Title
Context Matters: Differential Gendering of Physics in Arabic-speaking, Hebrew-speaking, and Single-Sex State Schools in Israel

Journal
Sex Roles, 86(11-12)

ISSN
0360-0025

Authors
Blank, Carmel
Charles, Maria
Feniger, Yariv
et al.

Publication Date
2022-06-01

DOI
10.1007/s11199-022-01292-3

Peer reviewed

Sex Roles (2022) 86:620–633
https://doi.org/10.1007/s11199-022-01292-3

ORIGINAL ARTICLE

Context Matters: Differential Gendering of Physics in Arabic-speaking, Hebrew-speaking, and Single-Sex State Schools in Israel

Carmel Blank[1] · Maria Charles[2] · Yariv Feniger[3] · Halleli Pinson[3]

Accepted: 21 April 2022 / Published online: 8 June 2022

Abstract
Although physics is one of the most male-dominated educational fields in Europe and North America, this is not the case in all parts of the world. The present study investigates contextual variability in the physics gender gap by leveraging unique characteristics of the Israeli state educational system, including its highly standardized national curriculum and its distinct school sectors that differ on key analytical dimensions. First, comparison of schools serving different sociocultural groups reveals strong overrepresentation of boys in advanced physics courses in the Hebrew-speaking but not the Arabic-speaking school sector. This pattern aligns with previous cross-national studies showing more gender-integration of STEM fields in contexts characterized by more socioeconomic precarity and in Muslim-majority societies. Second, comparison of advanced physics course-taking between coeducational and single-sex schools provides no support for claims about the degendering effects of single-sex education. Results are consistent with accounts that treat educational gender segregation as the product of contextually contingent sorting processes rather than stable characteristics of boy and girl students. Initiatives aimed at addressing the gender gap in STEM fields must be calibrated to the diverse sociocultural contexts in which these sorting processes unfold.

Keywords Gender · STEM · Education · Physics · Single-sex Schooling · Israel

Introduction

Although gender gaps in academic attainment and college graduation have narrowed and even reversed around the world since the 1970s, this equalizing trend in overall access has been accompanied in many countries by strong gender segregation *within* educational institutions (DiPrete & Buchmann, 2013; United Nations Educational Scientific and Cultural Organization, 2017). Science and technology fields, especially physics, engineering, and computer science, are among the most male-dominated educational and occupational domains in advanced industrialized countries today (National Science Foundation, 2021; Sax et al., 2016; Xie et al., 2015; Zeldin & Pajares, 2000). Despite decades-long research and policy efforts aimed at equalizing access, extreme gender disparities persist in scientific, technical, engineering, and mathematical (STEM) fields, even where women outperform men in overall achievement (Brotman & Moore, 2008; Cheryan et al., 2009; United Nations Educational Scientific and Cultural Organization, 2017).

Many STEM pursuits have strongly masculine cultural associations and are understood to require qualities such as brilliance and aggressiveness that Westerners regard as quintessentially masculine (Breda et al., 2020; Francis et al., 2017; Leslie et al., 2015; Nosek et al., 2002). Contrary to such gender-essentialist understandings, research shows that the gendering of STEM fields varies a great deal across time and space (Charles, 2017; Eagly & Koenig, 2021; Ensmenger, 2015; Moss-Racusin et al., 2018; Nosek et al., 2002; Soylu Yalcinkaya & Adams, 2020). Efforts to identify specific social and cultural forces driving this variability and to develop equalizing pedagogic strategies are confounded when units are compared (e.g., countries or educational systems) that vary on several relevant dimensions simultaneously (Dajani et al., 2020; Soylu Yalcinkaya & Adams, 2020). In the present study, we facilitate these efforts by exploiting

✉ Yariv Feniger
fenigery@bgu.ac.il

1 Ruppin Academic Center, Kfar Monash, Israel

2 University of California, Santa Barbara, USA

3 Ben-Gurion University of the Negev, Beersheba, Israel

unique sectoral distinctions within a single education system – specifically by comparing the gender gap in high school physics course-taking across three Israeli state school sectors that share similar national curricula and matriculation examinations but differ on key structural and cultural dimensions.

Israel's state education system is comprised of three main sectors: Hebrew-speaking state schools that serve the secular Jewish majority, Arabic-speaking state schools that serve students from the Arab-Palestinian minority, and Jewish religious state schools that are mostly single sex schools (while the other two sectors are mostly coeducational). All three sectors adhere to a standardized national state curriculum and a centralized testing regime, with religious state schools adding religious subjects to the standard curriculum. These differences allow us to explore two key contextual distinctions and their relationships to the physics gender gap within a single national school system.

The first contextual distinction is sociocultural, specifically between Hebrew- and Arabic-speaking coeducational schools. These school sectors serve populations that differ with respect to dominant religious culture (Jewish versus Muslim, Druze and Christian-Arab) and lived socioeconomic experience (security versus precarity), both reliable predictors of the STEM gender gap (Charles, 2011; Dajani et al., 2020; Folberg & Kaboli-Nejad, 2020; Hazzan et al., 2020; Moshfeghyeganeh & Hazari, 2021). Recent comparative studies have suggested a tendency for more gender-integration of mathematics-intensive fields in poorer and reputably gender-traditional societies, including Muslim-majority societies, than in the affluent West (Breda et al., 2020; Charles & Bradley, 2009; Chow & Charles, 2020; Liu, 2020; Stoet & Geary, 2018). We assess the generalizability of this cross-societal pattern by comparing the gender gap in advanced physics course-taking between schools serving Jewish- and Arab-Palestinian students, while controlling for parental education and contextual (i.e., school-level) affluence.

The second contextual distinction is between the coeducational and single-sex state schools. This comparison allows us to assess the argument that single-sex education reduces the salience of gender stereotypes and increases girls' participation in mathematics-intensive STEM fields (James, 2009; Mael et al., 2004). Although this claim has been widely challenged by academic researchers (Bigler & Signorella, 2011; Pahlke et al., 2014a, b), single-sex schooling is still commonly invoked as a solution to diverse educational problems (Bridge, 2019; National Coalition for Girls' Schools, 2020). Our data provide unique analytical leverage on these claims because they allow us to compare physics course-taking between two nonelite public-school sectors that are similar in terms of curriculum, testing, regional distribution, and socioeconomic status.

We focus on physics for two reasons. First, physics is among the most persistently male-dominated fields of study in the Western world (e.g., Archer et al., 2020; Baram-Tsabari & Yarden, 2008; Reid & Skryabina, 2003; Sax et al., 2016; Zohar & Sela, 2003). Second, physics programs are not as costly as computing programs, and can therefore be offered at Israeli schools spanning the socioeconomic spectrum. Due to a long history of budgetary discrimination, Arabic-speaking schools are less likely than Hebrew-speaking schools to offer advanced computer science courses because they more often lack the needed computing infrastructure or the trained personnel (Belikoff, 2014; Hadad Haj-Yahya et al., 2021). Before turning to the data analysis, we provide a brief review of existing literature on the gender segregation of scientific and technical fields.

Contextual Variability in the STEM Gender Gap

Popular Western understandings of gender segregation are typified in best-selling books that depict men and women as natural "opposites" with categorically divergent aptitudes and affinities (e.g., Brizendine, 2006; Gray, 2012; James, 2009). This individual-centric narrative is intuitively appealing and taps into the sorts of "equal but different" gender beliefs that pervade North American and European cultures (Cotter et al., 2011; Grunow et al., 2018). Yet, while girls in affluent societies are indeed more likely to perceive STEM and STEM careers in negative terms (Brotman & Moore, 2008; Cheryan et al., 2009; Sandler et al., 2012; Thébaud & Charles, 2018; Weisgram & Diekman, 2017), a growing body of research shows wide contextual variability in the gendering of aspirations and outcomes (Billger, 2009; Breda et al., 2020; Charles, 2011, 2017; Chow & Charles, 2020; Schneeweis & Zweimüller, 2012; Stoet & Geary, 2018). Among the central contextual distinctions emerging from this research literature are societal affluence and school gender composition.

Societal Affluence

Several recent studies have documented a so-called "gender equality paradox," which refers to the greater gender-integration and weaker male-stereotyping of STEM fields in less affluent and reputably gender-traditional countries, including in many Muslim-majority societies (Breda et al., 2020; Charles & Bradley, 2009; Chow & Charles, 2020; Stoet & Geary, 2018). The latter finding has been met with surprise given Western stereotypes of Muslim gender relations as traditional and uniformly patriarchal (Charles, 2011; Dajani et al., 2020; Folberg & Kaboli-Nejad, 2020; Lagesen, 2008; Moshfeghyeganeh & Hazari, 2021). These research findings also pose some challenge to modernization accounts, which posit a gradual degendering of public institutions as economic development advances and postmaterialist values become more widespread (Inglehart & Norris, 2003; Jackson, 1998).

One explanation for the observed patterns is that broad-based material security gives rise to cultural individualism and a higher propensity for people to treat school and work as vehicles for personal self-expression (Charles & Bradley, 2009; Francis et al., 2017; Soylu Yalcinkaya & Adams, 2020). When encouraged to follow their passions and "do what they love," adolescents (who often do not know yet what they love) may fall back on gendered choices based on the prevailing stereotypes about what boys and girls love. Consistent with this argument, cross-national research shows that eighth graders' STEM aspirations become more gender differentiated as social affluence grows, even holding constant their individual social class backgrounds, mathematical achievement, age, and affinity for school (Charles, 2017).

