	493	1.399	449	1.545	44	0.343
Parental earnings	1769.532	382.853	453	1774.575	416	1712.838	37	0.348
Raven score (cognitive ability)	21.109	4.294	485	21.348	442	18.651	43	0.000
Education data								
Grade Point Average (GPA)	8.012	1.024	412	8.015	408	7.75	4	0.608
Vocational track	0.158	0.365	449					
Academic technical school (Fachoberschule)	0.548	0.498	449					
Academic high school	0.294	0.456	449					

Notes: Parental earnings are computed as the mean earnings of the mother and the father of the child. In case earnings for one parent are missing, parental earnings represent the earnings of the parent whose earnings are known. Columns 1 to 3: means, standard deviations (SD), and number of observations for the whole sample of primary-school children in grades two through five in the school year 2012/2013. Columns 4 and 5: Analytical sample for a subset of children with known educational-track choice. Columns 6 and 7: Subset of children with missing information about educational-track choice. Column 8: p-values of two-sided tests (t-tests or χ^2 tests) between children with known and unknown educational-track choice. For a description of the variables see Section 3.

delivered 4 weeks after the experiment. On average, children invested 2.245 (SD: 1.657) tokens into the future (see Table 1 for descriptive statistics). We take the number of invested tokens as our measure of patience. A major advantage of this procedure is that it is very easy to understand, which is crucial to minimize measurement error when eliciting preferences in young children, and at the same time strongly relates to more traditional measures of patience, like choice list tasks.[8]

Experimental procedure and subject pool. Our experiment was part of a larger research project investigating the development of economic decision-making in primary-school children. The project was conducted in all fourteen primary schools in Meran (South Tyrol, Italy) with 86 % of children participating between 2011 and 2013, and entailed six experimental sessions run during regular school hours (see, e.g., Angerer et al., 2016, for details on the general setting and Sutter et al., 2019, for a review). The time-investment task was part of the fourth experimental session and was conducted in the school year 2012/13, the second year of the research project. Thus, we measured children's patience in grades two to five of primary school. For this paper, only data from children attending German-speaking primary schools are analyzed as we did not obtain educational data from Italian-speaking schools as explained below. In total, we obtained time-investment data from 493 second- to fifth-graders (aged 7 to 11 years) in 47 classrooms of seven German-speaking schools. Appendix Table A1 presents the number of subjects broken down by grade and gender.

At the beginning of the experimental session, children were fetched from the classroom and brought to a separate room where the experiment took place. The room contained several individual workplaces for a one-to-one explanation of the task by trained experimenters. All experimenters explained the game orally (see Appendix C for the experimental instructions) to every single child. To check for comprehension, the explanation involved control questions, and children had to repeat the rules of the game in their own words before making their decisions. The decisions were incentivized with experimental tokens that could be exchanged for little presents, like candies, peanuts, stickers, marbles, balloons, wristbands, hair ties, and other non-monetary rewards in an experimental shop.[9] Each present was worth one token. Children exchanged the tokens chosen for immediate consumption into presents right after the experimental session. Presents selected with the tokens invested into the future were delivered in a sealed envelope with an anonymized child ID exactly 4 weeks after the experiment.

The fact that the time-investment task was embedded in a larger research project allows us to draw on an unusually rich set of control variables. For instance, the dataset contains information on children's family background (migration background[10] and proxies for parental earnings), an incentivized risk-investment measure, and children's cognitive abilities from a modified version of Raven's test (see Appendix C for details on parental earnings and risk elicitation).[11][12]

3.2. Administrative education data, attrition, and sample characteristics

Educational data is provided by all German-speaking schools in Meran after the graduation of children from middle school.[13] Anonymized administrative data from school records contain the middle-

[8] In fact, only 4 out of 493 children (0.81 %) from our sample had comprehension problems. Excluding these subjects with comprehension problems from the analytical sample does not affect our results qualitatively.

[9] After children selected their presents, we asked them whether or not they liked the presents. Virtually all children stated that they liked the presents.

