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Students' grit and their post-compulsory educational choices and trajectories: evidence from Switzerland

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ABSTRACT

We examine how the personality trait grit relates to post-compulsory educational choices using survey data linked to register data. Exploiting variation in self-reported grit within a cohort of students finishing compulsory school, we find that higher grit is associated with a higher likelihood of starting a vocational education over general education. This association is robust to cognitive skill measures and other background characteristics. Using novel data on skill requirements of vocational training occupations, we find that grittier vocational education students sort into math-intensive occupations. We find no evidence that grit reduces dropout rates in post-compulsory education..

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1. Introduction

For well over three decades, it has been empirically well documented that so-called non-cognitive skills or personality traits have contributed a great deal to the understanding of individual success or failure in the education system (see, e.g. Koch, Nafziger, and Nielsen 2015) and in the labour market (see, e.g. Heckman, Stixrud, and Urzua 2006, and for a recent overview Cabus, Napierala, and Carretero 2021). Even if causal relationships are not always easy to establish, the correlations between non-cognitive skills and various outcomes show that individual decisions and results can be better explained and understood if non-cognitive skills are taken into account in addition to measurements of cognitive skills. However, as with cognitive skills, there is no single measure for personality traits and non-cognitive skills and a wide variety of concepts are proposed and empirically tested in the literature. The variants of non-cognitive skills are so numerous that they can practically only ever be used individually or in combination with a few other characteristics. Although this paper is no exception in this respect, we use the concept of 'grit', which was introduced by Angela Duckworth (see, e.g. Duckworth et al. 2007), because there are now several empirical studies showing that grit is a good predictor of academic achievement (for an overview, see Christopoulou et al. 2018), that higher grit leads to fewer school dropouts (Eskreis-Winkler et al. 2014), correlates with higher grades (Akos and Kretchmar 2017; Duckworth et al. 2007) and less frequent changes of majors (Akos and Kretchmar 2017).

Grit is intended to map two dimensions of personality traits, namely consistency of interest, sometimes also called passion, and perseverance, which has a certain overlap with the trait of conscientiousness, which is important for self-regulation and is covered, for example, as one of the five

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personality traits of the big five (see, e.g. Volz and Masicampo 2021). The importance of grit is, however, not undisputed, as some studies have criticized the concept of grit for different reasons (for an overview, see Credé, Tynan, and Harms 2017). For example, not all studies find a correlation between grit and academic performance (see, e.g. Bazelaïs, Lemay, and Doleck 2016), or its additional explanatory power is low compared to other personality traits (e.g. conscientiousness from the Big Five traits) (Rimfeld et al. 2016; Steinmayr, Weidinger, and Wigfield 2018). This has also led to questioning the use of grit as a higher-order construct/higher-order structure, as both subcomponents (persistence of effort and consistency of interest) are not always equally relevant or the relevance of the two components differs depending on the outcome (Bowman et al. 2015; Karlen et al. 2019; Wolters and Hussain 2015).

Given that grit potentially promises to improve our understanding of certain empirical phenomena, while at the same time its significance remains controversial, we are motivated to examine grit in more detail in relation to educational decisions and trajectories using a novel data set. We are doing this in Switzerland, a country which, unlike Anglo-Saxon countries, where grit has been studied extensively in the past, not only offers post-compulsory general education but also has a strong vocational training system.

In education systems like Switzerland's, where students make the choice between vocational and general education after compulsory school, this decision plays an important role in individuals' long-term educational and career trajectories. Understanding whether and how grit influences this decision is therefore important to debate on educational equity, social mobility, and educational policy interventions during this transition phase.

In this paper, we examine the association between grit and students' post-compulsory educational choices and trajectories using data from a large survey linked to longitudinal student register data of students in Switzerland. Exploiting variation in self-reported grit (8-item grit scale, see Duckworth and Quinn 2009) within a cohort of students in the last year of compulsory school in the last year of compulsory school, we find that students with higher levels of grit are found more often in vocational training programs after compulsory schooling than in general education and that in this respect it is only the subcomponent of perseverance of effort that is significantly related to this difference. Furthermore, we find, that in both strands of post-compulsory education, general and vocational, students with higher grit are more likely to be found in study courses and occupations with higher demands on mathematical skills. While in the case of general education, both subcomponents of grit are related to math-intensive majors, in the case of vocational education and training, it is only the consistency of interest subcomponent that is related to math-intensive training occupations.

Our contribution to the existing literature is fourfold: First, we examine the explanatory power of the concept of grit not only for educational success, but also for educational choices and preferences. Secondly, and to the best of our knowledge, the importance of grit in the choice of type of education has never been demonstrated in the way we have studied, in an education system that has both a strong vocational orientation, with 2/3 of young people choosing vocational education as their first education, as well as a strong academic track. Thirdly, the population we have analysed is a cross-section of the entire population of students in the last year of compulsory school and not, as in many studies, only selected groups, such as e.g. college students. Finally, the empirical analysis is based not only on a large representative survey of more than 2,000 students, but also on linking this survey data with administrative data on education, which allows us to follow the educational trajectories of the population without data attrition.

