



# Gender peer effects on students' educational and occupational expectations

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## ABSTRACT

To date, little is known about how gender peers affect students' educational and occupational expectations. This study investigates the gender peer effects on students' educational and occupational expectations, using the 2014 China Education Panel Survey. To address students' self-selection into classes, we choose a sample of schools that randomly assign students to classes. We find that exposure to more female peers increases students' probability of expecting to attend university and reduces their probability of expecting to complete only middle school. Besides, exposure to more female peers increases boys' and girls' probabilities of expecting to pursue a career as a manager, and reduces their probabilities of expecting to become a teacher, doctor, or lawyer. Moreover, exposure to more female peers has significant positive effects on both girls' and boys' probability of expecting to pursue prevalently male occupations. In addition, we discuss the mechanisms and check the robustness of the results. This study helps to understand the gender peer effects in education and the variations in individuals' educational and occupational choices.

## 1. Introduction

Understanding how individuals form educational and occupational expectations is critical to understanding variations in their educational and occupational choices. Expectations have been found to be important predictors of future outcomes: there is a systematic relationship between expectations and future outcomes (e.g., Arcidiacono, Joseph Hotz, & Kang, 2012; Attanasio & Kaufmann, 2009; Jacob & Wilder, 2010; Schoon, 2001; Sewell & Hauser, 1972; Sewell, Hauser, & Wolf, 1980; Sewell, Haller, & Ohlendorf, 1970; Sewell, Haller, & Portes, 1969; Wiswall & Zafar, 2015; Wiswall & Zafar, 2021; Zafar, 2013). Moreover, even if the *ex ante* expectations (beliefs) need not be exactly the same as *ex post* outcomes realized years later, expectations (beliefs) may be more important than realized outcomes in later periods to understand individuals' choices, as argued by Wiswall and Zafar (2021).<sup>1</sup> Despite the importance of expectations, little is known about how individuals form expectations. Individuals' expectations may be affected by many factors

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<sup>1</sup> To illustrate, it is difficult to infer whether realized outcomes were actually anticipated at the time of individuals made their choices. See Wiswall and Zafar (2021) for a detailed discussion about the relationship between *ex ante* outcomes, potential outcomes, and realized outcomes.

such as their parents, family socioeconomic status, teachers, and own ability and personality.<sup>2</sup> Moreover, because there are intensive social interactions among school peers, school peers may play an important role in shaping individuals' educational and occupational expectations.

To date the literature on peer effects in education has mainly focused on academic performance (e.g., Gong, Yi, & Song, 2021; Hill, 2015; Hill, 2017; Hoxby, 2000; Hu, 2015; Huang & Zhu, 2020; Lavy & Schlosser, 2011; Oosterbeek & van Ewijk, 2014; Xu, Zhang, & Zhou, 2022).<sup>3</sup> But there is little evidence on how gender peers affect students' educational and occupational expectations. In this paper, we investigate how gender peers (having a higher proportion of female classmates) affect students' educational and occupational expectations, using a representative sample of middle school students from China.<sup>4</sup> Chinese middle schools are ideal places to examine the peer effects, since in the schools students interact with their classmates intensively: they not only attend the same courses every day but also participate in extracurricular activities together frequently. Also, our study may have important policy implications, since understanding gender peer effects is important for evaluating the consequences of imbalanced sex ratios in coeducational schools, for an optimal grouping of students in schools and classrooms, and for an efficient allocation of resources across and within schools.

To identify the peer effects on students' outcomes, we need to address two major problems: the selection and the reflection problems (e.g., Feld & Zölitz, 2017; Manski, 1993; Manski, 2000). The selection problem states that individuals usually self-select into peer groups, i.e., individuals with similar characteristics are more likely to enter the same peer group, so it is difficult to distinguish between peer effects and selection effects. The reflection problem states that if the effect of peers on the individual and the effect of the individual on peers are determined simultaneously, then it is difficult to distinguish between the two effects.<sup>5</sup> To address the selection problem, two methods are widely used in the literature. The first method uses variation in the composition of students across grades within the same school to estimate compositional peer effects for same-grade schoolmates (e.g., Hoxby, 2000; Lavy & Schlosser, 2011). The second method exploits institutional random assignment of peers (e.g., Hu, 2015; Gong et al., 2021). We use the second method to overcome the selection problem. Specifically, we choose a sample of students who were randomly assigned to classes upon their entry to middle schools and had stayed in the same classes from then on. Also, we control for school and grade fixed effects in all estimations. That is to say, our strategy relies on comparison of students in a grade-school unit who are randomly assigned to classes with different proportions of girls, so our strategy is unlikely to suffer from the selection problem. In addition, the proportion of girls is predetermined in our setting, so our strategy is unlikely to suffer from the reflection problem.