By comparing curricular distributions in more affluent Hebrew-speaking state schools, characterized by Western individualist cultures, with those in poorer Arabic-speaking state schools, characterized by more collectivist Muslim religious cultures, we can assess the generalizability of observed cross-national patterns within a single national educational policy regime. Our data also allow us to explore the relationship of physics course-taking to material security measured at the school level (as school socioeconomic status) and at the individual level (as parental education).

School Gender Composition

The idea that single-sex education can reduce the salience of gender stereotypes and contribute to the integration of STEM fields has been advanced frequently in the academic literature and by advocacy organizations and media outlets (Billger, 2009; Sax et al., 2009; Schneeweis & Zweimüller, 2012). Policy proponents argue that all-girl high school environments help degender school cultures and encourage girls' STEM course-taking and career pursuits. Loren Bridge, the executive officer of the Alliance of Girls' Schools Australasia has written, for example, that:

> [un]conscious stereotyping and biases often exist in co-educational schools, from teachers encouraging boys to do STEM subjects while directing girls to humanities subjects, to research showing that girls are less confident and have lower self-esteem and body image issues…(I)n a single-sex school, girls are free to be themselves inside and outside the classroom (2019).

The website of the National Coalition for Girls' Schools presents similar claims, adding another popular argument:

> (W)hen every student in advanced calculus and physics or in the computer club is a girl, then every other girl at the school gets the clear message they can excel in those areas (2020).

The social scientific evidence for these claims is mixed, with some authors concluding that girls in all-girl schools have more positive, less masculine perceptions of STEM subjects (Haag, 1998; Mael, 1998;), and others challenging these conclusions or countering that any equalizing effect disappears once socioeconomic background and prior achievement are controlled (Law & Sikora, 2020; Pahlke et al., 2014a, b; Sikora, 2014;). In one vigorously critical account, Halpern et al. (2011) characterize single-sex school advocacy as "pseudoscience" and advance the claim that "gender divisions are made even more salient in [single-sex] settings because the contrast between the segregated classroom and the mixed-sex structure of the surrounding world provides evidence to children that sex is a core human characteristic along which adults organize education" (p. 1707). Pahlke et al. (2014a, b) argue, likewise, that rationales for single-sex schooling are "consistent with gender essentialist views in that they posit that girls' and boys' brains, interests, and peer relationships, respectively, differ in fundamental ways" (p. 268).

Assessing this relationship is greatly complicated by selection bias – the fact that single-sex schools are usually private or independent and may attract students and parents who differ in unmeasured ways from those attending public schools (e.g., more privileged socioeconomic background, stronger prior achievement). Technical solutions to this selection issue include special corrective algorithms and a lottery system for random assignment of students to schools. Based on the first strategy, Jackson (2012) found no effect of single-sex secondary schooling on girls' science course-taking in Trinidad and Tobago; based on the second strategy, Park et al. (2018) found positive effects of single-sex schooling on STEM outcomes for boys but not girls in Seoul, South Korea. A meta-analysis of existing literature found studies that control for selection effects tend to show trivial or insignificant differences in the STEM gender gap (Pahlke et al., 2014a, b).

The Israeli Educational System and the STEM Gender Gap

Features of the Israeli state educational system provide excellent analytical leverage for understanding contextual variability in boys' and girls' STEM enrollments. Particularly relevant is the high level of curricular and testing standardization in Israel and the distinction between three state school sectors: state schools that serve the secular

Jewish majority; state schools that serve students from the Arab-Palestinian minority (about 21% of Israel's population, about 85% of whom are Muslim, the rest Christian and Druze); and Jewish state-religious schools that adhere to the national curriculum but add religious subjects. (A fourth educational sector, comprised of independent ultra-orthodox Jewish schools, is not included in the present study because these schools do not follow the national curriculum and are not strictly speaking state schools). Almost all non-religious state schools, whether serving the Jewish or Arab-Palestinian populations, are coeducational, while about 86% of Jewish state-religious schools are single-sex. The language of instruction in schools that serve the Jewish population is Hebrew; in schools that serve the Arab-Palestinian population it is Arabic.

We refer to state schools that serve predominantly the Jewish majority as Hebrew-speaking schools and those serving the Arab-Palestinian minority as Arabic-speaking schools. Members of the latter group variously identify as Arab citizens of Israel, Arab-Israelis, Palestinians, or Arab-Palestinians, reflecting different political perspectives and different understandings of the Israeli-Palestinian conflict and the power relations between the minority and the majority in Israel. Most persons identifying as Arab or Palestinian in Israel send their children to state coeducational Arabic-speaking schools that follow a similar curriculum to other coeducational state schools except in their language of instruction. In our comparison of coeducational state schools, we therefore distinguish between Arabic-speaking and Hebrew-speaking sectors.

All state and state-religious school sectors are highly regulated by the Israeli Ministry of Education; they follow similar curricula in mathematics, natural sciences and technology, and their students take the same national matriculation examinations in these subjects (offered in either Hebrew or Arabic). Jewish families can choose whether to enroll their children in state or state-religious schools. Students admitted to state-religious schools, which are mostly single-sex, are expected to conform to Jewish religious rules and traditions. Data show that most students in state-religious schools are from religiously observant families, while most students in Hebrew-speaking state schools are from either secular or less-observant (sometimes referred to as "traditional") families (Dagan, 2006). In contrast to Jewish ultra-Orthodox communities, families whose children attend state-religious schools are highly integrated into Israeli society, labor market, and civic life. A recent study found that this group is characterized by neoliberal individualistic conceptions that are very similar to those found among non-religious Jewish families (Elyakim, 2020). Arab-Palestinian society in Israel tends to be more inclined towards collectivistic values than the Jewish majority, which by and large adheres to Western individualistic values (Lavee & Katz, 2003; Sagy et al., 2001; Sharabi, 2014; Yuchtman-Yaar, 2002).

As we show below, the average socioeconomic status (SES) of students in Hebrew-speaking state and state-religious schools is similar, and considerably higher than the average SES of students in Arabic-speaking schools. The Arab-Palestinian community in Israel is characterized by much higher poverty rates and lower levels of parental education than the Jewish majority. Although Israeli education is mainly state funded, official data show that Arabic-speaking schools are poorly funded, while state-religious schools enjoy the highest funding levels (Blass & Bleikh, 2020). It is not surprising, therefore, that academic achievement is lower in the Arabic-speaking school sector than in the two Hebrew-speaking sectors (Blass, 2017).

Recent data show that the formal dropout rate during secondary education is very low in Israel: 2.2% among Jewish students and 2.5% among Arab-Palestinian students. In the Hebrew-speaking state school sector 78.4% of all high school graduates were eligible for a matriculation diploma, compared to 79.5% in state-religious schools and 62.4% in Arabic-speaking state schools (Israel Central Bureau of Statistics, 2020). The lower eligibility rate in Arabic-speaking schools is due to higher failure rates on the matriculation examinations (Blass, 2017).

As in many other countries, Israeli secondary education is characterized by three main forms of differentiation: between academic and non-academic (mainly vocational) programs; within-subject, whereby students study similar subjects at different levels; and between-subject, whereby students can choose their area of specialization. The present study focuses on differentiation between subjects, which occurs between the 9th and the 10th grades when students, usually in academic programs, choose from a range of advanced-level subjects. Secondary education culminates in matriculation examinations, which include several compulsory subjects (such as, civics, mathematics, and English), along with elective subjects that correspond to the advanced courses taken during high school.

Although matriculation subjects are not formally stratified, an informal status hierarchy exists, with students, parents, and teachers valuing the sciences more highly than the humanities and social sciences, based on the perception that advanced science courses improve opportunities in higher education (Ayalon, 2006; Bar-Haim & Feniger, 2021). Students who take advanced-level science courses belong to their school's elite. Members of privileged groups, as well as high-achieving students, tend to specialize in the sciences, whereas lower achieving and socially disadvantaged students are more likely to specialize in the humanities and social sciences. In the last decade, the Israeli Ministry of Education has attempted to raise the percentage of high school students who take the highest levels of mathematics, scientific and technological subjects. Recruitment strategies have included popular media advertisements and school financial incentives. While these efforts have increased overall STEM enrollments, they have also exacerbated inequalities because increases have occurred mainly among high-achieving students and boys (Maagan & Zussman, 2019).

The combination of a standardized curricular and testing structure with clear sectoral differentiation makes the Israeli state school system almost a natural laboratory for assessing how course-taking varies by sociocultural group and material security. While gender differences in advanced STEM course-taking have not been studied extensively in Israel, two previous analyses have shown larger STEM gender gaps in Hebrew-speaking than Arabic-speaking secondary schools (Ayalon, 2002; Friedman-Sokuler & Justman, 2020). Both studies used data collected prior to the Ministry of Education's policy initiatives to increase STEM course-taking, however. Since the recent enrollment increases have skewed toward more privileged populations, it is possible that Jewish girls have benefited relative to their Arab counterparts.