[10] In Meran (South Tyrol) about 50 % of the population belong to the Italian language group and 50 % to the German language group. Migration background is thus a dummy variable indicating whether at least one parent speaks another language than German or Italian as the main language.

[11] In the risk-investment task, children were endowed with 5 tokens and had to decide how many tokens to invest into a risky lottery (following Gneezy and Potters, 1997, and Charness and Gneezy, 2010). The lottery yielded 2 or 0 tokens with equal probability for each token invested, and non-invested tokens were save earnings for the child. To measure cognitive ability, we used 27 of Raven's colored progressive matrices (Raven et al., 2004). Each matrix consisted of a geometric figure or pattern with a missing piece. The children had to find the missing piece among 6 possible items. The cognitive ability measure for each subject gives the number of correct answers and ranges from 0 to 27.

[12] Another advantage of drawing on a larger research project in which the same children participated in different incentivized decision tasks (involving delayed payments already before) is that children learned that experimenters follow through with their promises and therefore could trust that the delayed payments will be actually delivered. Thus, the concern that our patience measure is confounded by a lack of trust toward the experimenter is likely not an issue in our context.

[13] Note that the school board for Italian primary schools did not consent to provide equivalent data for the seven Italian schools.

school GPA and the chosen high school (see the bottom part of Table 1 for descriptive statistics on the education data).

Middle-school GPA. The middle-school GPA is a measure of school performance at the end of middle school and is determined as a weighted average of the overall performance during the three middle-school years (including a grade for student behavior), and the grades of the final exam and pre-exams. The final exam includes four written exams in the subjects German, Italian, English and Math/Science, and one oral exam. The exams are prepared and evaluated by the teachers of the respective subjects and as such are not standardized, but the contents are based on the overall guidelines provided by the department of education of the government of South Tyrol. Students with a positive admission grade can take the final exam. The admission grade is determined by the class council who evaluates a pre-exam of Math and German together with the performance of the student throughout middle school. The GPA is determined as the weighted average of the admission grade with a weight of 50 % (which includes a grade for student behavior), together with the four written exams and the oral exam, each with a weight of 10 % (Autonome Provinz Bozen-Südtirol, 2017). The lowest passing grade is 6, and the highest possible grade is 10 (average grade in our sample: 8.012).

High-school track choice. The administrative school-record data contain the name of the high school which the child attended in the subsequent year. In our analysis, we distinguish between a child choosing an academic or a vocational high-school track. As explained in Section 2, the academic track consists of generic high schools and technical schools ("Fachoberschulen") whereas the vocational track comprises all vocational schools ("Berufsschule" and "Fachschule").[14]

Attrition. Experimental and educational data were matched by using a unique and anonymous identification code that was assigned to each child at the beginning of the project. In the administrative data, 449 observations contain information on high-school track choice. Thus, attrition amounts to 44 observations (out of 493) and is exceptionally low at <9 %.[15] Based on school records, 19 subjects either left or changed school (e.g., due to movings), or had to repeat a grade. From the remaining 25 subjects, 4 children graduated from middle school (i.e., obtained a grade 6 or higher), however, no high-school track choice data is available. For another 21 children both, GPA and high-school track choice information are missing without further record, which is <4 % of the whole sample.

Sample characteristics. Table 1 reports descriptive statistics of all variables for our whole sample (columns 1 to 3), as well as broken down for our sample with known/unknown educational-track choice (columns 4 and 5, respectively 6 and 7). The final column 8 reports p-values of two-sided tests between the two samples. The table reveals that for most variables the two samples are not significantly different from each other. Yet, it appears that children with missing high-school choice information are significantly less patient, have a lower score on Raven's test, and are significantly more likely to have a migration background. These differences across samples are consistent with the interpretation that children with missing high-school information had to repeat a grade or dropped out from school, which would be in line with Castillo et al. (2018) who show more impatient children being less likely to graduate from high school. Importantly, in the next section, we employ inverse-probability weighting and attrition bounding to show that selective attrition does not affect our results.

