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Are boys that bad? Gender gaps in measured skills, grades and aspirations in Czech elementary schools

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This article examines gender gaps in academic performance (grades in mathematics and reading) between boys and girls of ninth-grade elementary schools in the Czech Republic. Our analysis is based on 2003 data from the Programme for International Student Assessment, encompassing the academic performance and family background of ninth-grade pupils. Similar to research on other countries, we find that girls strongly outperform boys in grades in Czech language, but that this gender gap is not explained by measured ability in reading nor on family background or student attributes. We also find gender bias in mathematics grades, after controlling for measured ability and other factors. Girls are also substantially more likely than boys to apply to secondary grammar schools, as well as aspire to a college education, even after controlling for measured ability. We put forward a number of theoretical perspectives that shed light on the possible causes of these empirical findings.

Keywords: gender gaps; gender inequality; educational inequality; academic achievement; educational aspirations; Czech Republic

Introduction

Understanding the factors that shape gender gaps[1] in education can be a critical tool for achieving a variety of policy goals. Gender inequalities in education, as well as inadequate measures to solve such inequalities, can contribute to the reproduction of gender gaps in labour-market outcomes (Mechtenberg 2009) and also impact economic growth by increasing employment gaps and lowering the average quality of human capital (Klasen 2002; Klasen and Lamanna 2009). The post-World War II rise in women's educational attainment to match, and sometimes exceed, that of men has had profound consequences for both the labour market and the balance between work and family life. The trend that women outnumber

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men among college graduates in many industrialized societies has also been associated with increasing total returns to education for women in comparison with men (DiPrete and Buchmann 2006).

One of the fundamental questions of sociological research on gender gaps in education is whether teacher evaluations of student performance are biased in favour of boys or girls for different subjects. Teacher evaluations are subjective and often prone to many forms of stereotyping, and thus can be inaccurate measures of student achievement (Hoge and Coladarci 1989). Teachers' gender stereotypes – such as that boys excel in mathematics and science but girls excel in other topics – are often believed to impact on their evaluations of pupils' academic performance (Bernard 1979; American Association of University Women 1992; Tiedemann 2000). Those stereotypes, combined with reports that teachers provide more attention and feedback to boys than girls (Sadker and Sadker 1994), strengthened the view that girls are systematically disadvantaged in many school systems.

However, a large body of cross-national evidence has shown that there has been a reversal of the trend from a male to female advantage in many areas of educational performance and attainment (for an overview, see Buchmann, DiPrete, and McDaniel 2008). While the stereotype that girls are poor at mathematics might be used to steer them into non-technical careers, this may no longer be true: in many OECD countries, there is no statistical difference in mathematics performance between boys and girls, whereas girls continue to outperform boys by large margins in reading (OECD 2011). These trends have given rise to a sometimes-fierce debate – dubbed 'gender wars' – about whether previous research on girls' disadvantage in education was itself gender biased (Sommers 1994).

In light of the importance of gender gaps in education, this article seeks to measure those gaps in the Czech Republic in several key ways. First, we seek to measure gender bias in grading by analysing the effect of the pupil's sex, while controlling for family background, measured ability in the Programme for International Student Assessment (PISA) assessment and other factors on teacher evaluations of student performance in the ninth grade. Because attempts to measure achievement gaps based on percentage point differences in educational indicators between groups are marginally sensitive to scaling (Gorard 2000), we focus instead on the relative size of gender gaps measured in terms of the odds ratios that contrast boys and girls in the attainment of a particular educational threshold. Our logistic regression models also control for the effect of family socio-economic background, student characteristics and other variables in the measurement of gender gaps.

This article also contributes to the literature on the role of educational system stratification on gender gaps. In the Czech Republic, pupils apply freely to secondary schools through school specific admission processes, which are highly competitive. There are three main types of secondary

schools: three-year secondary vocational education schools, where girls constitute one-third of the school population; four-year technical schools, which have even attendance rates by sex; and four-year, six-year and eight-year grammar schools (*gymnasia*), where girls now constitute over 60% of the school population. Czech pupils choose between these tracks depending on their own perceived study aptitudes, their perceived admission probabilities in local schools, and their own aspirations. Many of those who apply to grammar schools devote a great deal of time for the preparation, such as through private tutoring courses. Some grammar schools use their own admission tests, while others require applicants to pass commercially provided tests. The grammar schools are by far the most prestigious and competitive to enter, as they provide the greatest access to tertiary education: in 2011, 95% of grammar school students enrolled in tertiary education, while only 50% of graduates of technical schools succeeded in doing so. By contrast, vocational schools do not typically terminate with a school-leaving examination, making further education difficult.

Given that the Czech secondary educational system is highly stratified, we also examine sex group differences in both applications to grammar schools and aspirations to attend college. The analysis builds on previous research on gender gaps in educational aspirations in the Czech Republic (Potužníková and Straková 2006; Matějů and Smith 2009) and the role of the educational system in shaping educational inequalities (Matějů and Straková 2005; Straková 2007, 2010).

We would like to stress that our analysis is not causal, but descriptive: we seek to clearly measure the degree and nature of the gender gaps in question, a task that has not been sufficiently carried out in past research. It is not causal because our data are unable to take into account the mechanisms through which gender identities and attitudes, normative expectations, school culture and other factors that drive the gender gaps in educational achievement we observe are affected. PISA data enable us to take into account student and family characteristics that are very much shaped by gender, but data on the gender attitudes of teachers, for example, are unfortunately not available. In the conclusion, we elaborate on a number of theories that may explain these gaps, although a thorough investigation will have to be left for future research.

Gender gaps in academic achievement

Cross-national and country-specific research on gender gaps has identified a number of mechanisms behind gender gaps in education that may be present in the Czech context. Studies have found that the academic achievement of girls not only meets, but often surpasses, that of boys, with the gender gap in achievement emerging at a very early age (Mickelson 1989). In reading, girls have more advanced skills as early as kindergarten (Tach and Farkas

2006), and five-year-old to seven-year-old boys are more likely than girls to have learning disabilities, which contributes to antisocial behaviour and other problems later in life (Trzesniewski et al. 2006). Across OECD countries, boys outperform girls by an average of 12 points in the PISA test in mathematics, compared with the 39-point gap in favour of girls in reading performance (OECD 2009). In many countries, differences in mathematics performance are not statistically different between boys and girls; by contrast, girls have higher reading proficiency than boys in every PISA country, with the largest gaps among pupils in the lowest achievement brackets. Gender gaps in academic achievement continue throughout the academic career, and are not shaped by differences in curriculum between boys and girls (Leonard and Jiang 1999; Diprete and Buchmann 2006). While not without controversy, the great majority of research on gender gaps in educational achievement indicates that female underachievement no longer applies.