Israel's relatively large public single-sex educational sector also makes it an ideal comparative case. The most relevant previous study of STEM effects, by Feniger (2011), was based on students who graduated in the mid-1990s. Results showed that girls at all-girl state-religious schools did not differ from girls at coeducational state schools in their advanced math, physics, or biology course-taking, but that they did take advanced computer science courses at a higher rate. Feniger attributed the computer science finding to differences across sectors in the mathematics requirements of computing courses, and not to the single-sex environment. (Computer science is generally combined with intermediate-level math in all-girl state-religious schools, but with the highest level of math in coeducational non-religious state schools. Physics, by contrast is combined with the highest level of math in all schools).

Study Aims and Research Questions

This study leverages characteristics of the Israeli state education system to explore how social context influences the gender gap in advanced high school physics. We assess the validity of two claims, derived from previous research and policy analysis. The first, developed from cross-national comparisons, is that STEM fields tend to be more gender integrated in non-Western societies, including in Muslim-majority societies. By comparing the physics gender gap in Hebrew- and Arabic-speaking coeducational schools we have an opportunity to assess this relation in a single education system, holding constant curricular content and structure, type of final examinations, national education regulations and more. Specifically, we advance the following research questions:

RQ 1a. Does the gender composition of advanced physics programs ("physics gender gap") differ between Arabic- and Hebrew-speaking state coeducational schools?
RQ 1b. Does the physics gender gap differ between Arabic- and Hebrew-speaking schools after accounting for differences in school affluence, student mathematics achievement, and parental education?

Our second series of analyses compare Hebrew-speaking coeducational with Hebrew-speaking single-sex schools to test the argument that single-sex education has a degendering effect on curricular choice. Here, we advance the following research questions:

RQ 2a. Does the physics gender gap differ by school gender composition (i.e., between Hebrew-speaking coeducational and Hebrew-speaking single-sex schools)?
RQ 2b. Does the physics gender gap differ between Hebrew-speaking coeducational and Hebrew-speaking religious single-sex schools after accounting for sectoral differences in school affluence, student mathematics achievement, and parental education?

Method

Our analyses are based on administrative data from the Israeli Ministry of Education that encompass all students who graduated from high school and took the matriculation examinations between 2015 and 2017. While the examinations are not mandatory, nearly all high school graduates take them because they are the main criterion for enrollment in higher education and a basic requirement for many jobs. According to the Israeli Central Bureau of Statistics, about 95% of graduates from the state high school system took at least one examination between 2015 and 2017 (Israel Central Bureau of Statistics, 2020).

Because the administrative data used for this study are confidential, analyses were conducted via secure remote access to the Israeli Ministry of Education's virtual research room. Israeli scholars may obtain permission to access these data from the Ministry of Education. Ministry personnel check all results for confidentiality to prevent the risk of identifying individual students or schools. The study also received the ethical approval of the Chief-Scientist of the Ministry of Education.

Our regression models are based on a large sample of students who attended state schools offering advanced physics courses and for whom scores from a nationally standardized eighth-grade mathematics test were available between

2015 and 2017. About 28% of schools did not offer advanced physics courses and were excluded from the analysis. These were mainly small schools with limited advanced course offerings, and they served only 9.3% of the total student population. Since state schools do not conduct standardized national testing every year, eighth-grade mathematics scores are available for only about one-third of the student population. To assess the representativeness of this "test-score sample," we merged the datasets with and without test scores using anonymized individual identification numbers that were created by the Ministry of Education. The sample of students with mathematics scores was very similar to the population from which it was drawn (See Table S1 in the online supplement for detailed information). The full population was comprised of 235,070 graduates, and our analytic sample was comprised of 48,627 students in 549 schools. To avoid the possible confounding effect of immigration, we excluded a small number of students who immigrated to Israel after the age of five and would have been influenced by different school structures and cultures (Finseraas & Kotsadam, 2017; Röder & Mühlau, 2014). Conclusions are unchanged in analyses that include school-aged immigrants, as shown later.

We also restricted the sample to control for gender composition. Since not all state-religious schools are single-sex, we used information on school and classroom gender composition to identify single-sex schools. While it would be interesting to compare single-sex and coeducational schools within the state-religious sector, the number of coeducational schools in this sector is small and these mainly cater to students from disadvantaged social backgrounds in peripheral areas (see Feniger, 2011). We therefore omitted the 13.6% of state-religious students attending coeducational schools. Sensitivity tests show that including these students does not change overall findings. In the Arabic-speaking school sector, 3.9% of the students were enrolled in single-sex schools, mainly independent and selective Christian schools, and these were also omitted from the analysis. In the Hebrew-speaking state sector 99.5% of students attended coeducational schools; the remaining 0.5% were omitted.

Study Variables

Subject of Matriculation Examination

Students who enrolled in an advanced physics examination are coded 1; otherwise they are coded 0.

Gender

Gender was treated as a binary variable, with boys coded 0 and girls coded 1. The Israeli Ministry of Education includes no other gender categories.

Parental Education

Measured in years, taking the highest value between two parents, or the only value for students with a single parent.

School Sector

Hebrew-speaking state schools, Hebrew-speaking state-religious single-sex schools, and Arabic-speaking schools are distinguished with individual 0/1 dummy variables.

School Socioeconomic Index

Measured on a 1–10 scale developed by the Ministry of Education for the purpose of budgetary allocations (based on mean parental education and income, central versus peripheral location, and students' immigration status). In the original index, high values denote greater funding deservedness (i.e. lower SES); we reversed the scale.

High School Graduation Year (2015, 2016, 2017)

Represented by 0/1 indicators, with 2015 the reference category.

Ministry of Education Geographical District (North, Haifa, Center, Tel Aviv, Jerusalem, and South, Center)

Controls (0/1) were added to all models, with Center the reference category.

Previous Mathematics Achievement

Student scores from a nationally standardized eighth-grade mathematics test. Values range 200–800, with a mean of 500 and a standard deviation of 100.

Analysis Plan

To explore the predictors of enrollment in advanced physics programs, we compute a series of mixed effects logistic regression models. The mixed effects specification allows us to account for unmeasured similarities among students who attend the same schools (Raudenbush & Bryk, 2002). A first set of nested models, restricted to coeducational schools, explores differences in the physics gender gap between Hebrew- and Arabic-speaking schools. A second series, restricted to Hebrew-speaking state schools, compares the same gender gap between single-sex and coeducational students.

Results

Preliminary evidence related to Research Question 1a and 2a can be found in the first panel of Table 1, which shows girls' proportion of advanced physics students in each of the three state school sectors before adjusting for sectoral differences in student characteristics and school affluence. These raw numbers show a striking difference between the Arabic- and Hebrew-speaking coeducational schools and a modest difference between coeducational Hebrew-speaking and single-sex Hebrew-speaking schools. While girls comprised only about a third of physics students in the two Hebrew-speaking sectors, they made up the majority (57%) of these students in Arabic-speaking schools. The difference between coeducational and single-sex schools (32% vs. 35% girls in physics, respectively) is small by contrast, but consistent in direction with arguments suggesting weaker gendering of STEM fields in single-sex settings.

The remainder of this article explores cross-sectoral similarities and differences in a multivariate context, with particular attention to how gender gaps are influenced by the different demographic compositions of the respective student populations and the different resources available to their schools. These models allow us to address Research Question 1b and 2b, concerning the sectoral differences that remain after accounting for key student and school characteristics.

Descriptive statistics for the student- and school-level variables included in the regression models are shown in the second and third panels of Table 1, broken down by school sector (see Table S2 in the online supplement for breakdowns by both sector and gender). As expected, students in Hebrew-speaking coeducational schools were more advantaged than their counterparts in Arabic-speaking schools (as measured by parents' educational attainment and school SES indices) and had higher average mathematics test scores. Comparing Hebrew-speaking single-sex and Hebrew-speaking coeducational schools, we see a slight advantage for the former with respect to family class background (parental education) but a slight advantage of the latter with respect to school SES. Consistent with these socioeconomic differences, total (boy and girl) test scores and physics enrollment rates were somewhat lower in the Arabic-speaking school sector. Mean scores also show that girls were overrepresented in all three state school sectors, but to varying degrees; girls make up 52% of students in Hebrew-speaking schools (coeducational and single sex) and 58% of students in Arab-serving schools. The skewed gender composition of the Arabic-speaking school sample can be explained by Arab-Palestinian boys' higher dropout rates and lower likelihood of taking the matriculation examination (Israel Central Bureau of Statistics, 2020). If the entire cohort of Arab-Palestinian boys were considered, instead of this positively selected subset, girls' physics advantage in Arabic-speaking schools would likely be even larger (Table 2).