4. Results

4.1. Main results

Table 2 presents our main result that children's experimental measure of patience is robustly related to academic-track choice three to six years later. Column 1 starts with a bivariate OLS regression of a dummy variable for academic high-school track choice at the end of the middle school on the number of tokens invested into the future in the experimental task that children completed in primary school.[16] The significant coefficient estimate reveals that increasing the number of tokens saved for the future by one is associated with a 2.7 percentage points increase in the probability to attend an academic track. Controlling for age, gender, and migration background of children in column 2 does not affect this result. One concern with the results so far might be that they simply pick up between-school differences in academic-track choice and the student populations' patience, but that they might not be robust when only considering within-school variations. In column 3, we, therefore, include school fixed effects as well as fixed effects for primary-school grade levels and find this does not affect our coefficient estimate of interest. In column 4 we even go a step further and include school-class fixed effects, and find that our results remain robust after eliminating any (potentially confounding) between-class variation. In what follows, we use this regression model that effectively only compares children *within* the same class as our starting point for further robustness analyses.

Accounting for attrition. The regressions in Table 3 show that our results remain robust after accounting for sample attrition. Given that the probability that we observe a child's high-school track choice is positively related to a child's patience (see Section 3.2 and Table 1), one obvious concern is that our estimated relationship between patience and school-track choice is biased due to systematic sample attrition. We employ two types of attrition analysis to investigate this issue. First, in column 1, we reweight the observed data using the inverse probabilities of observing children's educational-track choice and find that our results do not budge when employing inverse-probability weighting.[17] Second, columns 2 and 3 present bounding analyses where we assign children with missing information on school-track choice different counterfactual values. In column 2 (column 3), we assume that all children with missing information attend (do not attend) an academic track, and find that the estimated relationship of interest remains significant and very similar in magnitude in both scenarios. In sum, our analysis shows that attrition (which is comparably low in our data anyway) does not bias our main results.

4.2. Robustness analysis

In this section, we draw on the exceptional richness of our data to investigate whether our results hold when we control for additional variables. To assess whether the relationship between patience and school-track choice described above suffers from omitted variable bias, we first control for possible confounding factors that may be correlated with both variables (Angrist and Pischke, 2009, chapter 3). Based on this analysis, we then examine stability of our results against selection on unobservables (Oster, 2019). Second, we assess whether children's middle-school GPA

[14] Throughout the paper, we use the binary measure "academic track" for our analysis, but using a three-point scale for track choices yields qualitatively identical results. Appendix Tables A4 and A5 replicate our main results with a three-point measure as dependent variable using OLS regressions. These robustness results also hold when using Ordered Probit models instead (results are available upon request).

[15] As a comparison, attrition in Castillo et al. (2018) is 32 %.

[16] Throughout the paper, we employ OLS estimations with robust standard errors, but non-linear Probit models yield qualitatively identical results (see Appendix Tables A2 and A3).

[17] The predicted probabilities stem from a Probit regression of a dummy variable coded 1 if a child's school-track choice is known (0 else) on the time-investment decision, age, gender, and migration background.

Table 2
Relationship between academic track choice and experimental patience measure.

	Academic track choice			
	(1)	(2)	(3)	(4)
Time-investment decision	0.027**	0.032***	0.030***	0.028**
	(0.011)	*(0.011)*	*(0.011)*	*(0.011)*
Exact age		−0.039**	−0.081	−0.049
		(0.016)	*(0.049)*	*(0.049)*
Female (=1)		0.036	0.034	0.039
		(0.034)	*(0.035)*	*(0.035)*
Migration background (=1)		0.030	0.024	0.039
		(0.052)	*(0.051)*	*(0.052)*
Grade-level fixed effects	No	No	Yes	No
School fixed effects	No	No	Yes	No
School-class fixed effects	No	No	No	Yes
Constant	0.779***	1.096***	1.406***	1.066***
	(0.033)	*(0.144)*	*(0.360)*	*(0.392)*
Observations	449	449	449	449
R^2	0.015	0.031	0.053	0.135

Notes: OLS regressions. *Time-investment decision*: incentivized decision on how many (of five) tokens to invest into the future, elicited when children were in primary school (grades two to five). Dependent variable: Dummy variable coded 1 if the child is enrolled in academic high-school track, elicited at the end of middle school (grade eight), 0 otherwise. For a description of the other covariates see Section 3. Robust standard errors in parentheses. Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10.