Nonetheless, a controversial debate on whether teachers systematically favour one sex over another has continued for a number of decades. In 1992, the American Association of University Women published a report entitled *How Schools Shortchange Girls*, which argued that girls have fallen behind their male classmates in important areas such as mathematics, and that boys receive substantially more attention from teachers than girls (American Association of University Women 1992). Key claims in that report were based on observations later published by Sadker and Sadker (1994); however, evidence indicating male advantage in the latter study have 'mysteriously disappeared' (Kleinfeld 1999) and are thus unverifiable. Indeed, some of the older studies in the United States indicating male advantage may have been politically biased (Sommers 1994), with the implication that the needs of underperforming children, particularly African-American boys, are being insufficiently addressed.

Even if teachers give boys or girls more attention in the classroom, research suggests that much of that attention is negative and disciplinary (Bossert 1981; Kleinfeld 1999), in part due to their greater propensity to have attention-deficit disorders. In a 1999 British study, teachers acknowledged that:

> the noise level of the boys, their off-task activities, their poor behaviour pattern and apparent limited attention span, inevitably attracted more attention. Boys were perceived as more disruptive, more disinterested, but also in need of more prompting, in need of more support for learning. (Younger, Warrington, and Williams 1999, 329)

Those authors also found that boys are more active than girls in some classroom discussions, but that girls were more involved in individual teacher–student interactions that were much more conducive to learning.

Given the role of teachers in academic achievement, research has also focused on whether the teacher's sex also plays a role. The studies have mixed results. Analysing 10th-grade pupils participating in the 1988 National Education Longitudinal Study, Ehrenberg, Goldhaber, and Brewer (1995) found that a teacher's sex had no significant relation to the academic achievement of either girls or boys. However, using the same study, Dee (2006) found that having teachers of the same sex has strong effects (for both boys and girls) on both test scores and teacher perceptions of student performance. Research using the National Longitudinal Survey of Youth (Nixon and Robinson 1999) found that the proportion of female teachers at high schools was positively correlated to higher educational achievement among girls. However in Germany, Neugebauer, Landmann, and Helbig (2011) found no systematic effect of the sex of a teacher on the performance of boys or girls in either standardized tests or school grades. To date, there has not been systematic research conducted on the role of teachers' sex on the academic performance of Czech boys and girls.

In addition to the role of teachers, gendered perceptions of school can also be pivotal. What matters is not only how different academic subjects are stereotyped as boys' or girls' domains, but also the feminization of school: 'the school setting itself is feminine rather than masculine, in the sense that behaviour congruent with the female gender role is expected and rewarded, while behaviour congruent with the male gender role is sanctioned' (Heyder and Kessels 2013, 608). Since boys are socialized to exhibit masculine characteristics of independence and assertiveness, and girls are socialized to exhibit traits of cooperativeness and orderliness, the school context itself can be perceived as valuing more the female stereotypes, which in turn can lead to negative school attitudes by boys or critical evaluations by teachers (Orr 2011). Indeed, Heyder and Kessels (2013) found that the more strongly boys associated school with female and the more they ascribed masculine traits to themselves, the lower their grades in language were, while boys' mathematics achievement as well as girls' language and mathematics achievement were unrelated to their gender stereotyping of school.

Gender gaps in educational performance can also be due to differences in family background and national context. In a new analysis of the 2009 PISA study (González de San Román and Rica Goiricelaya 2012), the authors found that girls perform better when their mothers work outside the home, but that the effect does not hold for boys, indicating significant intergenerational transmission of values from mothers to daughters. They also found that female outperformance in both mathematics and reading is positively influenced by gender equality at the national level. That is, 'in more gender-equal societies such as those of the Nordic countries girls become better in both maths and reading, thus narrowing the gender gap in maths and widening it in reading' (2012, 14). Those results confirm the findings of Hausmann, Tyson, and Zahidi (2011) and Guiso et al. (2008), which

found that the gender gap in mathematics scores in PISA 2003 disappears in countries with a more gender-equal culture.

Research on gender gaps in academic achievement and attainment in the Czech Republic has found that girls receive higher grades than boys in practically all measured subjects (Straková, Potužníková, and Tomášek 2006), despite sex differences in test scores. Vojtíšková (2011), in her qualitative comparison of school culture in two Prague schools, found that teachers' evaluations of pupils' achievement are strongly shaped by their assessments of pupils' behaviour and interactions within the classroom, as well as their assessments of pupils' motivation and effort. Girls also have a higher chance of attending grammar schools, which in turn are associated with greater performance on achievement tests and acceptance to college in comparison with other types of secondary school (Straková 2007, 2010; Šmídová, Janoušková, and Katrňák 2008). Similarly, girls also have a greater chance of both aspiring for and achieving college education than boys, even after controlling for measured ability and family background (Matějů and Smith 2009).

Hypotheses

If gender gaps in measured academic achievement are a result of sex-based differences in the characteristics of boys and girls, we can take into account some of those differences by utilizing the wealth of questions in the PISA survey. One common stereotype of sex group differences in education is that boys and girls have different degrees of self-efficacy (Bandura 1994), although this pattern is not universal (Worell 2002). Another possible gender difference is that boys are thought to have a stronger tendency to problematic, asocial behaviour than girls. Other stereotypes are that boys and girls make use of different learning strategies, and that there are gender differences in strategies of life success, with boys being much more risk-taking, for example. These gender stereotypes are very culturally or country specific, and thus our aim is to measure their relevance for the Czech context. If odds ratios in boy–girl achievement gaps are large even after accounting for gender differences among pupils, then we can assume that those gaps are the result of other unobservables, such as gender attitudes or bias on the part of teachers or other characteristics of pupils that we are unable to measure. Assuming that gender bias in education is real, for the purposes of our analysis we put forward the following hypotheses:

(1) First, we hypothesize that grades in Czech language (associated with PISA reading assessments) are significantly higher for girls than boys, even after controlling for measured reading skills, socio-economic and cultural background, and other characteristics of the pupil (e.g. self-efficacy, behavioural problems, etc.).

(2) Similarly, we hypothesize that grades in mathematics (associated with PISA mathematics assessments) are significantly higher for girls than boys, even after controlling for measured mathematics skills, socio-economic and cultural background, and other characteristics of the pupil.
(3) In line with previous research, we also hypothesize that girls have significantly greater chances of applying to a four-year grammar school, even after controlling for measured reading and mathematics skills, socio-economic and cultural background, grades in mathematics and Czech language, and other characteristics of the pupil.
(4) Lastly, we hypothesize that girls are more likely to aspire to a college education than boys, even after controlling for measured reading and mathematics skills, socio-economic and cultural background, grades in mathematics and Czech language, and other characteristics of the pupil.