We use two methods to test whether the students in our sample were really assigned to classes randomly. First, if students were assigned to classes randomly, we should observe no correlation between the proportion of girls in a class and students' background characteristics. Indeed, we find that the correlation between the proportion of girls and the students' characteristics is generally insignificant. Second, using Monte Carlo simulations, we show that the within grade-school variation in the proportion of girls resembles the variation that we would get by a random process. These results suggest that the students in our sample were really assigned to classrooms randomly, lending support that our empirical strategy is valid.

We estimate the effects of classroom gender peers on students' educational and occupational expectations.<sup>6</sup> For educational expectations, we find that a higher proportion of female peers reduces students' probability of expecting to achieve a low level of education (middle school) and increases their probability of expecting to achieve a high level of education (university or graduate school). Using expected years of education as an alternative measure, we find that a 10-percentage-points increase in the proportion of female peers increases girls' and boys' expected years of schooling by about 0.13 and 0.35 years, respectively. For occupational expectations, we find that a higher proportion of female peers increases students' probability of expecting to pursue a career as a manager, and reduces their probability of expecting to pursue a career as a teacher, doctor, or lawyer. Also, we find that a higher proportion of female peers increases students' probability of expecting to pursue a career as an athlete, but the effects are significant for only boys. Besides, we find little evidence of peer effects on students' probability of expecting to pursue a career in the other occupations.

In addition, we explore whether exposure to more female peers increases students' gender segregation in occupational choice. We classify the occupations into two broad groups according to the share of females: prevalently female (PF) group which consists of occupations (art performer, teacher/doctor/lawyer, and designer) with the highest share of girls, prevalently male (PM) group which consists of occupations (corporate manager, civil servant, athlete, scientist/engineer, and technician) with the smallest share of girls.

<sup>2</sup> See Jacob and Wilder (2010) for an analysis of educational expectations and see Bradley (1991) for an analysis of occupational expectations. Besides, Reuben, Wiswall, and Zafar (2017) find that individuals' overconfidence and competitiveness are important determinants of their expectations, and gender differences in the two attributes can explain a large part of the gender gap in earnings expectations.

<sup>3</sup> Some studies have also examined the peer effects on drug use, cigarette smoking, alcohol drinking, and criminal activity. See Epple and Romano (2011, chap. 20) and Sacerdote (2011, chap. 4) for a survey of peer effects in education.

<sup>4</sup> In this paper, we use expectations and aspirations interchangeably, although some studies argue that there is a slight difference between expectations and aspirations (see, e.g., Jacob & Wilder, 2010).

<sup>5</sup> Manski (1993, 2000) states the problems in a slightly different way. According to Manski (1993, 2000), it is generally difficult to disentangle three types of effects: (1) endogenous effects, wherein a member's outcome varies with the average outcome of the group; (2) exogenous (contextual) effects, wherein a member's outcome varies with the exogenous characteristics of the group members; and (3) correlated effects, wherein individuals with similar attributes self-select into groups. Because in our setting the gender composition is predetermined, endogenous effects are not applicable. The objective of our study is to separate exogenous (contextual) effects from correlated effects.

<sup>6</sup> Unfortunately, the data do not contain information on the majors that the students expect to pursue in university or graduate school, so we cannot examine the gender peer effects on students' major choice.