Table 3
Accounting for attrition in the dependent variable.

	Academic track choice		
	Inverse-probability weighting	Imputation of missing values	
	(1)	(2)	(3)
Time-investment decision	0.027**	0.025**	0.030**
	(0.011)	*(0.010)*	*(0.012)*
Exact age	−0.050	−0.048	−0.064
	(0.049)	*(0.044)*	*(0.050)*
Female (=1)	0.041	0.027	0.061
	(0.035)	*(0.032)*	*(0.037)*
Migration background (=1)	0.040	0.066	−0.079
	(0.051)	*(0.043)*	*(0.058)*
Grade-level fixed effects	No	No	No
School fixed effects	No	No	No
School-class fixed effects	Yes	Yes	Yes
Constant	1.065***	1.096***	1.079***
	(0.405)	*(0.349)*	*(0.392)*
Observations	449	493	493
R^2	0.138	0.122	0.191

Notes: OLS regressions. *Time-investment decision*: incentivized decision on how many (of five) tokens to invest into the future, elicited when children were in primary school (grades two to five). Dependent variable: Dummy variable coded 1 if the child is enrolled in academic high-school track, elicited at the end of middle school (grade eight), 0 otherwise. For a description of the other covariates see Section 3. Column 1: Inverse-probability weighting based on predictions using children's time-investment decision, age, gender, and migration background. Column 2: Missing values imputed with academic track choice. Column 3: Missing values imputed with non-academic track choice. Robust standard errors in parentheses. Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10.

acts as a mediator for the relationship between patience and school-track choice.

Controlling for potential confounders. The first column of Table 4 depicts our preferred specification (from column 4 of Table 2) as a benchmark, and additional control variables are added in the subsequent columns. In column 2, we add our incentivized measure of children's risk-taking as an additional control variable. Given the intertemporal nature of educational investment decisions and the fact that only the present is certain whereas the future always contains an element of uncertainty, one might expect that risk preferences may affect children's educational choices. Furthermore, previous studies have shown that time and risk preferences are intertwined (e.g., Andreoni and Sprenger, 2012b; Epper and Fehr-Duda, 2023), which highlights the need to control for risk preferences to isolate the independent relationship between patience and educational choices. Adding risk preferences as an additional control variable leaves our coefficient of interest on children's time-investment decision intact. Furthermore, the coefficient on the risk-investment decision is small and statistically insignificant, reflecting the theoretically ambiguous relationship between risk preferences and human capital investment.[18]

Next, we add an alternative measure of children's patience, namely the number of patient choices from a time-preference choice list task, as an additional control variable in column 3,[19] which leaves our coefficient of interest statistically and economically significant. In contrast, the coefficient of the alternative patience measure is small and insignificant, suggesting that the time-investment task is better suited to depict the relationship between patience in children and their school-track choice.[20]

[18] A priori, the expected relationship between children's risk preferences and educational choices is undetermined, since an academic track choice entails a range of risky elements that may be negatively correlated (e.g., lower unemployment risk for occupations with higher human-capital requirements, versus higher earnings variance in these jobs). The undetermined direction of the relationship between risk preferences and human-capital investment is highlighted, for instance, in the review by Benzoni and Chyruk (2015).

[19] Children had to take three binary decisions between receiving two experimental tokens today, and receiving 3, 4, respectively 5 experimental tokens in four weeks. We take the number of patient choices in these three tasks as our alternative measure of time preferences.