Table 1 Variables characterizing Israeli students and high schools

Variables	Total	Arabic-speaking Coeducational Schools	Hebrew-speaking Coeducational Schools	Hebrew-speaking Single-Sex Schools
Physics Students				
Girl (=1)	0.37	0.57	0.32	0.35
All Students				
Enrolled in Physics (=1)	0.13	0.11	0.14	0.15
Girl (=1)	0.53	0.58	0.52	0.52
Parental Education, in Years	13.94 (3.30)	11.67 (2.79)	14.41 (3.11)	15.06 (3.54)
Math Score (200–800)	524.54 (96.90)	496.88 (93.47)	532.29 (97.11)	530.86 (92.41)
Cohort Year (ref=2015)				
2016	0.33	0.34	0.33	0.33
2017	0.32	0.32	0.32	0.33
Schools+				
Arabic-speaking (=1)	0.19	1.00	0.00	0.00
Single-Sex School (=1)	0.28	0.00	0.00	1.00
School Affluence (1–10)	4.84 (2.38)	2.19 (1.13)	5.91 (2.02)	5.52 (1.82)
Student *N* / School *N*	48,627/ 549	10,426 / 101	32,770 / 292	5,431 / 156

Values are sample means (standard deviations) with listwise deletion of missing values. Data are from Israel's Ministry of Education administrative files for 2015–2017 and include only schools offering physics coursework and students with available mathematics test scores. Students who immigrated to Israel after the age of 5 were excluded from the analysis

+At the student level, 21.4% attend Arab schools, 11.2% attend single-sex schools, and mean school affluence score is 5.03

Table 2 Mixed-models predicting physics enrollment in Hebrew- and Arabic-Speaking State Coeducational High Schools, Israel

Variable	Model 1	Model 2
Student Characteristics		
Girl (=1)	-1.252*** (0.101)	-1.241***(0.101)
Parental Education, in Years	0.087*** (0.009)	0.084*** (0.009)
Parental Education × Girl	-0.011 (0.012)	0.000 (0.013)
Math Score (200–800 scale)	0.026*** (0.001)	0.026*** (0.001)
Math Score × Girl	0.000 (0.001)	0.001 (0.001)
Cohort Year (ref = 2015)		
2016	0.289*** (0.082)	0.287** (0.083)
2017	0.357*** (0.076)	0.361*** (0.075)
School Characteristics		
Arabic-speaking (=1)	-0.048 (0.155)	-0.151 (0.176)
Affluence (1–10)		-0.054 (0.036)
Cross-Level Interactions		
Arabic-speaking × Girl	1.047*** (0.102)	0.855*** (0.123)
School Affluence × Girl		-0.060** (0.022)
Intercept	-4.126*** (0.125)	-3.990*** (0.138)
Student *N* (school *N*)	41,067 (390)	41,016 (389)

Values are coefficients (standard errors) from hierarchical logistic regression models with fixed effects for six geographically defined school districts (North, Haifa, Center, Tel Aviv, Jerusalem, and South). All continuously scaled variables are centered around their national mean scores (rounded to 5.0 for school affluence). Data are from Israel's Ministry of Education administrative files and cover state coeducational schools that offer physics courses

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Research Question 1b asks whether the physics gender gap differs between Arabic- and Hebrew speaking schools after accounting for differences in school affluence, student mathematics achievement, and parental education. We addressed this question through two nested regression models. Model 1 compared the physics gender gap between Arabic- and Hebrew speaking school sectors, holding constant cohort, geographic region, and student-level characteristics that might vary by sector; Model 2 added indicators for school affluence and its interaction with gender. We also allowed associations with parental education, and mathematics scores to vary by gender.

The positive "Arabic-by-girl" regression coefficient in Model 1 confirms descriptive results from Table 1, suggesting significantly stronger representation of girls in physics courses in the Arabic-speaking school sector even after accounting for sectoral differences in student characteristics. This result is consistent with previous cross-national studies, which have shown more women in STEM occupations and degree programs in less affluent contexts, and particularly in Muslim-majority contexts (Breda et al., 2020; Charles, 2017; Chow & Charles, 2020; Dajani et al., 2020; Folberg & Kaboli-Nejad, 2020; Moshfeghyeganeh & Hazari, 2021).

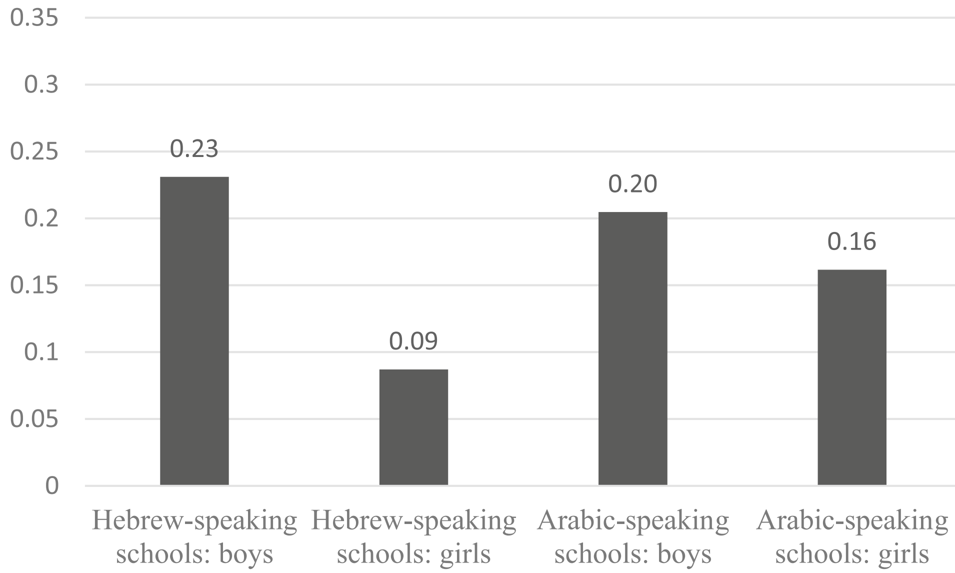
In Model 2, we examined whether this difference persists once we account for sectoral differences in school SES. We addressed this question by adding an indicator of school affluence, along with a cross-level interaction of school affluence with gender. Based on the modest attenuation of the Arabic-by-girl interaction with addition of these school-affluence terms, we conclude that enrollment differences across sectors are not attributable to differences in material security alone. Specifically, we found in Model 2 that the adjusted odds of enrolling in advanced physics are about 250% higher for boys than girls in Hebrew-speaking schools (exp[1.241] = 3.459), while the odds advantage for boys is much smaller in Arabic-speaking schools, at about 47%, adjusting for school affluence and individual-level characteristics. The latter figure is calculated by subtracting the Arab-girl supplement (0.855) from boys' overall log-odds advantage (1.241) and exponentiating (exp[1.241-0.855] = 1.47).

Consistent with previous cross-national research, Model 2 results also showed that physics enrollment rates are lower in more affluent schools, and that this negative association is significantly stronger for girls than boys. As expected, physics enrollment was positively associated with eighth-grade mathematics scores and parental education; these relationships did not differ by gender. Coefficients for cohort showed increasing physics enrollment between 2015 and 2017.

The differential gendering of physics in Arabic- and Hebrew-speaking schools thus appears to reflect forces beyond students' mathematics achievement, social class background, or school-level affluence. These findings are similar to Friedman-Sokuler and Justman (2020) for cohorts that completed high school ten years earlier, and they are consistent with arguments suggesting a gendering effect of economic security and postmaterialist culture (Breda et al., 2020; Charles, 2017).

The magnitude of adjusted group differences is represented visually in Fig. 1, which shows predicted probabilities of advanced physics enrollment in Arabic- and Hebrew-speaking schools for girls and boys at one standard deviation above the mean mathematics score (as students who enroll in physics usually score relatively high in mathematics) and with all other variables set to their sample means. The patterns described above are still evident, with Jewish boys most likely to study physics, followed by Arab-Palestinian boys, Arab-Palestinian girls, and finally Jewish girls. In supplementary models (see Table S3, columns 1 and 2, in the online supplement), we tested the statistical significance of within-gender sector effects. These analyses showed that the difference between girls in Arabic-speaking and girls in Hebrew-speaking schools is statistically significant, controlling for student and school characteristics, whereas the difference between boys in these two school sectors is not.

Fig. 1 Predicted probabilities of physics enrollment in Arabic- and Hebrew-speaking state coeducational high schools



Note. Predicted values are based on regression Model 2 in Table 2, for the year 2016, the Central region, one standard deviation above the mean mathematics score, and with other covariates set to their means.

We turn next to Research Question 2a and 2b, on how single-sex schooling relates to physics enrollments in the Hebrew-speaking state-school context. Percentage scores presented earlier (Table 1) show that girls' share of physics students was slightly higher in single sex than coeducational schools (35.4% vs. 31.6%). Multivariate analysis can tell us whether this raw difference persists once we account for sectoral differences in student and school characteristics, especially the more socioeconomically advantaged students attending single-sex schools (Question 2b).

Model 1 tested whether single-sex schooling is associated with a smaller physics gender gap for students with similar characteristics (parental education, math achievement, cohort) and regional locations (see Table 3). Claims about the degendering effect of single-sex schooling imply a significant positive interaction of "girl" with "single-sex school," which we did not find here. While single-sex schooling is associated with higher rates of physics enrollment *overall* (as indicated by the positive main effect of single-sex schooling), results of these models provide no evidence that the size of the physics gender gap differs between the single-sex and coeducational sectors.