We find that a higher proportion of female peers significantly increases both girls' and boys' probabilities of expecting to pursue PM occupations, but has negative (statistically insignificant) effects on their probabilities of expecting to pursue PF occupations. One may think it is a little counter-intuitive that exposure to more female peers increases girls' probability of pursuing prevalently male occupations. One possible explanation is that girls establish a higher degree of self-confidence and are less restrained by gender stereotypes when they are exposed to a higher proportion of female peers in classes. As a result, girls will invest more human capital in male-dominated subjects (e.g., math and science) and make a less restrained occupational choice, i.e., girls are less likely to choose a traditionally female dominated occupation and are more likely to choose a traditionally male dominated occupation (e.g., Goulas et al., 2018; Schneeweis & Zweimüller, 2012).

Then we explore the mechanisms through which gender peers can affect students' expectations. We find that the proportion of female peers may affect students' educational expectations by improving their school enjoyment, academic performance and course satisfaction. Female peers affect students' occupational expectations by influencing their information acquisition and extracurricular activities. We further implement a decomposition analysis to quantify how much each mechanism explains the gender peer effects. Evidently, what we find are just suggestive evidence. We cannot rule out that there may be other mechanisms through which the gender composition plays a role. Our findings are consistent with Gong et al. (2021), who find that the proportion of female peers can affect students' study efforts and teachers' responsibility and patience, but are in contrast to Lavy and Schlosser (2011), who find that gender composition has insignificant effects on either students' or teachers' behavior.

We use several methods to check the robustness of the results. First, we show that teachers are also randomly assigned to classrooms, indicating that our estimates are unlikely to be biased due to non-random assignment of teachers. Second, we show that our estimates do not change significantly when we randomly drop some schools, implying that our baseline estimates are unlikely to be biased due to possible inclusion of some schools that actually did not assign students randomly. Third, we show that our results are unlikely to be biased due to sample attrition. Fourth, we provide evidence that our estimates are robust to an alternative specification. Fifth, we find evidence that peer effects are also significant for the students in the first grade of middle school, suggesting that our results are not entirely driven by students who have a longer period of exposure to their classmates. Sixth, our results remain consistent when we add additional controls for students' socio-economic status. Lastly, we adopt multiple choice models and find our estimates remain similar.

This study is related to the literature that investigates the effects of gender peers on students' major choice and labor market outcomes.<sup>7</sup> But to date the literature is still mixed regarding the influence of gender peers. First, some studies find that gender peers have little effects. For instance, utilizing initial random assignment of high school students to different classes within school-cohorts in Milan, Italy, Anelli and Peri (2019) find that the proportion of own-gender peers generally has little effects on students' major choice and earnings. Second, some other studies find that exposure to more female peers may increase students' gender segregation in major choice. For instance, using data from 525 public four-year colleges in the US, Hill (2017) finds that having more female peers increases men's graduation rates but reduces girls' probability of graduating in STEM majors. Besides, using data from Danish high school, Brenoe and Zölitz (2020) find that women exposed to a higher proportion of female peers become less likely to choose a male-dominated major (STEM) and more likely to choose a female-dominated major (health-related studies), whereas men exposed to more female peers are more likely to choose a male-dominated major and less likely to choose a female-dominated major. Also, using data from a Dutch business school, Zölitz and Feld (2021) get results that are similar to those of Brenoe and Zölitz (2020). In contrast, some studies find that exposure to more female peers may reduce students' gender segregation in major or school choice. For instance, using a sample of students from Austria, Schneeweis and Zweimüller (2012) find that exposure to a higher share of girls in previous grades reduces girls' probability of choosing a traditionally female dominated school type and increases their probability of choosing a male dominated school type. Using data from Greece, Goulas et al. (2018) find that having more female peers in a school or a neighborhood increases girls' probability of enrolling in a STEM post-secondary degree, but it has small and insignificant effects on boys' decision to study STEM.