In our conception of equal educational opportunity by sex, the role of the pupil's sex should have a statistically insignificant effect on the measured outcomes when taking into account PISA test scores in the relevant subject. That is, when the effect of sex is insignificant, then we can reasonably say that both boys and girls of equal ability also have equal opportunities to achieve the measured outcome. When the effect of sex is very large, then we can speak of unequal opportunities by sex (i.e. gender bias) in achieving the measured outcome.

In addition, we would like to address a potential criticism to our analytical approach. One may argue that PISA test scores are themselves gender biased, because boys perform better than girls on high-stakes tests that have important consequences for their future academic careers. Girls may face a performance anxiety when taking such tests because of a 'stereotype threat' that boys outperform girls on them (Spencer, Steele, and Quinn 1999). However, the PISA examination is not high-stakes, as it has no bearing on students' grades or other educational outcomes. To our knowledge, we know of no research that has demonstrated a gender bias in PISA tests. Quite to the contrary, cross-national research on gender gaps in educational achievement has been based precisely on the PISA tests (for example, Fuchs and Wossmann 2007; Fryer and Levitt 2009).

Data, variables and methods

The data used in this article come from the 2003 PISA survey carried out in the Czech Republic. Schools were selected randomly from the database of all schools attended by pupils born in the calendar year 1987; pupils were then selected randomly from within those schools. The sample was stratified according to the type of school. The survey included a year-based

sample of 6320 pupils born in 1987 (used for international analyses in PISA) comprised of both elementary school pupils as well as those already in secondary school. Since we want to analyse pupils about to make the transition to secondary school, we focus on the subsample of the international data file covering ninth-graders in elementary schools (2599 students; 1410 boys and 1189 girls).[2]

In our analyses we make use of standard PISA variables as well as variables available only in the Czech PISA data file. A brief description of variables can be found in Table 1. In the Czech PISA survey, pupils were asked to indicate the grades they typically receive in mathematics (variable

Table 1. Descriptions of variables used in the analysis.

Variable name	Description	Coding	Definition
MATHGRD	Grade in mathematics	1 (best) to 5 (worst)	n.a.
READGRD	Grade in Czech language	1 (best) to 5 (worst)	n.a.
EXMATH	Excellent grade in mathematics	1 (yes), 0 (no)	n.a.
EXREAD	Excellent grade in Czech language	1 (yes), 0 (no)	n.a.
GYMAPP	Application submitted to grammar school	1 (yes), 0 (no)	n.a.
COLASP	Plans to go on to college	1 (yes), 0 (no)	n.a.
READ	First plausible value in reading	PISA score (165–796)	n.a.
READ4	First plausible value in reading	Quartiles of READ	n.a.
MATH	First plausible value in mathematics	PISA score (221–786)	n.a.
MATH4	First plausible value in reading	Quartiles of MATH	n.a.
SELFEF	Value on self-efficacy scale	*z*-score	Appendix[a]
MATHAPP	Value on 'application oriented' mathematics-learning strategy scale	*z*-score	Appendix[a]
MATHLRN	Value on 'learning oriented' mathematics-learning strategy scale	*z*-score	Appendix[a]
STEDUC	Value on education and knowledge-based life-success strategy scale	*z*-score	Appendix[a]
STENTREP	Value on entrepreneurship-based life-success strategy scale	*z*-score	Appendix[a]
PROBL	Value on troubled behaviour scale	*z*-score	Appendix[a]
FEMALE		0 = male, 1 = female	n.a.

Note: [a]The appendix to this article is freely available from the authors upon request.

MATHGRD) and Czech language (READGRD), which were coded in the exact same manner as the national grading system (four-point scale, where 1 = excellent and 4 = poor). To examine grades as a dependent variable, we created dummy variables EXMATH (coded 1 if the pupil received excellent grades in mathematics, other grades coded as 0) and EXREAD (1 if the pupil received excellent grades in Czech language, other grades coded as 0). These dichotomous variables fit well with Czech academic culture, which places a strong emphasis on receiving the top grade.

Second, given that grammar school attendance is one of the strongest predictors of future transitions to tertiary education, we also make use of a question in the PISA survey on whether the pupil is applying or not to a grammar school from the ninth grade of elementary school (GYMAPP). College aspirations, even at the ninth grade, can be a strong predictor of future college attendance. We therefore also examine gender gaps in such aspirations (COLASP).

We code sex as 1= female, 0 = male (variable 'FEMALE'). We recognize the key difference between sex and gender: the variable FEMALE simply indicates the sex of the respondent, but does not provide information about the gendered attitudes and behaviours that pupils hold. To explain potential gaps and measure the net effects of sex, we controlled for relevant intervening variables discussed in the literature above. First, to take into account reading and mathematics abilities (READ, MATH), we used PISA assessment scores in reading and mathematics, which we also recode into quartiles (READ4, MATH4).[3] To control for the effect of stress and anxiety during testing, we include the international scale of self-efficacy (SELFEF). To be able to control for the effect of socio-economic and cultural background, we use the variable ESCS, which is the official OECD PISA measure of family socio-economic and cultural status. Since we expect that behavioural problems can potentially account for male underperformance in grades (or conversely, relatively female outperformance), we include a measure of the occurrence of problematic behaviour (variable PROBL).

Since sex group differences can be due to gendered attitudes and behaviours of pupils in school, we also take into account intervening variables associated with gender roles available in the dataset. We anticipate that different learning strategies in mathematics could explain gender gaps in grades in that subject, as well as future educational plans and aspirations (questions on learning strategies in reading were not provided in PISA 2003). The latent variables MATHAPP and MATHLRN capture different approaches to learning mathematics: the former measures learning mathematics with an emphasis on applications, while the latter measures learning mathematics with an emphasis on memorizing and practicing. Lastly, we assume that both grades and aspirations are affected by strategies of life-success, which are shaped by different gender expectations in society. To account for this, we constructed the variables STEDUC and STENTREP via

principal component analysis from a battery of questions assessing beliefs about life-success among adolescents. The former measures the belief in achieving success largely through education, language learning and ambition, while the latter captures the belief that personal and political connections, risk-taking and self-assertion are key to life success.