[20] These regression results show that the alternative choice-list measure of patience has no *additional* predictive power for academic-track choice over our time-investment measure. In additional analyses available upon request, we find that, unlike the time-investment measure of patience, the choice-list measure alone does not significantly predict academic-track choice (note in this respect that the correlation between both measures of time preferences is far from perfect; Spearman's ρ = 0.3945, p<0.01). The lower predictive power of the choice-list measure in our setting is in line with the results by Andreoni et al. (2015): They show that the out-of-sample predictive power of a patience measure based on the convex time budget method (similar to our time-investment task) is greater than the predictive power of a multiple price list measure (similar to our alternative choice-list measure). In general, the predictive power of laboratory measures of time preferences is highly dependent on the method used to measure time preferences and the domain of field behavior considered (for reviews, see Cohen et al., 2020, and Ericson and Laibson, 2019). Exploring the reasons for these heterogeneous findings in the literature might be an interesting avenue for future research.

Table 4
Robustness analysis.

	Academic track choice						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Time-investment decision	0.028**	0.027**	0.031***	0.023**	0.023**	0.021*	0.024**
	(0.011)	*(0.011)*	*(0.011)*	*(0.011)*	*(0.011)*	*(0.012)*	*(0.012)*
Exact age	−0.049	−0.047	−0.049	−0.041	−0.036	−0.028	−0.030
	(0.049)	*(0.049)*	*(0.049)*	*(0.051)*	*(0.049)*	*(0.052)*	*(0.049)*
Female (=1)	0.039	0.041	0.037	0.042	0.038	0.044	0.038
	(0.035)	*(0.035)*	*(0.035)*	*(0.037)*	*(0.035)*	*(0.037)*	*(0.034)*
Migration background (=1)	0.039	0.037	0.036	0.049	0.047	0.051	0.048
	(0.052)	*(0.053)*	*(0.052)*	*(0.057)*	*(0.054)*	*(0.059)*	*(0.056)*
Risk-investment decision		0.012				0.023	0.015
		(0.016)				*(0.019)*	*(0.017)*
Alternative patience measure			−0.014			−0.020	−0.020
			(0.019)			*(0.020)*	*(0.019)*
Parental earnings (1000 €)				0.056		0.041	0.041
				(0.056)		*(0.055)*	*(0.054)*
Raven score (cognitive ability)					0.015***	0.014**	0.016***
					(0.006)	*(0.006)*	*(0.006)*
Imputation dummies	No	No	No	No	No	No	Yes
School-class fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.066***	1.032**	1.090***	0.889**	0.726*	0.574	0.610
	(0.392)	*(0.400)*	*(0.390)*	*(0.444)*	*(0.402)*	*(0.461)*	*(0.432)*
Observations	449	447	449	416	442	410	449
R2	0.135	0.136	0.137	0.142	0.153	0.160	0.160

Notes: OLS regressions. *Time-investment decision*: incentivized decision on how many (of five) tokens to invest into the future, elicited when children were in primary school (grades two to five). Dependent variable: Dummy variable coded 1 if the child is enrolled in academic high-school track, elicited at the end of middle school (grade eight), 0 otherwise. For a description of the other covariates see Section 3. Robust standard errors in parentheses. Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10.

In column 4, we show that our results are also robust to controlling for our measure of parental earnings. Given the previously documented positive relationships between parental socioeconomic status and children's school-track choice, and between income and patience (e.g., Dohmen et al., 2010), parental earnings may be an omitted variable driving the empirical relationship between children's patience and school-track choice. While parental earnings are significantly correlated with children's school-track choice (Spearman's ρ = 0.1417, $p < 0.01$), adding them as an additional control variable to the regression leaves the coefficient on the time-investment decision largely unchanged and significant.[21]

Turning to cognitive abilities, column 5 reveals that our results are also robust to accounting for children's performance on Raven's test. From the outset, one might suspect that the positive correlation between children's patience and academic school-track choice is due to the fact that both patience and the propensity to choose an academic school track are positively correlated with children's cognitive abilities. While adding cognitive ability as a control variable yields a highly significant and positive coefficient, the relationship between children's patience and academic track choice remains positive and significant, suggesting that this relationship is independent of the influence of cognitive abilities on school-track choice.