Does accounting for the slightly lower SES of single-sex schools change our conclusion regarding similarity in the two sectors' gender gaps? In Model 2, we added terms to capture gender-specific associations with school affluence. We still found no evidence that single-sex schooling promotes gender integration of physics programs (the

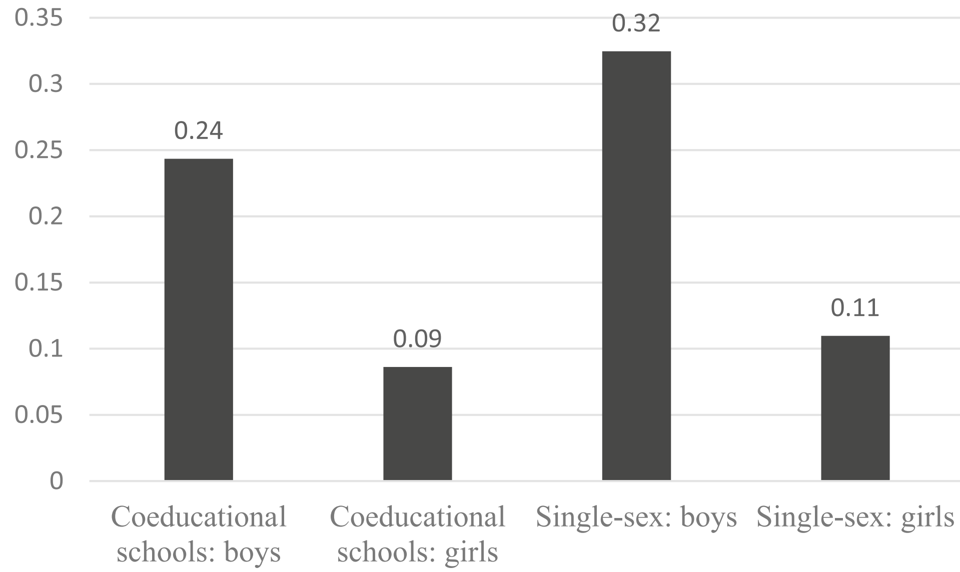
Table 3 Mixed-models predicting physics enrollment in Hebrew-speaking state coeducational and single-sex high schools, Israel

Variable	Model 1	Model 2
Student Characteristics		
Girl (= 1)	-1.425*** (0.109)	-1.419*** (0.109)
Parental Education, in Years	0.071*** (0.008)	0.069*** (0.008)
Parental Education × Girl	-0.002 (0.012)	0.010 (0.013)
Math Score (200–800 scale)	0.025*** (0.001)	0.025*** (0.001)
Math Score × Girl	0.002* (0.001)	0.002* (0.001)
Cohort Year (ref = 2015)		
2016	0.347*** (0.080)	0.336*** (0.080)
2017	0.359*** (0.073)	0.362*** (0.073)
School Characteristics		
Single-sex (= 1)	0.399** (0.136)	0.408** (0.133)
Affluence (1–10)		-0.055 (0.034)
Cross-Level Interactions		
Single-sex School × Girl	-0.079 (0.177)	-0.146 (0.176)
School Affluence × Girl		-0.068** (0.022)
Intercept	-4.022*** (0.117)	-3.872*** (0.129)
Student *N* (school *N*)	36,925 (442)	36,893 (441)

Values are coefficients (standard errors) from hierarchical logistic regression models with fixed effects for six geographically defined school districts (North, Haifa, Center, Tel Aviv, Jerusalem, and South). All continuously scaled variables are centered around their national mean scores (rounded to 5.0 for school affluence). Data are from Israel's Ministry of Education administrative files and cover Jewish state schools that offer physics courses

*$p < .05$; **$p < .01$; ***$p < .001$

Fig. 2 Predicted probabilities of physics enrollment in Hebrew-speaking single-sex and coeducational state high schools



Note. Predicted values are based on regression Model 2 in Table 3, for the year 2016, the Central region, one standard deviation above the mean mathematics score, and other covariates set to their means.

single-sex-by-girl interaction remains statistically insignificant). The negative interaction of gender with school affluence again indicates a larger physics gender gap in higher-SES schools. Figure 2 displays predicted probabilities of physics enrollment for girls and boys in coeducational and single-sex schools, with mathematics scores set at one standard deviation above the mean and with all other variables at their sample means. The statistical significance of within-gender sector effects is again formally tested and presented in Table S3 in the online supplement. Here we find a significant advantage of single-sex schooling for boys, but not girls.

In additional sensitivity tests (see Table S4 in the online supplement), we show that conclusions are unchanged when the sample is expanded to include school-aged immigrants.

Discussion

This paper explores variability in the high school gender composition of physics, one of the most strongly male-dominated fields of study in the advanced industrial world. Through targeted comparisons of physics enrollments across three Israeli state educational sectors, we assess the generalizability and robustness of previously documented contextual differences and similarities. We first consider whether the "paradoxical" patterns of variation in the STEM gender gap that have been identified through cross-national research are also evident within the Israeli state school system. Consistent with previous research showing more gender-integrated STEM programs in poorer and reputably gender-traditional societies (Chow & Charles, 2020; Dajani et al., 2020; Folberg & Kaboli-Nejad, 2020; Stoet & Geary, 2018), our analysis shows a significantly smaller physics gender gap in the Arabic-speaking than the Hebrew-speaking school sector, controlling for mathematics achievement and parental education. Within these two sectors, we also find that girls' representation in physics decreases with school affluence. The second contextual factor is school gender composition – specifically, we consider the argument that single-sex educational environments can weaken gender stereotypes and encourage more girls to enroll in mathematics-intensive STEM fields. To assess this claim, we compared two Hebrew-speaking state school sectors that follow the same national curriculum and are similar in regional distribution and socioeconomic status. Results add to the mounting evidence against single-sex schooling as a strategy for integrating STEM fields (Halpern et al., 2011; Pahlke et al., 2014a, b).

While this study provides compelling evidence that the physics gender gap varies across sociocultural contexts in Israel, the available administrative data provide little analytical leverage on the psychological and social processes driving the observed differences. Our results raise important questions about the mechanisms by which socioeconomic precarity and ethnic marginalization might affect STEM gender gaps. One common, intuitively appealing interpretation of the gender equality paradox is that girls and women are freer to realize their "natural" preferences for non-STEM pursuits in the absence of resource scarcity and overt discrimination. Yet research showing that career preferences themselves tend to become more gendered as material security increases suggests the operation of more complicated causal processes (Charles, 2017; Falk & Hermle, 2018).

Some comparative scholars have suggested that gender stereotypes more strongly influence career sorting processes in affluent societies because of the greater cultural emphasis on individualism and self-expressive life choices in these contexts (Breda et al., 2020; Charles, 2017; Charles & Bradley, 2009; Francis et al., 2017; Soylu Yalcinkaya & Adams, 2020). This argument requires closer on-the-ground scrutiny. One of the few relevant analyses compares sorting processes at two Israeli high schools, one Arabic- and one Hebrew-speaking (Pinson et al., 2020). In the Hebrew-speaking school, strong emphasis on the pursuit of individual affinities discouraged girls from enrolling in (male-labeled) physics and computing programs; in the Arabic-speaking school, strict achievement-based sorting led girls to aspire to the most prestigious matriculation subjects possible, including physics. While rigid tracking policies meet resistance in culturally individualistic societies, the principle of free choice can be an obstacle rather than a lever to gender equality if choices are informed by stereotypes about what girls and boys will love and be good at (Cech, 2021; Folberg & Kaboli-Nejad, 2020; Francis et al., 2017; Moshfeghyeganeh & Hazari, 2021; Thébaud & Charles, 2018;;).

Limitations and Future Research Directions

It is certainly true that students are limited to the elective courses that are offered at their schools, and that availability of a wide range of electives in the humanities and social sciences may have a gendering effect on enrollments. Future research should consider effects of differential course offerings on STEM enrollments, including the extent to which smaller STEM gender gaps in less affluent schools are attributable to a more restricted range of STEM and non-STEM electives in these schools. Israeli research on this question is inconclusive so far. Ayalon (2002) finds that controlling for the number of advanced non-STEM electives eliminates the difference between Arabic- and Hebrew-speaking schools in girls' math and science enrollments, while Friedman-Sokuler and Justman (2020) find no effect of course availability on ethnic differences in the physics and computer science gender gap. The latter study is more relevant for current purposes, since it is based on more contemporary data (2006 versus 1989), focuses on a more similar outcome (physics/computing vs. science in general), and includes controls for school SES, which is likely correlated with breadth of course offerings. In supplementary analysis of our data (not shown here), we found no evidence that the larger physics gender gap in Hebrew-speaking schools is attributable to girls' relative preference for computer science. While overall computer science enrollment rates are higher in Hebrew-speaking schools, they are still lower than physics enrollments, and sector-specific gender gaps are similar to those for physics: Boys enroll in computing at roughly equal rates to girls in Arabic-speaking state schools (4.5% and 4.0%, respectively) but at nearly three times girls' rate in Hebrew-speaking schools (15.2% and 5.6%). Disentangling the causal relationships of STEM enrollments to course offerings, school affluence, and school sector will require detailed school- and student-level data collected over time.