Table 2 depicts sex differences in the key explanatory variables used in the analysis. As can be observed, boys have significantly higher PISA scores than girls in mathematics, and girls score significantly better in reading. There is, however, larger variation in test scores among boys than among girls (standard deviations in mathematics for boys and girls are 89.4 and 85.1 respectively, while for reading it is 85.9 for boys and 81.4 for girls). Boys have a slightly higher degree of self-efficacy than girls, although this does not reach the level of statistical significance. Further, boys learn mathematics through applications and 'discovering' strategies more often than girls who, compared with boys, follow more traditional learning approaches (memorizing, practicing). As one would expect, boys admit to have problematic (asocial) behaviour more often than girls. Lastly, boys exhibit a stronger preference for life-success strategies based on entrepreneurial activities, risk-taking and using social networks (social capital), while girls tend to link life-success more to education, knowledge accumulation (cultural capital), honesty and obedience.

Table 3 also reports boy–girl differences in our dependent variables. As can be observed, girls more often receive higher grades in Czech language – 19.3% of girls receive excellent grades in Czech language, compared with only 6.6% of boys. In mathematics, girls also get higher grades than boys in mathematics (19.9% of girls get the highest grade in that subject, compared with only 14.3% of boys). There are also gender gaps in educational plans: only 14% of boys say that they were applying to a grammar school, compared with 22.6% of girls, while girls are only somewhat more likely to aspire to a college education.

Main results

As indicated above, Czech boys perform significantly better than girls in the mathematics PISA tests, while Czech girls perform significantly better in PISA reading competency (see Table 2 for distribution characteristics). This pattern is not unique across OECD countries. In seeking to understand gender gaps in educational performance, we sought to examine boy–girl differences in the relationship between academic performance in school grading (in which 1 = excellent, 4 = poor) and academic skills as measured by the PISA achievement test (broken down into quartiles, in which 1 = lowest quartile, 4 = top quartile). In principle, grades in Czech language should roughly correspond to measured aptitude in reading. The two panels of Figure 1 describe boy–girl differences in these two forms of academic

Table 2. Sex group differences in means of selected independent variables entering the analysis.[a]

Gender / parameter		MATH[b]	READ[b]	SELFEF	MATHLRN	MATHAPP	PROBL	STEDUC	STENTREP
MALE	Mean	504.1	456.5	0.027	−0.168	0.171	0.047	−0.122	0.241
	N	1410	1410	1349	1327	1327	1327	1324	1324
	SD	89.4	85.9	1.024	1.080	1.047	1.061	1.054	0.986
	SE	5.698	4.779	0.040	0.041	0.035	0.038	0.042	0.039
FEMALE	Mean	483.9	483.5	−0.032	0.195	−0.200	−0.055	0.142	−0.281
	N	1189	1189	1148	1133	1133	1133	1136	1136
	SD	85.1	81.4	0.969	0.856	0.901	0.921	0.912	0.942
	SE	5.179	4.772	0.041	0.034	0.029	0.032	0.033	0.035
TOTAL	Mean	495.2	469.1	−0.032	0.000	0.000	0.000	0.000	0.000
	N	2599	2599	2497	2460	2180	2194	2460	2460
	SD	88.1	84.9	1.000	1.000	1.000	1.000	1.000	1.000
	SE	4.944	4.159	0.041	0.029	0.024	0.029	0.028	0.028

Notes: [a]All estimations used PISA student final weight (w_fstuwt) as well as design (replicate) weights (w_fstr1 to w_fstr80); see PISA Data Analysis Manual (OECD 2005). SD, standard deviation; SE, standard error.
[b]Estimates of all parameters for performance scales MATH and READ were computed using SPSS macros handling plausible values; see PISA Data Analysis Manual (OECD 2005).

Table 3. Sex group differences in means of selected dependent variables entering the analysis (means of dummy variables).

Gender / parameter		EXMATH	EXREAD	GYMAPP	COLASP
MALE	Mean	0.143	0.066	0.140	0.373
	N	1370	1370	1410	1410
	SD	0.350	0.248	0.347	0.484
	SE	0.013	0.008	0.015	0.018
FEMALE	Mean	0.199	0.193	0.226	0.413
	N	1178	1177	1189	1189
	SD	0.399	0.395	0.418	0.493
	SE	0.018	0.016	0.019	0.025
TOTAL	Mean	0.169	0.125	0.179	0.392
	N	2548	2547	2599	2599
	SD	0.375	0.330	0.384	0.488
	SE	0.014	0.009	0.013	0.016

Note: All estimations used PISA student final weight (w_fstuwt) as well as design (replicate) weights (w_fstr1 to w_fstr80); see PISA Data Analysis Manual (OECD 2005). SD, standard deviation; SE, standard error.

performance. As can be observed, only 10% of the boys who are in the top quartile measured by PISA reading performance get the top grades in Czech language in school, while 29% of girls with the same measured ability get the top grade. Often, some of the best pupils as measured by PISA reading skills receive poor grades (Grades 3 and 4), with boys more likely to be in that situation than girls (43% and 24%, respectively). Our data therefore confirm the standard observation in studies of gender gaps in academic performance, in which boys tend to benefit from standardized testing whereas girls tend to benefit from traditional grading techniques (Duckworth and Seligman 2006).

We also analysed boy–girl differences in mathematics performance in the same manner as reading (Figure 2). The two panels of Figure 2 show that only 22% of the boys in the highest quartile in PISA mathematics performance received the highest mathematics grade in school, whereas 35% of girls of the same ability received that grade. Likewise, of the pupils who do the best in PISA mathematics performance, boys outnumber girls (35% to 23%) in receiving poor mathematics grades (Grades 3 and 4).

Substantial academic research has sought to determine whether gender gaps in grading and test scores are influenced or shaped by the socio-economic status of the pupil's family background, as well as how those gaps change throughout the pupil's academic career (Entwisle, Alexander, and Olson 2007; Penner and Paret 2007). Research has also found that girls' gender advantage in grading is linked to self-control and a range of non-cognitive skills (Farkas et al. 1990; Duckworth and Seligman 2006). In order to control for potentially relevant intervening variables, we included in the analyses