In sum, this analysis reveals that the relationship between children's patience and academic-track choice remains robust after controlling for various potential confounding factors. While including all these control variables at the same time in column 6 slightly decreases the statistical significance of the coefficient of interest (p = 0.09), it turns significant at the 5-% level again when we impute missing covariates and include imputation-dummies in column 7. Thus, our results suggest an independent and direct relationship between children's patience and their later school-track choice.

To test whether our coefficient of interest is stable to selection on unobservables, we next perform the stability analysis proposed by Oster (2019). In particular, we compare the model in column 7 of Table 4 to the restricted model without any controls (column 1 of Table 2). Following Oster (2019), we set $R_{max} = 1.3\tilde{R}$, and assume that selection on unobservables is as strong as selection on observables ($\delta = 1$).[22] The estimated bias-adjusted coefficient on the time-investment decision is 0.023, which is very similar to the coefficients in our analysis above. Likewise, the degree of selection on unobservables relative to observables for which our coefficient of interest is zero is $\delta = 4.516$, and thereby exceeds the suggested cutoff of $\delta = 1$ by far. Put differently, the degree of selection on unobservables would have to be more than four times as large as selection on observables to eliminate our main result, speaking against the concern that omitted variables undermine our main results.

GPA as mediating factor? Next, we scrutinize the role that children's middle-school GPA plays in mediating the relationship between patience and academic-track choice. As we described in Section 2, in the Italian school system, children's middle-school GPA does *not* determine access to an academic high school, because it is not an admission criterion for these schools. Yet, the GPA may serve as an important signal indicating whether a child is fit for the requirements of an academic high school. As we show in columns 1 and 2 of Table 5, patient children have in fact a higher GPA (probably reflecting more time and effort invested in studying), which may indicate that the relationship between patience and school-track choice operates through children's GPA. To assess the extent to which GPA mediates the relationship of interest, we re-estimate our preferred specification, and add GPA as an additional control (this mediation analysis is along the lines of e.g., Pearl, 2012, and Heckman et al., 2013). Inspecting coefficient

[21] Note that we proxy parental earnings based on parents' professions reported by the children, which means that measurement error in this variable may bias the coefficient on parental earnings toward zero. Despite this potential measurement error, we see the expected positive correlation between parental earnings and children's school-track choices.

[22] R_{max} is the R-squared from a hypothetical regression of the outcome on observed *and* unobserved controls, $\tilde{R}$ is the R-squared from a regression with all observable controls (in our case column 7 of Table 4). See Oster (2019) for details.

Table 5
Middle-school GPA as mediating factor?

	Middle-school GPA		Academic track choice		
	(1)	(2)	(3)	(4)	(5)
Time-investment decision	0.078***	0.052*	0.018*	0.021*	0.024**
	(0.030)	*(0.031)*	*(0.011)*	*(0.011)*	*(0.011)*
Exact age		−0.229*		−0.021	−0.025
		(0.129)		*(0.052)*	*(0.048)*
Female (=1)		0.609***		−0.042	−0.016
		(0.103)		*(0.039)*	*(0.037)*
Middle-school GPA			0.093***	0.109***	0.098***
			(0.017)	*(0.020)*	*(0.020)*
Migration background (=1)		−0.516***		0.107**	0.085*
		(0.147)		*(0.050)*	*(0.051)*
Imputation dummy	No	No	No	No	Yes
School-class fixed effects	No	Yes	No	Yes	Yes
Constant	7.838***	8.830***	0.056	0.150	0.177
	(0.086)	*(1.038)*	*(0.149)*	*(0.459)*	*(0.423)*
Observations	408	408	408	408	449
R^2	0.015	0.250	0.080	0.221	0.188

Notes: OLS regressions. *Time-investment decision*: incentivized decision on how many (of five) tokens to invest into the future, elicited when children were in primary school (grades two to five). Dependent variable: Dummy variable coded 1 if the child is enrolled in academic high-school track, elicited at the end of middle school (grade eight), 0 otherwise. For a description of the other covariates see Section 3. Robust standard errors in parentheses. Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10.