The association of affluence with the STEM gender gap should be studied at different levels of aggregation and in different cultural contexts. At the individual level, research suggests that weaker parental safety nets increase the instrumental motivation of less privileged girls and women to pursue fields perceived to be more lucrative and secure (Liu, 2020; Ma, 2009; Mullen, 2014; Quadlin, 2020). While our analyses show no within-school effects of family socioeconomic status, they do suggest a smaller physics gender gap in contexts characterized by greater economic precarity – indicated by attendance at Arabic-speaking schools. These patterns may be attributable to population differences in cultural individualism versus collectivism (i.e., different tendencies for "gendered self-expression"), different vocational orientations of Muslim and Jewish religious adherents, or the stark differences in material security characterizing the lived experiences of Jewish and Arab-Palestinian citizens in Israel. Longitudinal surveys, ethnographic studies, and in-depth interviews may help gain leverage on the mechanisms linking STEM gender gaps, economic precarity, culture, and religious faith.

Practice Implications

Results of this study underscore the sociocultural embeddedness of curricular sorting processes. Broader appreciation of this contextual contingency by policy makers and the public is important for two reasons. First, the recognition that gender takes on different shapes in different economic and cultural environments helps undermine widespread gender-essentialist tropes that treat men and women as categorically opposite creatures (e.g., "Men Are from Mars, Women Are from Venus"; see, Gray, 2012). Research has shown that these sorts of stereotypes can be powerful drivers of gender segregation, especially when combined with expectations that adolescents choose paths that allow them to realize their "true selves" (Breda et al., 2020; Cech, 2013; Charles & Bradley, 2009; Correll, 2004; Francis et al., 2017; Soylu Yalcinkaya & Adams, 2020; Thébaud & Charles, 2018; Vincent-Ruz & Schunn, 2017; Wonch Hill et al., 2017).

Second, recognizing that gender equality is achievable in some STEM contexts may spur educators and administrators to look beyond their immediate environments to find ways of decreasing gender disparities. Although not every solution is transferable, the knowledge that gender integration is possible might encourage stakeholders to think more critically about their own contexts and to ask how knowledge from elsewhere might be used to improve local decision-making.

Conclusion

The underrepresentation of women and girls in many STEM fields has been an increasingly central theme in research and policy worlds over the last three decades (Brotman & Moore, 2008; United Nations Educational Scientific and Cultural Organization, 2017). Countless public and private initiatives aimed at equalizing gender distributions have been motivated by interests in promoting social justice and gender equality and by practical concerns about labor shortages and their potential effects on economic development. In the United States, other than increasing women's presence in biological and health-related fields, these efforts have so far fallen short. Our results underscore the importance of making policy decisions based on carefully controlled studies and multivariate analysis, rather than gendered anecdotes. They also highlight the strong context-sensitivity of processes generating gender segregation and the need to attend to the specific sociocultural environments in which organizational and policy initiatives operate.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11199-022-01292-3.

Acknowledgements Authors are listed in alphabetical order to denote their equal contribution to this paper. An earlier version of this paper was presented at the European Educational Research Association conference held (online) in Geneva in September 2021. The authors wish to thank Eyal Bar-Haim for methodological assistance, anonymous reviewers and editors for helpful comments, and BGU graduate students Gila Manevich Malul, Dalal Assadi, and Nusiba Abo Riash for important contributions to the larger comparative project supporting this study.

Funding This study was funded by the U.S.-Israel Binational Science Foundation (BSF) (grant number 2018156).

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

References

Archer, L., Moote, J., & MacLeod, E. (2020). Learning that physics is 'not for me': Pedagogic work and the cultivation of habitus among advanced level physics students. *Journal of the Learning Sciences, 29*(3), 347–384. https://doi.org/10.1080/10508406.2019.1707679

Ayalon, H. (2002). Mathematics and sciences course taking among Arab students in Israel: A case of unexpected gender equality. *Educational Evaluation and Policy Analysis, 24*(1), 63–80. https://doi.org/10.3102/2F01623737024001063

Ayalon, H. (2006). Nonhierarchical curriculum differentiation and inequality in achievement: A different story or more of the same? *Teachers College Record, 108*(6), 1186–1213. https://doi.org/10.1111/j.1467-9620.2006.00690.x

Bar-Haim, E., & Feniger, Y. (2021). Tracking in Israeli high schools: Social inequality after 50 years of educational reforms. *Longitudinal and Life Course Studies, 12*(3), 423–440. https://doi.org/10.1332/175795921X16113479066488

Baram-Tsabari, A., & Yarden, A. (2008). Girls' biology, boys' physics: Evidence from free-choice science learning settings. *Research in Science & Technological Education, 26*(1), 75–92. https://doi.org/10.1080/02635140701847538

Belikoff, M. (2014). *Gaps between Jews and Arabs in the education system: Physical infrastructures*. Jerusalem: Sikkuy – The Association for the Advancement of Civic Equality. In Hebrew. http://www.sikkuy.org.il/wp-content/uploads/2014/12/%D7%A4%D7%A2%D7%A8%D7%99%D7%9D-%D7%91%D7%9E%D7%A2%D7%A8%D7%9B%D7%AA-%D7%94%D7%97%D7%99%D7%A0%D7%95%D7%9A-15.12.14.pdf. Accessed 19 November 2021.

Bigler, R. S., & Signorella, M. L. (2011). Single-sex education: New perspectives and evidence on a continuing controversy. *Sex Roles, 65*, 659–669. https://doi.org/10.1007/s11199-011-0046-x

Billger, S. M. (2009). On reconstructing school segregation: The efficacy and equity of single-sex schooling. *Economics of Education Review., 38*(3), 393–402. https://doi.org/10.1016/j.econedurev.2007.08.005

Blass, N. (2017). *The Arab education system in Israel: Are the gaps closing?* Jerusalem: Taub Center for Social Policy Studies in Israel. In Hebrew.

Blass, N. & Bleikh, H. (2020). *Expenditure per class and per student in the primary school education system*. Jerusalem: Taub Center for Social Policy Studies in Israel. In Hebrew.

Breda, T., Jouini, E., Napp, C., & Thebault, G. (2020). Gender stereotypes can explain the gender-equality paradox. *Proceedings of the National Academy of Sciences, 117*(49), 31063–31069. https://doi.org/10.1073/pnas.2008704117

Bridge, L. (2019). *Opinion: We are short-changing our girls in co-ed schools*. The Educator Online. https://www.theeducatoronline.com/k12/news/opinion-we-are-shortchanging-our-girls-in-coed-schools/265413. Accessed 19 November 2021.

Brizendine, L. (2006). *The female brain*. Morgan Road Books.

Brotman, J. S., & Moore, F. M. (2008). Girls and science: A review of four themes in the science education literature. *Journal of Research in Science Teaching, 45*(9), 971–100. https://doi.org/10.1002/tea.20241

Cech, E. A. (2013). The self-expressive edge of occupational sex segregation. *American Journal of Sociology, 119*(3), 747–789. https://doi.org/10.1086/673969

Cech, E. A. (2021). *The trouble with passion: How searching for fulfillment at work fosters inequality*. University of California Press.

Charles, M. (2011). What gender is science? *Contexts, 10*(2), 22–28. https://doi.org/10.1177/2F1536504211408795

Charles, M. (2017). Venus, Mars, and math: Gender, societal affluence, and eighth graders' aspirations for STEM. *Socius, 3*, 1–16. https://doi.org/10.1177/2F2378023117697179

Charles, M., & Bradley, K. (2009). Indulging our gendered selves? Sex segregation by field of study in 44 countries. *American Journal of Sociology, 114*(4), 924–976. https://doi.org/10.1086/595942

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*(6), 1045–1060. https://doi.org/10.1037/a0016239

Chow, T., & Charles, M. (2020). An inegalitarian paradox: On the uneven gendering of computing work around the world. In C. Frieze & J. L. Quesenberry (Eds.), *Cracking the digital ceiling: Women in computing around the world* (pp. 25–45). Cambridge University Press.

Correll, S. J. (2004). Constraints into preferences: Gender, status, and emerging career aspiration. *American Sociological Review, 69*(1), 93–113. https://doi.org/10.1177/2F000312240406900106

Cotter, D., Hermsen, J. M., & Vanneman, R. (2011). The end of the gender revolution? Gender role attitudes from 1977 to 2008. *American Journal of Sociology, 117*(1), 259–289. https://doi.org/10.1086/658853

Dagan, M. (2006). *Religious Zionist education and the challenges of modern time*. Ministry of Defense Publishing. In Hebrew.

Dajani, R., Dhawan, S., & Awad, S. M. (2020). The increasing prevalence of girls in STEM education in the Arab world. *Sociology of Islam, 8*, 159–174. https://doi.org/10.1163/22131418-00802002

DiPrete, T. A., & Buchmann, C. (2013). *The rise of women: The growing gender gap in education and what it means for American schools*. Russell Sage Foundation.

Eagly, A. H., & Koenig, A. M. (2021). The vicious cycle linking stereotypes and social roles. *Current Directions in Psychological Science, 30*(4), 343–350. https://doi.org/10.1177/F09637214211013775

Elyakim, N. (2020). Neo-liberalism and religiosity in state-religious secondary education: Sorting, parental choice and social stratification. [Unpublished doctoral dissertation] Ben-Gurion University of the Negev. In Hebrew.