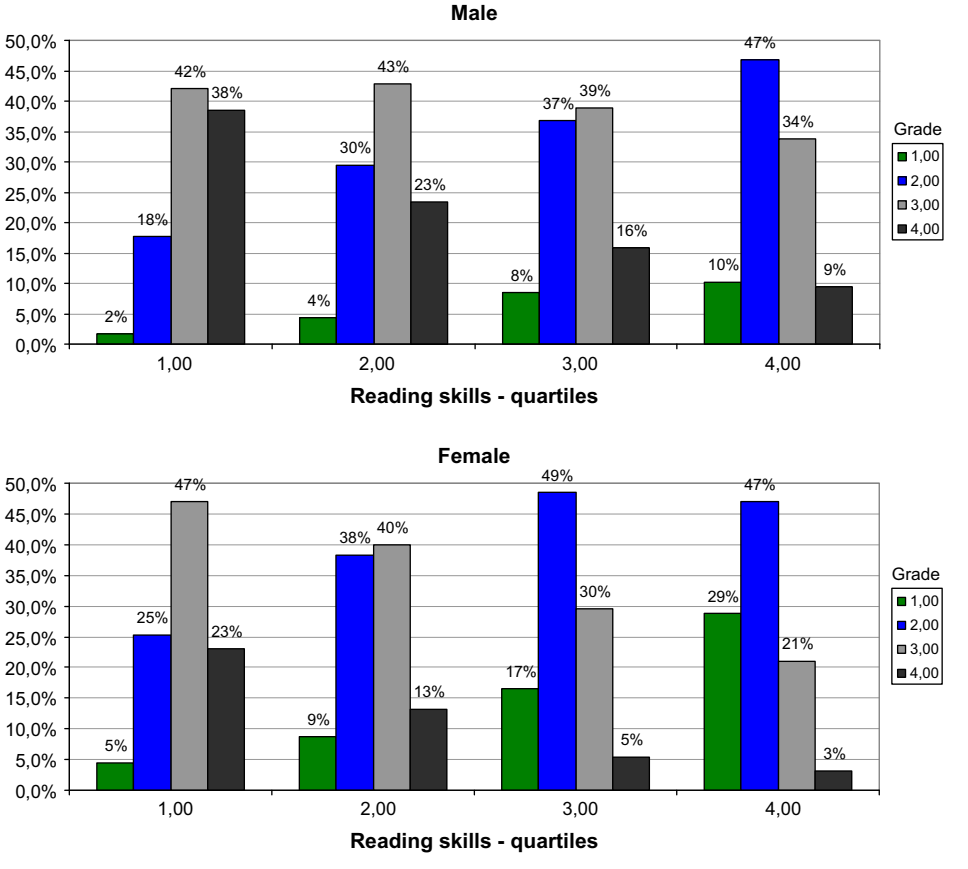

Figure 1. Grades in Czech language by sex and measured reading ability.

latent variables described above on self-efficiency, problematic behaviour and learning strategies (see Table 2).

We then examined gender bias in grading by running a series of logistic regressions on reading and mathematics grades by sex, measured ability, and ESCS.[4] Again, we used a dichotomous dependent variable of whether the pupil received the highest grade in mathematics or reading (= 1) or not (= 0). We report the results for the gender bias in mathematics grades in Table 4, and for Czech language in Table 5.

The logistic regression of whether a ninth-grader received the best grade in mathematics indicates that the effect of sex is very strong: girls have a 2.5 times greater chance than boys in getting the top grade even after taking into account the role of PISA mathematics performance and the socio-economic and cultural status of the background family. Additionally controlling for PISA reading performance (model 2) leads to a modest reduction in the effect of being female. Even after adding other relevant variables (model 3),

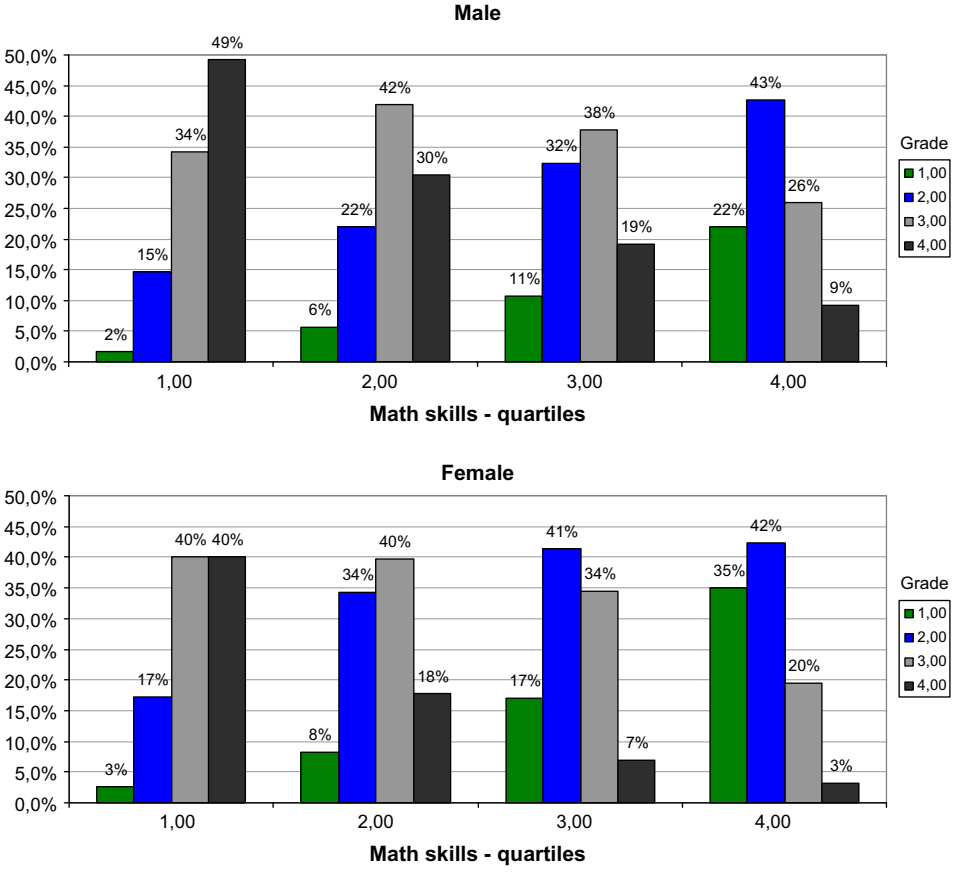

Figure 2. Mathematics grades by sex and PISA mathematics performance.

the log odds of getting an excellent grade in mathematics remain large, with girls having twice the chance of boys in getting the top grade.

It is worth noting that the net effect of socio-economic and cultural background (ECSC) on grading is not negligible and statistically significant, increasing the chance of getting the best grade in mathematics by factor 1.3. As predicted, the propensity to problematic behaviour (PROBL) also plays a significant role in grading. Its net effect (0.754) is highly significant. However, its inclusion in the model does not eliminate the existing gender gap. Both partially and fully standardized coefficients (last two columns of the table) allow us to compare the change in the strength of the effect of sex across models. There is a slight decrease of their values (from 0.167 in model 1 to 0.131 in model 3, 0.609 to 0.483 respectively), but they remain quite strong.

The logistic regression of whether a ninth-grader received the best grade in Czech language (Table 5) indicates that gender bias in Czech language

Table 4. Gender bias in mathematics grading.