The rest of the paper is structured as follows: In Section 2.1, we briefly describe the institutional setting, the Swiss education system, in which we analyse the choices and educational trajectories of adolescents. In Section 3, we describe the data, in Section 4, the empirical strategy and Section 5 shows the empirical results, followed by our conclusions in Section 6.

2. Background

2.1. Swiss education system

In the Swiss education system, students sort after compulsory schooling (K + 9) either into a vocational track or continue with a general education. Around two thirds of school-leavers opt for the vocational track, whereas the remaining third follows general education leading either to a university entrance diploma (the academic baccalaureate) or a specialized baccalaureate giving access to universities of applied sciences or universities of teacher education. The decision to pursue vocational training or general education depends to a large extent on the grade point average of the last compulsory school report, but only pupils at the bottom of the ability distribution have no real choice. Students in the middle of the ability distribution and at the upper end have a choice and, as a result, there is also quite a large overlap in academic performance between those students who choose general education and those who prefer vocational education (Wolter et al. 2018, 2023). The general education options lead to a baccalaureate certificate, which grants practically free access to university, while the vocational options offer the possibility of a vocational baccalaureate, which opens up direct access to universities of applied sciences and, with an additional year of training, access to academic universities. The permeability of the system is therefore a prerequisite for ensuring that decisions at the end of compulsory schooling are not made solely on the basis of school grades, but that preferences also play a role.

Students going into the vocational track can choose from more than 240 different occupations to train for (State Secretariat for Education, Research, and Innovation 2022). While some programs are fully school-based, the majority of VET programs (around ninety percent) are completed in a dual training system where students study 1–2 days in a week in a vocational school and work 3–4 days in the training company. Many of these company-based programs are highly competitive as in contrast to most academic programs, admission is not only based on school academic records or an academic entry test, but on a multidimensional selection process by which training companies select and recruit their students from a pool of applicants.

Students who opt for the general education (the academic baccalaureate schools) can choose between seven different specializations. Two of these are in STEM subjects (maths & physics; chemistry & biology), two in languages, one in economics and law, one in the arts, and finally one in psychology, education and philosophy. Although the baccalaureate certificate at the end of upper secondary level grants universal access to universities and study subjects (with the exception of medicine at certain universities), the choice of specialization is usually a decision with far-reaching consequences, because in practice these specializations prepare students for university subjects to varying degrees and can therefore limit their later choice of subject at university.

Age-earnings profiles for vocational and general education graduates tend to follow distinct trajectories (see, e.g. Hampf and Woessmann 2017; Hanushek et al. 2017). Vocational education is typically associated with higher earnings in the early stages of a career, particularly within the first five to ten years after graduation, as vocational graduates enter the labour market earlier and with job-specific skills. General education often leads to slower initial earnings but higher returns in the long run, especially for those who pursue further education at a university. However, the magnitude and persistence of these differences vary by country and depend on the structure and occupational focus of vocational programs (e.g. Saltiel 2021; Silliman and Virtanen 2022). In the Swiss context, studies highlight sustained benefits of vocational education (Saltiel 2021), also due to the high degree of educational permeability after upper-secondary education, so that, in Switzerland, it cannot automatically be assumed that choosing vocational training instead of general education leads to economic disadvantage.

2.2. Grit and Post-Compulsory Educational Choices

Non-cognitive skills are increasingly recognized as important determinants of educational outcomes (Koch, Nafziger, and Nielsen 2015). Among them, grit – defined as perseverance and passion for

long-term goals – may play a critical role in shaping students' educational success (Duckworth et al. 2007). Understanding how grit influences educational decisions may help inform policies aimed at promoting grit, which has been shown to be malleable and responsive to targeted interventions in school settings (Alan, Boneva, and Ertac 2019).

Grit consists of two subcomponents: perseverance of effort (PE), the capacity to sustain hard work despite obstacles, and consistency of interest (CI), the tendency to remain committed to long-term goals (Duckworth et al. 2007). Both dimensions may influence students' post-compulsory educational choices in distinct ways.

Students with high perseverance may be more inclined toward general education. On the one hand, because entry into general education, which is intended to prepare students for university education, requires good academic performance in compulsory schooling, which in turn may be the result of greater grit. On the other hand, it involves a long-term investment, which is perhaps more likely to be made by people with greater perseverance. At the same time, vocational tracks – especially in dual systems – require substantial early effort. At a very young age, usually between 14 and 16, students not only have to decide on a career, but also have to compete in a competitive job market (Schilter, Lüthi, and Wolter 2024). This involves submitting multiple applications to different employers, passing competitive entrance exams and attending job interviews. For this reason, students who choose vocational training may well have to show more perseverance than those who, thanks to good school grades, move on to general post-compulsory education almost 'automatically.'