To sum up, previous studies find that exposure to more female peers may have little effects on students' major choice and future incomes (e.g., Anelli & Peri, 2019), may increase students' gender segregation in major choice (e.g., Brenoe & Zölitz, 2020; Hill, 2017; Zölitz & Feld, 2021), or may reduce students' gender segregation in major or school choice (Goulas et al., 2018; Schneeweis & Zweimüller, 2012). By contrast, we find that both girls' and boys' probability of choosing prevalently male (PM) occupations increases when they are exposed to a higher proportion of girls. The findings imply that exposure to more female peers may have ambiguous effects on students' gender segregation in occupational choice. The differences in findings may result from different outcome variables: the literature mainly uses *ex post* measures of choices (realized outcomes), whereas we use *ex ante* measures of choices (expectations); also, previous studies mainly look into major choices, whereas we investigate occupational choices. Besides, the differences may also result from different definitions of peer groups (e.g., classmates versus school mates) or different study environment (e.g., middle

<sup>7</sup> In this study, we focus on the influence of gender peers in education. Another strand of literature investigates the influence of high-ability, low-ability, or disruptive peers in education (e.g., Arcidiacono & Nicholson, 2005; Bietenbeck, 2020; Booi, Leuven, & Oosterbeek, 2017; Carrell, Hoekstra, & Kuka, 2018; Feld & Zölitz, 2017; Feld & Zölitz, 2022; Hanushek, Kain, Markman, & Rivkin, 2003; Huang & Zhu, 2020; Lavy, Silva, & Weinhardt, 2012; Mouganie & Wang, 2020; Xu et al., 2022).

school versus college).<sup>8</sup>

This study contributes to the literature as follows. First, this study helps to understand how individuals form their educational and occupational expectations.<sup>9</sup> Our findings imply that classroom gender composition is an important factor that can shape individuals' educational and occupational expectations, which helps to understand the variations in individuals' educational and occupational choices. Second, although many studies have examined the peer effects on academic performance and other non-cognitive outcomes, few studies have explored the peer effects on educational and occupational expectations. Thus, this study expands the literature on peer effects in education.

More generally, by documenting that individuals' educational and occupational expectations can be affected by their peers, this study adds to empirical analysis of social interactions. According to Manski (2000), agents can interact with each other through three channels: constraints, expectations, and preferences, which are given formal expressions through choice sets, subjective probability distributions, and utility functions, respectively. In our setting, students can learn about the earning potential associated with an academic degree or an occupation from their peers. Besides, students' preferences towards an academic degree or an occupation could also be affected by their peers. Hence, what we estimate here is likely related to both expectation and preference interactions (Manski, 2000).

Lastly, this study provides new evidence on the mechanisms. Although many studies investigate gender peer effects, there is limited evidence on the mechanisms. To explore the mechanisms, a few studies have examined the gender peer effects on students' study efforts, classroom environment, teachers' teaching style and effort, and the quality of teacher-student relations (e.g., Gong et al., 2021; Lavy & Schlosser, 2011), but few studies examine the effects on students' course evaluation and extracurricular activities. We find that classroom gender peers can affect students' course satisfaction and extracurricular activities, which are novel in the literature.

This paper progresses as follows. Section 2 introduces the empirical strategy; Section 3 describes the data; Section 4 reports the results; Section 5 explores the mechanisms; Section 6 checks the robustness of the results; and the last section concludes the paper.

## 2. Empirical strategy

We investigate the effects of female peers on girls' and boys' outcomes by implementing a linear-in-means regression model, which is similar to those of previous studies such as Brenoe and Zölitz (2020) and Zölitz and Feld (2021). By using this specification, we allow for heterogeneous peer impacts on gender and implicitly assume that boys and girls are linearly affected by the proportion of female peers. Our estimation equation is as follows:

$$Y_{icgs} = \beta_1 Girl_i \times Peergirl_{-icgs} + \beta_2 Boy_i \times Peergirl_{-icgs} + \beta_3 Girl_i + \tau X_{icgs} + \lambda P_{-icgs} + \xi T_{cgs} + \theta_{gs} + \epsilon_{icgs} \quad (1)$$