Ensmenger, N. (2015). "Beards, sandals, and other signs of rugged individualism": Masculine culture within the computing professions. *Osiris, 30*(1), 38–65. https://doi.org/10.1086/682955

Falk, A., & Hermle, J. (2018). Relationship of gender differences in preferences to economic development and gender equality. *Science, 362*(6412), eaas9899. https://doi.org/10.1126/science.aas9899

Feniger, Y. (2011). The gender gap in advanced math and science course taking: Does same-sex education make a difference? *Sex Roles, 65*, 670–679. https://doi.org/10.1007/s11199-010-9851-x

Finseraas, H., & , Kotsadam, A. (2017). Ancestry culture and female employment: An analysis using second-generation siblings. *European Sociological Review, 33*(3), 382–392. https://doi.org/10.1093/esr/jcx048

Folberg, A. M., & Kaboli-Nejad, S. (2020). A mixed method examination of gender differences in perceptions of STEM among Iranian Americans. *Journal of Social Issues, 76*(3), 543–576. https://doi.org/10.1111/josi.12393

Francis, B., Archer, L., Moote, J., DeWitt, J., MacLeod, E., & Yeomans, L. (2017). The construction of physics as a quintessentially masculine subject: Young people's perceptions of gender issues in access to physics. *Sex Roles, 76*(3–4), 156–174. https://doi.org/10.1007/s11199-016-0669-z

Friedman-Sokuler, N., & Justman, M. (2020). Gender, culture and STEM: Counter-intuitive patterns in Arab society. *Economics of Education Review, 74*, 101947. https://doi.org/10.1016/j.econedurev.2019.101947

Gray, J. (2012). *Men are from Mars, women are from Venus: The classic guide to understanding the opposite sex*. Harper.

Grunow, D., Begall, K., & Buchler, S. (2018). Gender ideologies in Europe: A multidimensional framework. *Journal of Marriage and Family, 80*(1), 42–60. https://doi.org/10.1111/jomf.12453

Haag, P. (1998). Single-sex education in grades K-12: What does the research tell us? In S. Morse (Ed.), *Separated by sex: A critical look at single-sex education for girls* (pp. 13–38). American Association of University Women.

Hadad Haj-Yahya, N., Saif, A., Kasir, N., & Fargeon, B. (2021). *Education in Arab Society: Disparities and signs of change*. Jerusalem: IDI and Portland Trust. In Hebrew. https://www.idi.org.il/media/15620/education-in-arab-society-disparities-and-signs-of-change.pdf. Accessed 19 November 2021.

Halpern, D. F., Elliot, L., Bigler, R. S., Fabes, R. A., Hanish, L. D., Hyde, J., & Liben, L. S. (2011). The pseudoscience of single-sex schooling. *Science, 333*(6050), 1706–1707. https://doi.org/10.1126/science.1205031

Hazzan, O., Nativ-Ronen, E., & Umansky, T. (2020). A gender perception on computer science education in Israel from high school, through the military and academia to the tech industry. In C. Frieze & J. L. Quesenberry (Eds.), *Cracking the digital ceiling: Women in computing around the world*. Cambridge University Press. https://doi.org/10.1017/9781108609081.006

Inglehart, R., & Norris, P. (2003). *Rising tide: Gender equality and cultural change around the world*. Cambridge University Press.

Israel Central Bureau of Statistics. (2020). *Statistical abstracts of Israel 2019 – No. 70*. Jerusalem: The State of Israel.

Jackson, C. K. (2012). Single-sex schools, student achievement, and course selection: Evidence from rule-based student assignments in Trinidad and Tobago. *Journal of Public Economics, 96*(1–2), 173–187. https://doi.org/10.1016/j.jpubeco.2011.09.002

Jackson, R. M. (1998). *Destined for equality: The inevitable rise of women's status*. Harvard University Press.

James, A. N. (2009). *Teaching the female brain: How girls learn math and science*. Corwin Press.

Lagesen, V. A. (2008). A cyberfeminist utopia? Perceptions of gender and computer science among Malaysian women computer science students and faculty. *Science, Technology, & Human Values, 33*(1), 5–27. https://doi.org/10.1177/2F0162243907306192

Lavee, Y., & Katz, R. (2003). The family in Israel: Between tradition and modernity. *Marriage & Family Review, 35*(1–2), 193–217. https://doi.org/10.1300/J002v35n01_11

Law, H., & Sikora, J. (2020). Do single-sex schools help Australians major in STEMM at university? *School Effectiveness and School Improvement, 31*(4), 605–627. https://doi.org/10.1080/09243453.2020.1755319

Leslie, S. J., Cimpian, A., Meyer, M., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science, 347*(6219), 262–265. https://doi.org/10.1126/science.1261375

Liu, R. (2020). Do family privileges bring gender equality? Instrumentalism and (de)stereotyping of STEM career aspiration among Chinese adolescents. *Social Forces, 99*(1), 230–254. https://doi.org/10.1093/sf/soz137

Ma, Y. (2009). Family socioeconomic status, parental involvement, and college major choices: Gender, race/ethnic, and nativity patterns. *Sociological Perspectives, 52*(2), 211–34. https://doi.org/10.1525/2Fsop.2009.52.2.211

Maagan, D., & Zussman, N. (2019). *Assessing the effectiveness of the Scientific-Technological Reserves and Give Five programs*. Jerusalem: The Bank of Israel Research Department. In Hebrew.

Mael, F. (1998). Single-sex and coeducational schooling: Relationships to socioemotional and academic development. *Review of Educational Research, 68*, 101–129. https://doi.org/10.3102/2F00346543068002101

Mael, F., Smith, M., Alonso, A., Rogers, K., & Gibson, D. (2004). *Theoretical arguments for and against single-sex schools: A critical analysis of the explanations.* American Institutes for Research.

Moshfeghyeganeh, S., & Hazari, Z. (2021). Effect of culture on women physicists' career choice: A comparison of Muslim majority countries and the West. *Physical Review Physics Education Research, 17*(1), 010114. https://doi.org/10.1103/PhysRevPhysEducRes.17.010114

Moss-Racusin, C. A., Sanzari, C., Caluori, N., & Rabasco, H. (2018). Gender bias produces gender gaps in STEM engagement. *Sex Roles, 79*(11), 651–670. https://doi.org/10.1007/s11199-018-0902-z

Mullen, A. L. (2014). Gender, social background, and the choice of college major in a liberal arts context. *Gender & Society, 28*(2), 289–312. https://doi.org/10.1177/2F0891243213512721

National Coalition of Girls' Schools. (2020). *Why girls' schools*. National Coalition of Girls' Schools website. https://www.ncgs.org/advocacy/why-girls-schools. Accessed 19 November 2021.

National Science Foundation (NSF). (2021). Data tables. Women, minorities, and persons with disabilities in science and engineering. https://ncses.nsf.gov/pubs/nsf21321/. Accessed 19 November 2021.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math ≠ me. *Journal of Personality and Social Psychology, 83*(1), 44–59. https://doi.org/10.1037/0022-3514.83.1.44

Pahlke, E., Bigler, R. S., & Patterson, M. M. (2014a). Reasoning about single-sex schooling for girls among students, parents, and teachers. *Sex Roles, 71*(5–8), 261–271. https://doi.org/10.1007/s11199-014-0410-8

Pahlke, E., Hyde, J. S., & Allison, C. M. (2014b). The effects of single-sex compared with coeducational schooling on students' performance and attitudes: A meta-analysis. *Psychological Bulletin, 140*(4), 1042–1072. https://doi.org/10.1037/a0035740

Park, H., Behrman, J. R., & Choi, J. (2018). Do single-sex schools enhance students' STEM (science, technology, engineering, and math) outcomes? *Economics of Education Review, 62*, 35–47. https://doi.org/10.1016/j.econedurev.2017.10.007

Pinson, H., Feniger, Y., & Barak, Y. (2020). Explaining a reverse gender gap in advanced physics and computer science course-taking: An exploratory case study comparing Hebrew-speaking and Arabic-speaking high schools in Israel. *Journal of Research in Science Teaching, 57*(8), 1177–1198. https://doi.org/10.1002/tea.21622

Quadlin, N. (2020). From major preferences to major choices: Gender and the logics of major choice. *Sociology of Education, 93*(2), 91–109. https://doi.org/10.1177/2F0038040719887971

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Sage.

Reid, N., & Skryabina, E. A. (2003). Gender and physics. *International Journal of Science Education, 25*(4), 509–536. https://doi.org/10.1080/0950069022000017270

Röder, A., & Mühlau, P. (2014). Are they acculturating? Europe's immigrants and gender egalitarianism. *Social Forces, 92*(3), 899–928. https://doi.org/10.1093/sf/sot126

Sagy, S., Orr, E., Bar-On, D., & Awwad, E. (2001). Individualism and collectivism in two conflicted societies: Comparing Israeli-Jewish and Palestinian-Arab high school students. *Youth & Society, 33*(1), 3–30. https://doi.org/10.1177/2F0044118X01033001001

Sandler, P. M., Sonnert, G., Harazi, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education, 96*(3), 411–427. https://doi.org/10.1002/sce.21007

Sax, L. J., Arms, E., Woodruff, M., Riggers, T., & Eagan, K. (2009). *Women graduates of single-sex and coeducational high schools, differences in their characteristics and the transition to college*. Sudikoff Family Institute for Education & New Media, UCLA Graduate School of Education & Information Studies. http://heri.ucla.edu/PDFs/Sax_FINAL%20REPORT_Sing_1F02B4.pdf

Sax, L. J., Lehman, K. J., Barthelemy, R. S., & Lim, G. (2016). Women in physics: A comparison to science, technology, engineering, and math education over four decades. *Physical Review Physics Education Research, 12*(2), 020108. https://doi.org/10.1103/PhysRevPhysEducRes.12.020108. Accessed 19 November 2021.