The role of consistency of interest may also vary across educational tracks. Vocational training involves an earlier and very specific career commitment, which may appeal to students with stable interests. In contrast, general education offers greater flexibility and the opportunity to explore different fields over time. As a result, while perseverance is relevant in both pathways, and hence, its overall effect on educational choice is ambiguous, consistency of interest may be particularly important for students choosing vocational education, where early specialization is required.

3. Data

Our analysis uses data from the annual 'Nahtstellenbarometer' survey (State Secretariat for Education, Research, and Innovation 2020). This survey is administered by the Swiss State Secretariat for Education, Research and Innovation and gathers information from Swiss students in their last year of compulsory school through two telephone interviews conducted in March (i.e. shortly before the end of the school year) and August (i.e. when students enter upper-secondary school). Survey participants were drawn from a stratified random sample based on language region and gender, using population register data provided by the Swiss Federal Statistical Office. We focus specifically on the 2020 March wave, which includes data on students' grit.¹ Our sample consists of 2479 students.

We merge our survey data with longitudinal student register data (up to 2022), which provides annual information on students' education status, including education type, school track, and grades. This data allows us to determine if students choose general or vocational education after compulsory school, and for those pursuing a baccalaureate school within the general education track, their chosen major is also recorded. Similarly, vocational education students' chosen training occupation is included in the data.

We use the student register data to create three outcome variables. First, we generate a categorical variable indicating whether a student (a) enters a vocational education track (combined firm and school-based training), (b) enters a general education track, or (c) does not directly transition to the upper-secondary level in the year after compulsory school. Second, we create variables that measure the math content in upper secondary school. To assess the math content of the vocational education track, we utilize information from the official expert rating of cognitive requirements of vocational education programs for Switzerland, which provides skill requirement measures for math, natural

sciences, foreign languages and school language.² The skill requirements are measured on a scale of 0-100. To assess the math content of the general education track, we focus on students who enter baccalaureate school and generate a binary variable that indicates whether a student chooses a math-intensive major. Third, we create a variable that indicates whether a student dropouts early of upper secondary school. Specifically, we generate a binary variable that indicates if a student proceeds to the second year of upper secondary school. Students can, of course, still experience failure later, but in most education programs, the performance during the first year is crucial. Therefore, a successful transition from the first to the second year of an education program is an important sign of a good match between the requirements of the chosen education and a student's competences.

Our main variable of interest is grit – a compound personality trait that measures stamina in the dimensions of interest and effort (Duckworth et al. 2007). Students' grit is measured using the short grit scale (Grit-S) developed by Duckworth and Quinn (2009). Grit-S consists of eight questions, with four questions assessing students' consistency of interest (CI) and four questions assessing students' perseverance of effort. Participants rate their responses on a Likert scale ranging from 1 (very much like me) to 5 (not at all like me). To calculate students' overall grit score, we follow previous literature and take the average of their responses across all eight questions.

Table 1. Summary statistics.

	Mean	SD	Min	Max
<i>Outcome variables</i>				
Educational choice				
VE track	0.41	0.49	0	1
GE track	0.42	0.49	0	1
No track	0.17	0.38	0	1
Math-intensity of chosen track				
VE track	48.06	16.42	11.78	81.8
GE track	0.48	0.50	0	1
Passed first year of upper-secondary school	0.85	0.35	0	1
<i>Student characteristics</i>				
Grit	3.51	0.47	1.13	5
Female	0.50	0.50	0	1
Age	14.67	0.63	14	16
Municipality type				
Urban	0.60	0.49	0	1
Intermediary	0.22	0.41	0	1
Rural	0.18	0.39	0	1
Language region				
German	0.66	0.47	0	1
French	0.29	0.45	0	1
Italian and Rhaeto-romance	0.05	0.21	0	1
Parental education				
No college education	0.50	0.50	0	1
Father has college education	0.14	0.34	0	1
Mother has college education	0.11	0.31	0	1
Both have college education	0.19	0.39	0	1
Do not know	0.07	0.26	0	1
Migration background				
Foreign nationality and speaks foreign language at home	0.13	0.34	0	1
Foreign born	0.14	0.35	0	1
Track in lower-secondary school				
Low-track	0.24	0.43	0	1
High-track	0.69	0.46	0	1
Mixed	0.07	0.25	0	1
Grades				
Math (from 1=very poor to 4 = pass to 6=excellent)	4.82	0.68	3	6
Language (from 1=very poor to 4 = pass to 6=excellent)	4.91	0.55	3	6

Note: Summary statistics of student background characteristics and outcome variables. Number of observations: 2 479. Number of observations for Math-intensity of chosen track: 949 (VE track) and 880 (GE track). Math-intensity of the VE track is calculated by the math skill requirement of an occupation divided by the sum of all skills required for an occupation (times 100) using information from expert ratings (see Section 3). Number of observations for Passed first year of upper-secondary school: 2,057.