movements between the regression without and with GPA reveals how much of the patience effect on school-track choice can be explained by the mediator. Columns 3 and 4 show that the coefficient on the time-investment decision remains (marginally) significant and similar in magnitude when adding the GPA as a control variable. The statistical significance of the coefficient of interest turns significant at the 5-% level again when we impute the missing covariate (i.e., middle-school GPA) and include an imputation dummy in column 5. Thus, while the large and highly significant coefficient on the GPA clearly shows its importance for explaining school-track choices, these results again show that patience has independent explanatory power.[23]

In summary, this section has shown that our main result holds after accounting for a number of possible confounding factors, making it unlikely that the relationship between patience and high-school track choice is spurious. Moreover, the effect of patience on school-track choice is not mediated by its effect on GPA, suggesting a direct link between patience and school-track choice. In additional analyses presented in Appendix B, we also provide suggestive evidence that the relationship between patience and academic-track choice is not driven by children's impulsivity or school-related non-cognitive skills.

5. Conclusion

Experimental measures of patience predict economically important field behavior among adults as well as among children and adolescents (e.g., Khwaja et al., 2007; Chabris et al., 2008; Burks et al., 2009; Meier and Sprenger, 2010; Castillo et al., 2011, 2018,2020; Sutter et al., 2013). One particularly important economic decision that young children face is the one of choosing an educational track, a key feature of many school systems around the globe (see Betts, 2011, and OECD, 2020). We study the direct link between experimental measures of children's patience and educational track choices three to six years later. We find a strong and significant positive association between patience and choosing an academic high-school track (instead of a vocational school track), which is robust to accounting for attrition and controlling for a rich set of background characteristics. Controlling for middle-school GPA as a potential mediator, our results suggest a direct link between patience and academic-track choice.

An interesting question in our context is to what extent parents influence children's school-track choices. As we have shown, controlling for parental earnings in our regression analysis does not change the strong relationship between children's patience and their school-track choices, speaking for the direct importance of children's patience for explaining their educational decisions. Relatedly, Lergetporer et al. (2021) document that children and parents tend to have equal weight in children's educational decisions, which further highlights the relevance of studying the relationship between children's patience and school-track choices. We consider investigating the relative influence of children's and their parents' patience (which tend to be correlated across generations; Kosse and Pfeiffer, 2012) on children's educational choices an interesting avenue for future research.

From a policy perspective, our findings suggest that interventions that increase children's non-cognitive skills including forward-looking behavior (e.g., Heckman et al., 2010; Alan and Ertac, 2018) may affect children's school-track choice positively, and may thus have positive long-term consequences (e.g., on labor-market success or skill acquisition). The finding that children's patience is directly related to children's academic-track choice – over and above its indirect influence through increased school performance – furthermore suggests that even short-term interventions targeting the specific point in time when school-track decisions are made (e.g., Resnjanskij et al., 2021) can have lasting effects.[24] Given the strong link between parents' and children's patience (Kosse and Pfeiffer, 2012; Kiessling et al., 2021),

[23] Note that, while the empirical approach of the above confounder analysis and the mediation analysis is similar, their purpose and interpretation are different. The purpose of the confounder analysis is to study whether the relationship of interest is driven by omitted variable bias in our preferred specification, which would be the case if the relationship turned economically insignificant after accounting for possible confounders. The mediation analysis, on the other hand, is intended to determine whether the relationship of interest can be attributed to an intermediate outcome variable (mediator), in our case GPA, which would be indicated by a shift of the coefficient on the time-investment decision toward zero when the mediator is added. The key difference between confounders and mediators is that the latter are outcomes of patience, whereas the former are not (see, e.g., Falk et al., 2020b, for a similar discussion on the relationship between children's delay of gratification in the marshmallow test and later life outcomes).

[24] This is particularly true in education systems where children's previous GPAs are no binding determinant of their educational-choice set as in Italy or several German states.

and the fact that children from more disadvantaged backgrounds tend to be particularly impatient and engage in more present-oriented behaviors (e.g., Heckman et al., 2011; Andreoni et al., 2019; Falk et al., 2021), such interventions may foster intergenerational mobility and equality of educational opportunity.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpubeco.2023.104837.

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