	B	SE	Wald	Exp(B)	BStdXY	BStdY
Model 1 (–2LL = 1802.9, Nagelkerke RSQ = 0288, 81.8 % cases classified correctly)						
MATH	0.015	0.001	274.6	1.015***	0.486	0.010
Female	**0.904**	**0.124**	**53.1**	**2.469*** **	**0.167**	**0.609**
ECSC	0.362	0.082	19.6	1.436***	0.106	0.244
Constant	−10.205	0.527	375.3	0.000***	–	–
Model 2 (–2LL = 1676.4, Nagelkerke RSQ = 0299, 83.8 % cases classified correctly)						
MATH	0.014	0.001	129.5	1.014***	0.451	0.009
READ	0.002	0.001	3.5	1.002***	0.062	0.001
Female	**0.818**	**0.132**	**38.4**	**2.266*** **	**0.150**	**0.546**
ECSC	0.342	0.083	17.1	1.408***	0.099	0.228
Constant	−10.481	0.552	360.8	0.000***	–	–
Model 3 (–2LL = 1404.9, Nagelkerke RSQ = 0.304, 86.7 % cases classified correctly)						
MATH	0.012	0.001	92.8	1.013***	0.394	0.008
READ	0.003	0.001	4.4	1.003*	0.096	0.002
Female	**0.701**	**0.145**	**23.4**	**2.016*** **	**0.131**	**0.483**
ECSC	0.290	0.089	10.7	1.337***	0.086	0.200
MATHLRN	0.041	0.068	0.4	1.042	0.015	0.028
MATHAPP	0.126	0.066	3.7	1.134*	0.047	0.087
SELFEF	0.012	0.071	0.1	1.012	0.005	0.008
PROBL	−0.282	0.078	13.0	0.754***	−0.106	−0.194
STEDUC	0.112	0.074	2.3	1.119	0.042	0.077
STENTREP	−0.045	0.068	0.4	0.956	−0.017	−0.031
Constant	−9.951	0.604	271.7	0.000***	–	–

Notes: Dependent variable: EXMATH, excellent grade in mathematics. N = 2001 (listwise exclusion of cases with missing values). SE, standard error.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

grading is even stronger than it was in the case of mathematics. When we compare the results in model 2 of Table 3 with the results of model 3 in Table 5, we can observe that ninth-grade girls have a 2.3 times better chance of getting the top mathematics grade but have a 4.6 times better chance than boys in getting the better Czech language grade – even after controlling for PISA mathematics and reading performance and for ESCS. Similar to the model for excellence in mathematics, we also added the relevant controls, during which girls' chances of receiving an excellent grade in the Czech language remained 4.6 times higher than for boys. In this case both partially and fully standardized coefficients tend to grow between models 1 and 3, thus confirming the increasing advantage of girls.

Research on educational inequalities in Czech tertiary education has shown very strong effects of the role of the type of secondary school attended, with grammar schools by far providing the greatest chances of success. Descriptive statistics in Table 2 show that 23% of girls reported that they are applying to a grammar school, compared with only 14% of

Table 5. Gender bias in Czech language grading.

	B	SE	Wald	Exp(B)	BStdXY	BStdY
Model 1 (–2LL = 1555.5, Nagelkerke RSQ = 0.246, 86.7 % cases classified correctly)						
READ	0.012	0.001	143.5	1.012***	0.370	0.009
Female	**1.165**	**0.141**	**68.1**	**3.207***	**0.211**	**0.857**
ECSC	0.374	0.090	17.3	1.453***	0.107	0.275
Constant	−8.800	0.535	270.7	0.000***	–	–
Model 2 (–2LL = 1432.1, Nagelkerke RSQ = 0.267, 87.5 % cases classified correctly)						
READ	0.005	0.001	12.7	1.005***	0.148	0.003
MATH	0.010	0.001	59.9	1.011***	0.002	0.007
Female	**1.613**	**0.157**	**105.2**	**4.851***	**0.272**	**1.058**
ECSC	0.273	0.093	8.7	1.314***	0.073	0.179
Constant	−11.216	0.613	334.8	0.000***	–	–
Model 3 (–2LL = 1404.8, Nagelkerke RSQ = 0.286, 86.7 % cases classified correctly)						
READ	0.004	0.001	9.5	1.004**	0.119	0.003
MATH	0.010	0.001	49.5	1.010***	0.307	0.007
Female	**1.530**	**0.165**	**86.2**	**4.618***	**0.268**	**1.009**
ECSC	0.237	0.097	5.9	1.267**	0.066	0.156
SELFEF	0.102	0.079	1.6	1.107	0.036	0.067
PROBL	−0.270	0.087	9.6	0.763**	−0.095	−0.178
STEDUC	0.269	0.084	10.3	1.309***	0.095	0.177
STENTREP	0.079	0.074	1.1	1.082	0.028	0.052
Constant	−10.203	0.664	236.1	0.000***	–	–

Notes: Dependent variable: EXREAD, excellent grade in Czech language. $N = 2067$ (listwise exclusion of cases with missing values). SE, standard error.
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

boys. To gain a better sense of the role of gender behind those statistics, we ran a series of logistic regression models of the effect of being female on whether the respondent is applying to grammar school. The analysis included only ninth-graders of elementary schools. The models are depicted in Table 6. In model 1, girls have a 1.8 greater chance of applying to a grammar school compared with boys. Different models indicate that the effect of sex becomes even stronger after controlling for reading and mathematics performance. In model 2, the odds that girls apply to a grammar school compared with boys increases to 2.6 when mathematics and reading performance are controlled for. The advantage of girls remains the same even after adding to the model other relevant variables, such as self-efficacy, problematic behaviour, and learning strategies in model 3. The strength of the effect of being female is also confirmed by values of partially and fully standardized coefficients.

As can be observed in Table 6, the advantage of girls drops to the original level (1.8) when we add information about their grades in mathematics and the Czech language (EXMATH and EXREAD), although this should still be considered a quite large gender gap. In other words, among

Table 6. Role of gender in grammar school applications.