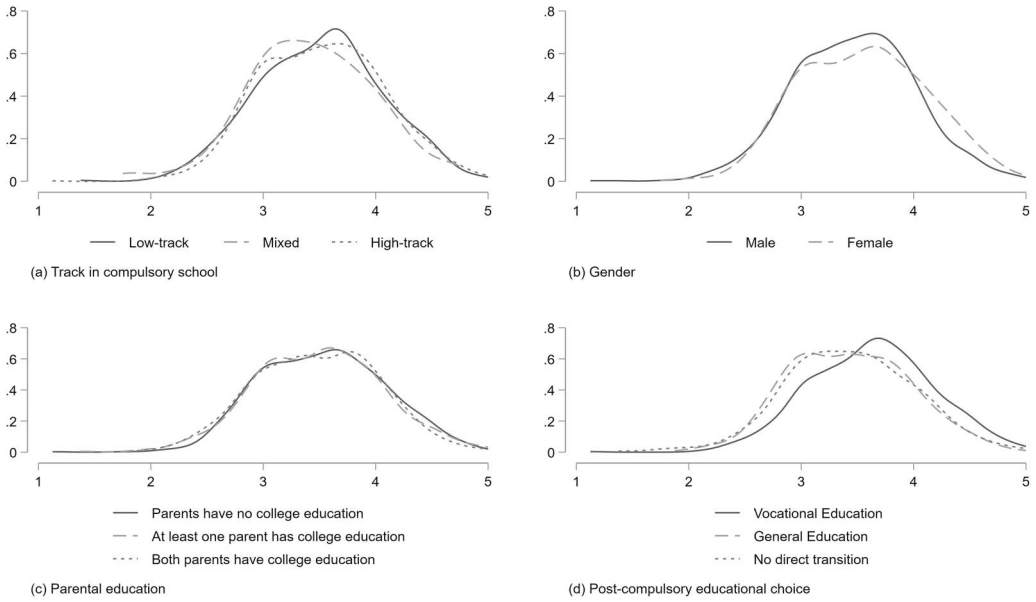


Figure 1. Distributions of students' grit scores by selected variables.

Note: Figure shows kernel density estimates of students' grit score distributions by selected variables (see note below each figure).

We include several control variables in our analysis. These control variables are gender, age, located in an urban area, language region, foreign born, language spoken at home, parental education, track in the last year of compulsory school, and students' grades in math and language. Summary statistics of the variables used in this paper are shown in [Table 1](#).

[Figure 1](#) illustrates differences in students' grit scores across selected background variables. The upper-left panel presents kernel density estimates of grit scores by school track in the final year of compulsory education. The distributions for students in the low- and high-track appear relatively similar, whereas students in the mixed-track tend to have lower grit scores. The upper-right panel of [Figure 1](#) shows that female students are slightly more frequently found in the upper range of the grit score distribution compared to male students. Interestingly, as seen in the lower-left panel, there is little difference in grit scores across students from different family backgrounds, measured by parental education.

4. Empirical strategy

To determine the effect of grit on students' educational choices and trajectories, we estimate the following model:

$$y_i = \alpha + \beta_0 \times Grit_i + \beta_1^T \times \mathbf{x}_{1i} + \beta_2^T \times \mathbf{x}_{2i} + \epsilon_i \quad (1)$$

where y_i is the education outcome of student i , which is either the educational track at upper secondary school, the math-intensity of the educational program in vocational and general education or dropout during the first year of upper secondary school. $Grit_i$ denotes student i 's grit score, $\mathbf{x}_{1i}$ denotes an $N_1 \times 1$ matrix of student-specific background characteristics (gender, age, located in urban area, language region, foreign born, language spoken at home, parental education), and $\mathbf{x}_{2i}$ denotes an $N_2 \times 1$ matrix of student-specific cognitive skill measures (grades in mathematics and language as well as track in lower secondary school).

The key parameter of interest, β_0 , is identified through variation of students' grit score across students in the sample. Hence, we assume that, conditional on the other variables included in our

model, there are no other factors that are correlated with students' grit and the outcome variable in Equation 1 (selection on observables). While this assumption cannot be tested, it should be noted that we control for a rich set of student background characteristics, such as gender, age, and parental education, that are likely correlated with students' grit as well as students' educational choices and trajectories. Moreover, we provide a bounding exercise following Oster (2019) to assess the extent to which selection on unobservables is driving our results.

Additionally, as students' character and cognitive skills have been shown to be correlated (see, e.g. Bowles, Gintis, and Osborne 2001), we also add measures of cognitive skills to our estimation equation. However, control variables that are outcomes of students' grit can induce additional bias to our estimate of β_{00} (see, e.g. Cinelli, Forney, and Pearl 2022). Again, this assumption cannot be tested, but as previous literature suggests that non-cognitive skills might indeed have the potential to foster the promotion of cognitive skills (Cunha and Heckman 2008), bias due to the inclusion of cognitive skill measures might be a concern in our setting. To assess such a potential bias, we report our baseline results both with and without the inclusion of the cognitive skill measures.