Schneeweis, N., & Zweimüller, M. (2012). Girls, girls, girls: Gender composition and female school choice. *Economics of Education Review, 31*(4), 482–500. https://doi.org/10.1016/j.econedurev.2011.11.002

Sharabi, M. (2014). The relative centrality of life domains among Jews and Arabs in Israel: The effect of culture, ethnicity, and demographic variables. *Community, Work & Family, 17*(2), 219–236. https://doi.org/10.1080/13668803.2014.889660

Sikora, J. (2014). Gender gap in school science: Are single-sex schools important? *Sex Roles, 70*(9–10), 400–415. https://doi.org/10.1007/s11199-014-0372-x

Soylu Yalcinkaya, N., & Adams, G. (2020). A cultural psychological model of cross-national variation in gender gaps in STEM participation. *Personality and Social Psychology Review, 24*(4), 345–3700. https://doi.org/10.1177/2F1088868320947005

Stoet, G. & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering and math education. *Psychological Science, 29*(4), 581–593. https://doi.org/10.1177/2F0956797617741719

Thébaud, S., & Charles, M. (2018). Segregation, stereotypes, and STEM. *Social Sciences, 7*, 111. https://doi.org/10.3390/socsci7070111

United Nations Educational Scientific and Cultural Organization (UNESCO). (2017). *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM) UNESCO.* Retrieved November 19, 2021, from https://unesdoc.unesco.org/ark:/48223/pf0000253479

Vincent-Ruz, P., & Schunn, C. D. (2017). The increasingly important role of science competency beliefs for science learning in girls. *Journal of Research in Science Teaching, 54*(6), 790–822. https://doi.org/10.1002/tea.21387

Weisgram, E. S., & Diekman, A. B. (2017). Making STEM family friendly: The impact of perceiving science careers as family-compatible. *Social Sciences, 6*(2), 61. https://doi.org/10.3390/socsci6020061

Wonch Hill, P., McQuillan, J., Talbert, E., Spiegel, A., Gauthier, G. R., & Diamond, J. (2017). Science possible selves and the desire to be a scientist: Mindsets, gender bias, and confidence during early adolescence. *Social Sciences, 6*(2), 55. https://doi.org/10.3390/socsci6020055

Xie, Y., Fang, M., & Shauman, K. (2015). STEM education. *Annual Review of Sociology, 41*, 331–357. https://doi.org/10.1146/annurev-soc-071312-145659

Yuchtman-Yaar, E. (2002). Value priorities in Israeli society: An examination of Inglehart's theory of modernization and cultural variation. *Comparative Sociology, 1*(3), 347–367. https://doi.org/10.1163/9789047404361_008

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*(1), 215–246. https://doi.org/10.3102/2F00028312037001215

Zohar, A., & Sela, D. (2003). Her physics, his physics: Gender issues in Israeli advanced placement physics classes. *International Journal of Science Education, 25*(2), 245–268. https://doi.org/10.1080/09500690210126766

Online supplement for Blank, C., Charles, M., Feniger, Y., & Pinson, H. (2022). Context matters: Gendering of physics in Arabic-speaking, Hebrew-speaking, and single-sex state schools in Israel. *Sex Roles*.

Table S1

Descriptive Statistics for Population and Sample

	Entire population					Math score sample					
School	*N*	% Girls	Parental Educ, yrs.	School Affluence (1-10)	% Physics Students	*N*	% Girls	Parental Educ, yrs.	School Affluence (1-10)	% Physics Students	Math Score (200-800)
Hebrew-speaking Coed	152,001	50.21	14.29 (3.11)	5.76 (2.08)	12.43	34,321	51.12	14.33 (3.06)	5.80 (2.04)	13.42	527.67 (98.63)
Hebrew-speaking Single-sex	30,420	55.2	14.70 (3.59)	5.25 (1.88)	10.24	6,108	54.44	14.86 (3.52)	5.33 (1.86)	12.60	525.07 (93.66)
Arabic-speaking Coed	52,649	57.5	11.64 (2.78)	2.11 (1.12)	9.42	11,457	58.09	11.61 (2.68)	2.02 (1.07)	9.69	491.92 (93.99)

Note. Values are means (standard deviations). Data are from Ministry of Education administrative files 2015-2017. Students who immigrated to Israel after the age of 5 were excluded from the analysis.

Table S2

Enrolment in physics and control variables by school sector and gender

	Hebrew-speaking Coeducational		Hebrew-speaking Single-sex		Arabic-speaking Coeducational	
	Boys N=15,897	Girls N=16,823	Boys N=2,594	Girls N=2,817	Boys N=4,468	Girls N=6,028
Enrollment						
Number enrolled in physics	3,164	1,447	511	299	469	645
Percent of physics students	69.5	31.5	63.0	37.0	41.4	58.6
Percent enrolled in physics	19.9	8.6	19.7	10.6	10.5	10.7
Girl-to-boy physics odds ratio	0.38		0.48		1.02	
Control variables						
Parental education	14.50 (3.02)	14.34 (3.09)	14.94 (3.67)	15.17 (3.27)	11.87 (2.71)	11.52 (2.65)
School SES	5.92 (2.00)	5.88 (2.00)	5.71 (1.96)	5.36 (1.68)	2.11 (1.09)	2.06 (1.05)
Prior math score	535.62 (97.43)	529.15 (96.70)	526.25 (94.96)	535.09 (89.82)	490.65 (94.34)	501.38 (92.58)

Note. The sample is comprised of all students with available 8th-grade mathematics test scores in schools that offer physics. Standard deviations are in parentheses. Within each sector, odds ratios are defined as (GP/BP) / (GNP/BNP), where GP= # girls taking physics, BP= # boys taking physics, GNP= # girls not taking physics, and BNP= # boys not taking physics.

Table S3

Mixed models predicting physics enrollment in state high schools, by gender

Variable	Coeducational schools (Arabic- and Hebrew-speaking)		Hebrew-speaking schools (coeducational and single-sex)	
	Girls	**Boys**	**Girls**	**Boys**
Student Characteristics				
Parental Education, in Years	0.089*** (0.010)	0.081*** (0.009)	0.082*** (0.011)	0.067** (0.009)
Math Score (200-800 scale)	0.026*** (0.001)	0.025*** (0.001)	0.027*** (0.001)	0.024*** (0.001)
Cohort Year (ref=2015)				
2016	0.330** (0.114)	0.263** (0.007)	0.322** (0.115)	0.347*** (0.095)
2017	0.490*** (0.108)	0.325*** (0.089)	0.510*** (0.108)	0.298** (0.088)
School Characteristics				
School sector: Arabic-speaking (=1)	0.740*** (0.190)	-0.252 (0.174)		
School sector: Single-sex (=1)			0.263 (0.153)	0.397** (0.129)
Affluence (1-10)	-0.341** (0.042)	-0.052 (0.035)	-0.150*** (0.041)	-0.053 (0.034)
Intercept	-5.294*** (0.172)	-3.789*** (0.138)	-5.354*** (0.173)	-3.763*** (0.135)
Student N (school N)	21,755 (375)	19,309 (374)	19,065 (354)	17,856 (370)

Note. Values are coefficients (standard errors). See Tables 2 and 3 for information on sample and model specification.

* p < .05, ** p < .01, *** p < .001.

Table S4

Mixed models predicting physics enrollment in state high schools (including all immigrants)

Variable	Coeducational schools (Hebrew- and Arabic-speaking)	Hebrew-speaking schools (coeducational and single-sex)
Student Characteristics		
Immigrant (=1)	0.087 (0.090)	0.117 (0.080)
Girl (=1)	-1.240*** (0.100)	-1.429*** (0.108)
Parental Education, in Years	0.081*** (0.009)	0.067*** (0.008)
Parental Education × Girl	0.003 (0.013)	0.014 (0.013)
Math Score (200-800 scale)	0.025*** (0.001)	0.024*** (0.001)
Math Score × Girl	0.001 (0.001)	0.002**(0.001)
Cohort Year (ref=2015)		
2016	0.281** (0.081)	0.341*** (0.078)
2017	0.367*** (0.074)	0.382*** (0.072)
School Characteristics		
School sector: Arabic-speaking (=1)	0.015 (0.089)	
school sector: Single-sex (=1)		0.425** (0.127)
Affluence (1-10)	-0.067 (0.035)	-0.064*(0.032)
Cross-Level Interactions		
School sector (Arabic-speaking or single-sex) × Girl	0.846*** (0.122)	0.027 (0.170)
School Affluence × Girl	-0.064** (0.022)	-0.070** (0.022)
Intercept	-3.955*** (0.134)	-3.813*** (0.124)
Student N (school N)	41,410 (397)	36,904 (471)

Note. Model 1 is analogous to Model 3 in Table 2; Model 2 is analogous to Model 3 in Table 3. See Tables 2 and 3 for other details.

* p < .05, ** p < .01, *** p < .001.