	B	SE	Wald	Exp(B)	BStdXY	BStdY
Model 1 (–2LL = 2213.5, Nagelkerke RSQ = 0.023, 80.0 % cases classified correctly)						
Female	**0.612**	**0.108**	**32.4**	**1.844*****	**0.158**	**2.089**
Constant	−1.753	0.080	475.7	0.173***	–	–
Model 2 (–2LL = 175.6, Nagelkerke RSQ = 0.307, 80.8 % cases classified correctly)						
Female	**0.943**	**0.133**	**50.3**	**2.569*****	**0.166**	**0.603**
MATH	0.012	0.001	104.6	1.012***	0.002	0.008
READ	0.006	0.001	22.4	1.006***	0.186	0.004
Constant	−11.217	0.567	391.3	0.000***	–	–
Model 3 (–2LL = 1603.8, Nagelkerke RSQ = 0.391, 80.8 % cases classified correctly)						
Female	**1.007**	**0.146**	**47.8**	**2.737*****	**0.173**	**0.557**
MATH	0.010	0.001	65.4	1.010***	0.293	0.006
READ	0.005	0.001	12.6	1.005***	0.151	0.003
ECSC	0.976	0.092	112.8	2.653***	0.266	0.540
SELFEF	0.144	0.071	4.0	1.155*	0.050	0.080
PROB	−0.294	0.077	14.4	0.746***	−0.102	−0.163
STEDUC	0.117	0.073	2.5	1.124	0.040	0.065
STENTREP	−0.132	0.068	3.7	0.877*	−0.046	−0.073
Constant	−10.017	0.594	284.6	0.000***	–	–
Model 4 (–2LL = 1429.5, Nagelkerke RSQ = 0.476, 83.7 % cases classified correctly)						
Female	**0.580**	**0.158**	**13.5**	**1.787*****	**0.103**	**0.299**
MATH	0.007	0.001	29.2	1.007***	0.210	0.004
READ	0.004	0.001	9.7	1.004**	0.124	0.002
ECSC	1.024	0.099	107.4	2.784***	0.286	0.528
SELFEF	0.124	0.075	2.7	1.132	0.044	0.064
PROB	−0.180	0.077	5.4	0.835*	−0.064	−0.093
STEDUC	0.069	0.078	0.7	1.072	0.024	0.036
STENTREP	−0.183	0.073	6.27	0.833**	−0.065	−0.094
EXMATH	**0.630**	**0.158**	**15.8**	**1.877*****	0.084	0.325
EXREAD	**1.722**	**0.172**	**99.7**	**5.598*****	0.202	0.887
Constant	−8.636	0.630	187.9	0.000***	0.020	0.059

Notes: Dependent variable: GYMAPP, whether the respondent is applying to grammar school (1 = yes, 0 = no). N = 1840 (listwise exclusion of cases with missing values). SE, standard error.
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

girls and boys of similar reading and mathematics ability, who are also similar in the other controls, girls still have 1.8 greater chances of applying to grammar school. One may seek to dismiss the importance of this simply on the basis that boys are probably more drawn to the technical education provided in technical schools, as well as possibly being more drawn to vocational education. While that may be the case, it belies the importance of the type of secondary school on later transitions to tertiary education. In their analysis of the transition to tertiary education, Matějů et al. (2012)

found that students who attended grammar schools have a 36-times higher chance of making the transition to tertiary education (compared with other outcomes) compared with students who attended other types of secondary school, and controlling for sex. When taking into account the key role of parental education and measured ability (on PISA tests), the authors found that gymnasium attendance still increases the odds of a successful transition to tertiary education by an order of 5.7. It can therefore be said that grammar school attendance for the current generation of Czech students is a

Table 7. Role of gender in college aspirations.

	B	S.E.	Wald	Exp(B)	BStdXY	BStdY
Model 1 (–2LL = 3120.1, Nagelkerke RSQ = 0.002, 60.8 % cases classified correctly)						
Female	**0.155**	**0.085**	**3.3**	**1.168***	**0.041**	**1.890**
Constant	−0.409	0.058	49.4	0.664***	–	–
Model 2 (–2LL = 2442.8, Nagelkerke RSQ = 0.345, 60.9 % cases classified correctly)						
Female	**0.373**	**0.108**	**12.0**	**1.452****	**0.078**	**0.267**
MATH	0.013	0.001	170.8	1.013***	0.003	0.009
READ	0.004	0.001	20.6	1.004***	0.147	0.003
Constant	−9.187	0.424	468.7	0.000***	–	–
Model 3 (–2LL = 2182.8, Nagelkerke RSQ = 0.452, 68.1 % cases classified correctly)						
Female	**0.343**	**0.119**	**8.3**	**1.410****	**0.063**	**0.188**
MATH	0.011	0.001	116.5	1.011***	0.343	0.006
READ	0.004	0.001	11.7	1.004***	0.129	0.002
ECSC	0.849	0.077	119.9	2.337***	0.247	0.466
SELFEF	0.186	0.059	9.9	1.204**	0.069	0.102
PROB	−0.060	0.056	1.2	0.942	−0.022	−0.033
STEDUC	0.546	0.062	77.5	1.726***	0.201	0.300
STENTREP	−0.025	0.057	0.2	0.975	−0.009	−0.014
Constant	−8.201	0.463	313.9	0.000***	–	–
Model 4 (–2LL = 2076.4, Nagelkerke RSQ = 0.486, 69.3 % cases classified correctly)						
Female	**0.114**	**0.125**	**0.8**	**1.120**	**0.020**	**0.059**
MATH	0.009	0.001	68.1	1.009***	0.274	0.005
READ	0.003	0.001	9.8	1.003**	0.094	0.002
ECSC	0.842	0.080	111.1	2.320***	0.238	0.434
SELFEF	0.183	0.061	9.1	1.201**	0.066	0.094
PROB	−0.013	0.058	0.1	0.987	−0.005	−0.007
STEDUC	0.538	0.064	71.2	1.712***	0.193	0.277
STENTREP	−0.044	0.059	0.6	0.957	−0.016	−0.023
EXMATH	0.966	0.166	33.7	2.627***	0.130	0.498
EXREAD	0.940	0.188	25.0	2.561***	0.111	0.485
Constant	−7.114	0.478	221.1	0.001***	–	–

Notes: Dependent variable: COLASP, whether the respondent plans to attend college (1 = yes, 0 = no). $N = 2066$ (listwise exclusion of cases with missing values). SE, standard error.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

vital mechanism for achieving high levels of educational and occupational attainment later in life.

One cannot overemphasize the importance of these findings. The secondary educational system is, to a certain degree, differentiated by sex, and the type of secondary school attended can influence the propensity to which boys and girls plan to attend a college or university in the future. In the Czech Republic, 91% of gymnasium students claim that they plan to attend a college or university, compared with only 29% of students in the other secondary schools. It is also interesting to note that among the gymnasium students planning to attend a college or university, there is very little difference by sex (92% of boys plan to apply, compared with 90% of girls). But even if that is the case, the greater number of girls compared with boys attending grammar schools directly translates into their greater enrolment numbers in higher education.