5. Results

5.1. Post-compulsory educational choices

Table 2 reports estimates of Equation 1, using students' post-compulsory educational track as outcome variable. We model the probability of selecting into a particular post-compulsory school track based on a multinomial probit model. Each column presents estimates for an outcome variable that distinguishes between vocational education, general education, and no transition to post-compulsory education. Columns 1–2 of Table 2 report estimated average marginal effects of students' overall grit score, column 3 reports estimated average marginal effects of students' grit subcomponent consistency of interest (CI), and column 4 reports estimated average marginal effects of students' grit subcomponent perseverance of effort (PE).

Table 2 provides clear evidence that students' grit in the last year of compulsory school is associated with their subsequent educational choices. Estimates in column 1, which exclude cognitive skill measures, indicate that a one-point increase in students' grit score – roughly equivalent to a two-standard-deviation increase – raises the probability of selecting vocational education by 8.7 percentage points (or 21% relative to the sample mean of 0.42). This increase is offset by an equivalent decline in the likelihood of choosing general education or forgoing post-compulsory education.

Table 2. Grit and students' post-compulsory educational choices.

	Grit score		CI	PE
	(1)	(2)	(3)	(4)
<i>Dependent variable: Educational choice</i>				
Vocational education	0.087*** (0.020)	0.097*** (0.020)	0.020 (0.014)	0.121*** (0.017)
General education	−0.042** (0.018)	−0.074*** (0.017)	−0.010 (0.012)	−0.100*** (0.014)
No transition	−0.045*** (0.16)	−0.023 (0.015)	−0.009 (0.010)	−0.021 (0.013)
Controls 1	Yes	Yes	Yes	Yes
Controls 2	No	Yes	Yes	Yes
Observations	2,479	2,479	2,479	2,479

Note: Results of multinomial probit regressions (marginal effects) using as dependent variable an indicator variable indicating if a student entered a vocational education, general education, or no track immediately after compulsory school on students' grit score (values 1–5, columns 1–2), consistency of interest (CI, values 1–5, column 3), and perseverance of effort (PE, values 1–5, column 4). Sample consists of students in the last year of compulsory school. Control variables: gender, age, located in urban area, language region, foreign born, language spoken at home, parental education (controls 1), track in compulsory school, math and language grade (controls 2). Heteroskedasticity-consistent standard errors reported in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In column 2, we control for cognitive skills, which strengthens the estimated association between grit and vocational education. However, unlike in column 1, this increase primarily reflects a shift from general to vocational education. Since it is difficult to determine whether cognitive skill measures are endogenous to grit, potential bias in our estimates of β_0 cannot be ruled out. Nonetheless, as our estimates remain directionally stable, concerns about ‘bad controls’ (Angrist and Pischke 2009) appear minimal. A robustness check confirms that omitting cognitive skill measures does not qualitatively alter our conclusions.³

To assess the potential impact of selection on unobservables, we conduct a bounding exercise following Oster (2019). As detailed in Appendix Section A, our analysis suggests that selection on unobservables would need to be 2.6 times stronger than selection on observables for our estimates to be nullified. Even under the assumption that selection on unobservables matches selection on observables, a one-point increase in grit still raises the probability of selecting vocational education by 7.2 percentage points.

Columns 3–4 of Table 2 further decompose grit into its subcomponents. The results reveal that the effect of grit on post-compulsory education is driven entirely by perseverance of effort (PE) rather than consistency of interest (CI). While CI – reflecting passion – shows no significant association with educational choices, PE – reflecting hard work – explains the observed correlation between grit and vocational education. This finding aligns with the highly competitive selection process in Switzerland’s dual vocational education system, where effort could be more critical than passion.

Finally, we examine whether the effect of grit on educational choices varies by parental education. Figure 2 presents average marginal effects of students’ grit on post-compulsory educational choices by parental education (no college education, at least one parent with college education, both parents with college education).⁴ The results suggest that parental education moderates to some extent the effect of grit. The estimated effect of grit on vocational education is highest for

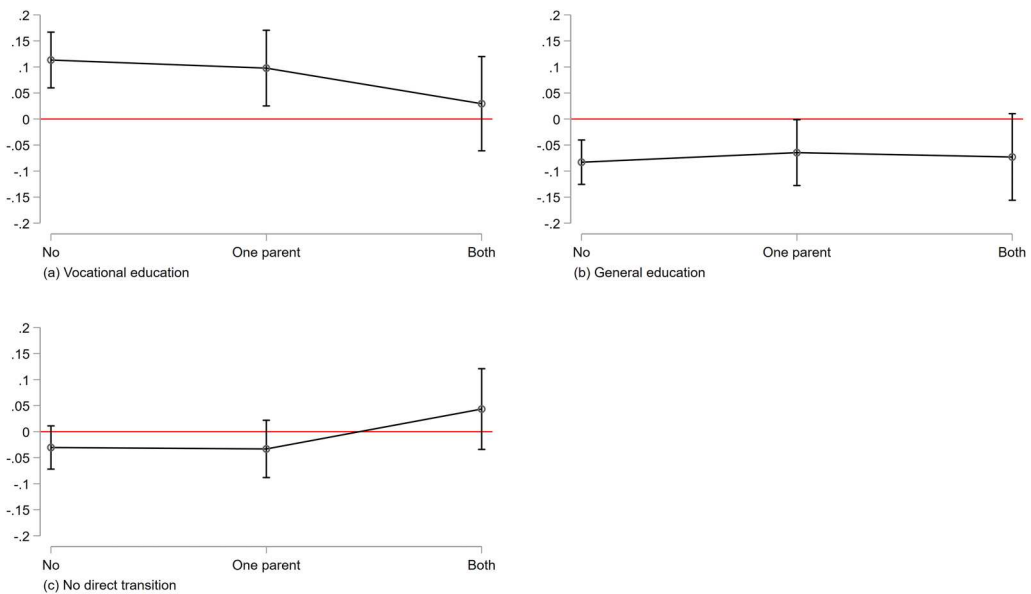


Figure 2. Grit and students’ post-compulsory educational choices.

Note: Figure shows estimates of the average marginal effect of student’s grit score on student’s post-compulsory educational choices (see note below each figure) by parental education (no college education, at least one parent has college education, both parents have college education). Estimates are derived from a multinomial probit regression based on an updated version of Equation 1, where *Grit_i* is interacted with parental education. Control variables: gender, age, located in urban area, language region, foreign born, language spoken at home, parental education, track in compulsory school, math and language grades. Vertical lines represent 95% confidence intervals, calculated using heteroskedasticity-consistent standard errors.

students whose parents have no college education (0.113) and lowest for those whose both parents have college education (0.029). While baseline differences partly account for the varying absolute effect sizes – 58.16% of students whose parents have no college education choose vocational education compared to 22.52% of students whose parents both have college education – grit remains also in relative terms to be more strongly associated with post-compulsory vocational education among students from more disadvantaged family backgrounds.

5.2. Math-intensity of study choices

Building on our finding that grit positively influences the choice of vocational education over general education, we now turn to the role of grit in selecting into math-intensive study programs. We expect that such programs are typically chosen by students who perceive themselves as relatively strong in mathematics – a subject that demands sustained effort and engagement (DiNapoli 2023). Hence, grit may help students persist through the challenges posed by mathematics and might be associated with selecting into math-intensive study programs.

Table 3 presents estimates of the relationship between students' grit and the math-intensity of their chosen post-compulsory education track. Columns 1–3 show least squares estimates for the restricted sample of vocational education students using the official expert rating of cognitive requirements of vocational education programs for the subject math as an outcome variable. Columns 4–6 show average marginal effects of probit estimates for the restricted sample of baccalaureate school students using a binary variable indicating whether a student chooses a math-intensive major as the outcome variable.

Table 3 makes clear that there is a significant association between students' grit and the math intensity of the educational track. Column 1 of 3 shows that a one-unit increase in students' grit score increases the expert rating of the math content of the vocational training occupation by 2.131 (or 4.4% relative to the sample mean of 48.06).⁵ Interestingly, as shown in columns 2–3, the correlation between grit and math-intensity is driven by consistency of interest rather than perseverance of effort. We find a qualitatively similar result for students selecting into a baccalaureate school, where a one-unit increase in student grit score increases the likelihood to choose a math-intensive major by 9.1 percentage points (or 19.1% relative to the sample mean of 47.6%). However, here both grit subcomponents appear to be equally important.

Our results indicate a strong association between grit and the likelihood of selecting a math-intensive educational track. However, unlike competitiveness, grit does not account for gender

Table 3. Grit and math-intensity of study choice.

	Math requirement in VE			Math-intensive major in GE		
	(1)	(2)	(3)	(4)	(5)	(6)
Grit score	2.131** (1.033)			0.091** (0.037)		
Consistency of interest		2.172*** (0.716)			0.051** (0.026)	
Perseverance of effort			−0.391 (0.959)			0.066** (0.032)
Controls 1	Yes	Yes	Yes	Yes	Yes	Yes
Controls 2	Yes	Yes	Yes	Yes	Yes	Yes
Observations	949	949	949	880	880	880

Note: Results of ordinary least squares regressions using as dependent variable the math requirement of a vocational education (VE) student's training occupation (values 0–100, columns 1–3) or results of probit regressions (marginal effects) using as dependent variable a binary variable indicating if a general education (GE) student selected a math-intensive major (columns 4–6) on students' overall grit score (values 1–5, columns 1 and 4), consistency of interest (values 1–5, columns 2 and 5), or perseverance of effort (values 1–5, columns 3 and 6). Sample consists of students who entered the vocational education track (columns 1–3) or baccalaureate school of the general education track (columns 4–6). Control variables: gender, age, located in urban area, language region, foreign born, language spoken at home, parental education (controls 1), track in compulsory school, math

Table 4. Grit and the math-intensity of study choice, gender gap.