To understand these complex relationships better, we also ran logistic regression models of the role of sex on college aspirations. For the analysis, we examine the binary dependent variable COLASP (aspirations to attend college = 1, no = 0). The results are displayed in Table 7, where we can observe that in the baseline model girls have a 1.2 greater chance compared with boys of aspiring to a college education, which increases to a 1.5 greater chance when reading and mathematics performance is taken into account. The advantage of girls drops and becomes insignificant only when we introduce grades in mathematics and Czech language into the model. In other words, we can speak of gender equality in educational aspirations, although we cannot speak of gender equality in the actual chances of achieving tertiary education. Again, the difference in the role of gender between college aspirations and college attendance is due to the role of the secondary school system in tracking boys and girls in different ways. Since girls have a greater chance than boys in attending grammar schools, and since grammar schools prepare their students for a future in higher education, the gender gap in educational attainment re-emerges.

Conclusion

In this study, we have sought to describe gender gaps in academic performance and educational plans among ninth-grade boys and girls in Czech elementary schools. We have found that girls have a large advantage over boys in Czech language grades, even after controlling for reading ability, family background and student characteristics that were thought to explain away such gender gaps. Girls also receive higher grades in mathematics, even though they have lower measured ability in the PISA mathematics assessment. In all of the educational outcomes we examined, except for college aspirations, girls enjoy a clear advantage over boys.

But what explains these gender gaps? To our surprise, problematic behaviour, self-efficacy or control, and perceptions of life-success have practically no significant impact in reducing the gender gaps in question. While we have found that parental background (ECSC) can impact educational attainment and plans in very critical ways, differences in parental background do not explain the gender gaps either. If the effect of sex remains strong even after taking into account these control variables, what then explains the size of these gender advantages?

One possible explanation could be gender bias on the part of teachers, in that they value the learning and classroom characteristics of girls more than boys in ways that are not captured by the variables measured in PISA. If teachers systematically assess boys' and girls' academic achievement differently based on such unobserved behavioural characteristics, it would explain the direction of the gender bias in grades in both Czech language and mathematics. In addition, the particularly large gender gaps we observed in Czech language could also be caused by boy–girl differences in the ways teachers assess Czech language skills not measured in PISA, such as the stereotype that girls have better handwriting than boys.

The sex of the teacher could also play a role. Females constitute 97.5% of teachers in Czech primary education, making the teaching occupation among the most segregated of OECD countries. This also means that there are few male teachers who can act as role-models for children during their formative years. Given the age structure of educators – where 68% of all educators are aged 40 years or older – and that the minimum and maximum salaries are among the lowest in OECD countries, the educational system has been unable to attract a new generation of male educators (OECD 2013). Research in other countries has indicated mixed results as to the role of the teacher's sex on gender gaps in grading. It needs to be tested whether teacher's sex matters for gender gaps in the Czech Republic, as this cannot be inferred from any current or past research. If this does matter, it would translate into a policy goal of encouraging men to become teachers, in the same way that the government seeks to encourage women to enter scientific and technical careers and attain managerial positions.

Another possible explanation is the possibility of the 'feminisation' of the school context, as discussed by Orr (2011) and Heyder and Kessels (2013). That is, if schools are themselves strongly gendered, then behaviour compatible with the female gender role, such as dutifulness and cooperativeness, is expected and rewarded, while behaviour congruent with the male gender role, such as assertiveness and independence, is sanctioned. Such expectations can be hidden in the way teachers evaluate pupils, but also in how pupils internalize their own sense of achievement, and their interest in school and in different subjects. Unfortunately, PISA data do not enable a serious testing of the role of the gendered school context in this way.

Lastly, we should address another important question: why should these gender gaps (i.e. girls' outperformance in grades compared with boys) matter, given that in the labour market men enjoy substantial earnings advantages over women for the same occupation. As is well known, men also are more likely to attain occupational positions of higher prestige and status compared with women. Indeed, we agree that earnings and occupational gaps advantaging men are large in the Czech Republic, and that these gaps deserve both research and policy attention. Nonetheless, gender gaps in the labour market advantaging men do not mean that gender gaps in educational attainment advantaging women are irrelevant (Jarkovská and Lišková 2008). It would be hypocritical to say that gender earnings gaps are unjust (which they are), but to also say that gender educational gaps are just or explain them away as irrelevant.

Moreover, it is likely that these two types of gender gaps, which occur at different stages of the lifecycle, are intertwined. One the most recent attempts to establish the causal link between gender wage gap and gender differences in education (Mechtenberg 2009) indicates that different labour-market outcomes for men and women with the same education can be explained, among others, by distortions at schools, particularly by biased grading. The equilibrium model the author developed and tested in OECD countries showed that one the driving forces of gender gaps in labour-market outcomes can be a loss of information due to potential biases in grades. 'Grades are signals that students receive about their own talent, and potentially biased grades are noisier signals than unbiased grades' and that 'the loss of information is generally larger for girls than for boys' (Mechtenberg 2009, 1443).

If one believes in the goal of a society of equal opportunity by sex, then it is just as important to find ways to increase boys' interest and achievement in reading as it is important to encourage girls to pursue technical careers. Perhaps if teachers were to find newer, more effective ways to teach reading and mathematics that would both improve overall performance while also decreasing gender gaps, then we would be one step closer to encouraging boys and girls to choose educational and occupational careers not by gender stereotypes, but by their genuine interests and abilities. Indeed, earnings gaps can hardly be reduced without a meaningful transformation of the social system, which, above all, includes the gendered nature of the educational system.

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Notes

1. Throughout this article we use the term 'gender gaps' to denote differences in systematically measured academic achievement between boys and girls, after controlling for ability, family background and other factors. While the term 'gender gaps' is widely used in the academic literature, such gaps are more precisely 'sex differences' in academic achievement. While sex differences refer to measured differences between boys and girls – which is prevalent in statistical analyses of these phenomena – gender analysis examines the role of gender stereotypes, roles, relations and other socio-cultural phenomena in school. Our main analysis involves comparisons by sex, and, to the degree possible, also intervening variables associated with gender roles.
2. We are aware of the fact that the subsample of ninth-graders of elementary school had already been subject to selection (about 16% of elementary school pupils transfer to multi-year grammar schools). While 19% of girls succeed in this transition compared with 13% of boys, when controlling for gender there are no significant differences in the effects of mathematics or reading scores on one's success in this transition. There still may be differences in unobserved variables. Therefore, this selection has to be kept in mind when interpreting the results of the analyses on the remaining population of ninth-graders.
3. We use first plausible values for reading and mathematics skills (variables pv1read and pv1math in the PISA dataset). To check for the robustness of relevant effects we performed the same analysis five times for all five plausible values.
4. Estimates were produced by procedure logistic regression in SPSS (version 20). This software does not solve the problem of unobserved heterogeneity (see, for example, Mood 2010). We addressed the problem by calculating both partially (Y-standardized, BStdY) and fully standardized (BStdXY) coefficients.

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