	Math requirement in VE		Math-intensive major in GE	
	(1)	(2)	(3)	(4)
Female	−14.998*** (1.067)	−15.226*** (1.071)	−0.234*** (0.037)	−0.238*** (0.037)
Grit		2.131** (1.033)		0.091** (0.037)
Controls 1	Yes	Yes	Yes	Yes
Controls 2	Yes	Yes	Yes	Yes
Observation	949	949	880	880

Note: Results of ordinary least squares regressions using as dependent variable the math requirement of a vocational education (VE) student's training occupation (values 0-100, columns 1-2) or results of probit regressions (marginal effects) using as dependent variable a binary variable indicating if a general education (GE) student selected a math-intensive major (columns 3-4) on students' gender (binary) and students' overall grit score (values 1-5). Sample consists of students who entered the vocational education track (columns 1-2) or baccalaureate school of the general education track (columns 3-4). Control variables: gender, age, located in urban area, language region, foreign born, language spoken at home, parental education (controls 1), track in compulsory school, math and language grade (controls 2). Heteroskedasticity-consistent standard errors reported in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

differences in these choices. Table 4 shows that the gender gap in math-intensive study choices remains substantial even after adjusting for grit. This aligns with our finding that men and women in our sample do only slightly differ in their grit score distribution (see Section 3). In contrast, previous studies suggest that differences in competitiveness contribute to gender disparities in math-intensive programs (see Buser, Peter, and Wolter 2017).

While both grit and competitiveness predict higher engagement in math-intensive fields, our findings suggest that they capture distinct personality traits. Competitiveness has been linked to a preference for general education among specific subgroups (e.g. women with average academic performance) but shows no strong correlation with overall post-compulsory track choices (see Buser, Peter, and Wolter 2022). In contrast, grit is consistently associated with a higher likelihood of selecting vocational education for both gender.⁶

Prior research further supports this distinction. Buser and Oosterbeek (2023) show only a weak correlation between grit and competitiveness, with a significant relationship emerging only for the 'challenge-seeking' sub-dimension of competitiveness. This suggests that while both traits may reflect persistence, they operate through different psychological mechanisms and should be considered separately when analysing educational choices.

5.3. Early attrition in post-compulsory education

Finally, we assess whether grit is associated with students' likelihood to drop out of their study program. We would expect that grittier students may be more willing to endure short-term costs in pursuit of long-term benefits, reducing the likelihood of dropout.

Table 5 presents estimates of the likelihood that students discontinue their initially chosen post-compulsory education program after the first year. We report these estimates for the entire sample of

Table 5. Grit and the probability to continue the initial post-compulsory education.

	Any program (1)	VE program (2)	GE program (3)
Grit score	0.005 (0.017)	0.008 (0.023)	−0.012 (0.023)
Controls 1	Yes	Yes	Yes
Controls 2	Yes	Yes	Yes
Observations	2,057	1,014	1,043

Note: Results of probit regressions (marginal effects) using as dependent variable a binary variable indicating if a student continues his or her initial educational program after one year after compulsory school on students' overall grit score (values 1-5). Sample consists of students who either entered the general education (GE) or vocational education (VE) track (column 1), vocational education track (column 2), or general education track (column 3). Control variables: gender, age, located in urban area, language region, foreign born, language spoken at home, parental education (controls 1), track in compulsory school, math and language grade (controls 2). Heteroskedasticity-consistent standard errors reported in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

students who continue their education in upper-secondary school (column 1) and restricted samples by type of education (vocational education and general education, columns 2–3).

Our estimates indicate that grit is not significantly associated with early dropout risk. Even after accounting for cognitive skills and other background characteristics, the estimated coefficients remain close to zero and statistically insignificant. This suggests that grit does not strongly influence short-term drop-out rates in post-compulsory education programs. However, dropout rates in post-compulsory education in Switzerland are very low, which could contribute to the imprecise null effects. Moreover, due to data limitations, our analysis focuses on one-year dropout rates, and the association between grit and two- or three-year dropout rates might differ substantially.

6. Conclusion

In this paper, we investigate whether individual differences in the personality trait ‘grit’ are associated with different educational trajectories. We can draw on a large national sample of adolescents whose grit was assessed before the end of compulsory schooling. By being able to link this measure and other information on these young people with the administrative data from the national education statistics, we can observe the decisions of the young people and their progression in the first post-compulsory school year without any attrition of data.

The results show that grit correlates strongly – with large effect sizes – with the choice of a vocational program as opposed to a general education program, and that in both types of education systems, individuals with higher grit are more likely to be found in math-intensive occupations or education programs. While this second finding reflects a pattern that can also be found for individuals with a higher propensity to compete, we conclude that these are two different personality traits, as the gender gap in the choice of math-intensive programs can be partially explained by the measure of competitiveness, but not by individual differences in grit.

However, the analyses in which the two dimensions of grit, consistency of interest and perseverance, are considered individually show that the overall measure of grit is not always the best specification of the personality trait. The selection of vocational training vs. general education only correlates with the grit component of perseverance, and while the correlation of mathematics-intensive programs in general education correlates with both dimensions of grit, this is only the case for the dimension of consistency of interest in mathematics-intensive occupations.

Grit may therefore be a measure of personality traits that provides additional insight into the preferences and educational choices of individuals, but it is not always clear from the outset whether the composite measure of grit is the best description of these personality traits. Finally, in contrast to other studies, we find no correlation between educational success and grit, at least in the short term, but in an education system in which young people are selected or select themselves into very different types of education at an early age. This may therefore also have to do with the fact that this selection is already very strongly influenced by differences in grit. In very homogeneous education systems, on the other hand, where the same or at least very similar demands are placed on young people, it is quite conceivable that success and failure correlate more with individual differences in grit.

Notes

1. The grit measure was piloted in the previous year of the survey, using the August wave. Since there are legitimate concerns that the individual grit is malleable and can change over time (see Hoeschler, Balestra, and Backes-Gellner 2018), it is possible that the measure is not stable during the transition from compulsory to post-compulsory education. Additionally, the 2020 student cohort may be unique due to experiences during the COVID-19 pandemic—although current evidence does not suggest major structural changes in the transition to post-compulsory education for this cohort (Goller and Wolter 2021). However, we do not find any statistically significant differences between the measurement times, nor do we find any differences between groups of people with higher or lower grit levels between the two survey times.

2. See: <https://www.anforderungsprofile.ch>. This website is administrated by the Swiss Trade Association and the Swiss Conference of Cantonal Ministers of Education and partially financed by the Swiss Secretariat for Education, Research, and Innovation.
3. We replicated all estimations without cognitive skill measures, and the interpretation of our results remains consistent.
4. Estimates are derived from a multinomial probit regression based on an updated version of Equation 1, where *Grit*_{*i*} is interacted with parental education.
5. Summary statistics of the variables used in our study are reported in Table 1.
6. Estimation results are available upon request.

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No potential conflict of interest was reported by the authors.

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Appendix: Bounding exercise

We conduct a bounding exercise following Oster (2019) to assess the extent of selection bias due to unobservables required to drive our estimates to zero. Since Oster bounds cannot be directly estimated for multinomial probit or logit models, we transform our model from Equation 1 into three linear probability models using each discrete outcome as a binary outcome variable: (a) selecting vocational education, (b) selecting general education, or (c) not transitioning directly to upper secondary school. Each specification uses the same set of explanatory variables as shown in Equation 1 of the paper.

We implement the Oster procedure by first estimating the degree of selection explained by our full set of controls. We then compute δ , the ratio of selection on unobservables to selection on observables, required to reduce our estimates to zero ($\beta_0 = 0$) at a given R^2 . Following Oster (2019), we set $R^2 = 1.3 \times R^2$ where R^2 is the R^2 from the baseline estimation using the full set of control variables. We also calculating β_0^* , a lower-bound estimate of our effects, assuming $R_{max}^2 = 1.3 \times R^2$ and setting $\delta = 1$, meaning selection on unobservables equals selection on observables..

The results of this analysis are shown in Table A1. Column 1 shows our estimates of β_0 , when we estimate Equation 1 separately for each outcome in a linear probability model. As these estimates closely align with those from our main specification (Table 2, Column 2), we are confident that the bounds derived from the linear probability model are also informative for the multinomial probit model used in our paper. Column 2 reports the R^2 for each linear probability model and column 3 reports R_2 calculated in accordance to Oster (2019). Column 4 presents our estimates for δ , the ratio of selection on unobservables to selection on observables, required to reduce our estimates to zero. Finally, column 5 reports β^* , the lower-bound estimate under the assumption that $\delta = 1$.

The first row of Table A1 suggests that selection on unobservables would need to be 2.648 times stronger than selection on observables for our estimated effect of grit on selecting into vocational education to be nullified. Assuming

selection on unobservables is equal in magnitude to selection on observables, the same row shows that a one-point increase in a student's grit score raises the probability of selecting vocational education by 7.2 percentage points.

Table A1. Testing for sensitivity to selection on unobservables.

Outcome	β_0	R^2	R^2_{max}	δ	β_0^*
Vocational education	0.099	0.222	0.289	2.648	0.072
General education	-0.077	0.352	0.457	3.416	-0.061
No direct transition	-0.022	0.149	0.194	2.101	-0.013

Note: Column 1 shows our estimates of β_1 when we estimate Equation 1 separately for each outcome (vocational education, general education, no direct transition) in a linear probability model. Column 2 reports R^2 from these models. Column 3 reports the R^2_{max} used to calculate Oster bounds which is $1.3 \times R^2$ as suggested in Oster2019. Column 4 reports δ , the magnitude of selection on unobservables relative to selection on observables required for a true treatment effect of 0. Column 5 reports β under the assumption that selection on unobservables equals selection on observables. The first row of the table indicates that selection on unobservables would need to be 2.648 times stronger than selection on observables for our estimated effect of grit on selecting into vocational education to be nullified. Assuming selection on unobservables is equal in magnitude to selection on observables, the same row shows that a one-point increase in a student's grit score raises the probability of selecting vocational education by 7.2 percentage points.