where  $i, c, g,$  and  $s$  denote student, class, grade, and school, respectively.  $Y_{icgs}$  denotes the outcomes of student  $i$ , and  $Peergirl_{-icgs}$  represents the proportion of female peers of student  $i$ , i.e., the proportion of girls in student  $i$ 's class excluding student  $i$ .  $Girl_i$  and  $Boy_i$  are dummies for student's own gender. By including the interaction terms of gender dummies with the proportion of female peers, we can estimate the heterogeneous effects by gender.  $X_{icgs}$  represents parents' education and students' predetermined characteristics. Students' predetermined characteristics include age, ethnicity, whether is an only child in the family, whether is from low-income family, whether is local hukou,<sup>10</sup> whether attended kindergarten, and whether skipped or repeated a grade in primary school.<sup>11</sup>  $P_{-icgs}$  controls for student  $i$ 's peers' academic ability—female peers' and male peers' average performance in grade repetition and grade skipping in primary school.  $T_{cgs}$  further controls for head teacher's characteristics, including gender, teaching experience, years of education, job title, academic qualification (whether graduated from a normal university that specializes in teacher training), and marital status.  $\theta_{gs}$  represents school-grade fixed effects, and  $\epsilon_{icgs}$  is an error term.

The main coefficients of interest are  $\beta_1$  and  $\beta_2$ , which capture the impacts of female peers on girls' and boys' outcomes, respectively.  $\beta_3$  captures the gender gap in outcomes. The main challenge of identifying causal impacts comes from the self selection of peers. For instance, students with similar attributes may be more likely to enter the same classes. To address the selection problem, we restrict our sample to schools that randomly assign students to classes. Also, we control for school-grade fixed effects ( $\theta_{gs}$ ) in all estimations. Thus, we are utilizing the class level exogenous variation in the proportion of girls within a school-grade unit. In other words, we are comparing students with similar characteristics in the same grade of a school, except that some were assigned to a class with a high proportion of girls, whereas the others were assigned to a class with a low proportion of girls, due to some random factors. Hence,  $Girl_i \times Peergirl_{-icgs}$  and  $Boy_i \times Peergirl_{-icgs}$  should not be correlated with the error term  $\epsilon_{icgs}$ . We cluster standard errors at the class level

<sup>8</sup> The interactions between males and females may be different for different age groups, as documented by Oosterbeek and van Ewijk (2014).

<sup>9</sup> Note that students may update their expectations when they get more information about their own ability or the labor market (Zafar, 2011). Also, Jones and Kofoed (2020) find that students update their occupational preferences in West Point. But our aim is not to track all students' updates on their expectations. Rather, our aim is to identify the influence of gender peers on students' expectation formation.

<sup>10</sup> hukou is a system of household registration used in mainland China. It is connected to social programs provided by the government, which assigns benefits based on residency status. Whether the family has the local hukou is a key determinant of the social benefits (e.g. subsidized education systems, healthcare and pension) the household can obtain from the local government. Non-local hukou residents are similar to immigrants.

<sup>11</sup> The data provide no information on students' test scores in primary school. Thus, we use grade repetition and grade skipping in primary school as the baseline measure of students' academic ability.

to account for potential correlations among students' outcomes within a class.

One concern with our empirical strategy is whether there is sufficient variation in the share of girls across classes. To address this concern, we present the original distribution of the proportion of girls across all classes in our sample in Fig. 1(a). We can see that there is a wide variation in the proportion of girls, which ranges from 12.5% to 80%.<sup>12</sup> Moreover, because our identification relies on the variation across classes within a school-grade unit, we further plot the conditional distribution of the standard deviation of the proportion of girls in Fig. 1(b). The conditional standard deviation of the proportion of girls is obtained from the residuals by regressing the proportion of girls on school-grade fixed effects and a full set of controls ( $1 - R^2 = 0.236$ ). The within school-grade standard deviation of the proportion of girls is 4.1%, suggesting a large variation in the proportion of girls across classrooms.

In addition, because our identification relies on between-classroom differences in the proportion of girls within school-grade units, we would expect that most of these differences are different from zero. To illustrate this, we plot Fig. A1. Each dot in panel (a) of Fig. A1 represents a classroom pair within a school-grade unit, with the proportion of girls in classroom 1 on the x-axis and the proportion of girls in classroom 2 on the y-axis. The results suggest that very few of the school-grade units fall exactly on the 45-degree line, confirming that there are sufficient between-classroom variations in the proportion of girls within school-grade. Panel (b) of Fig. A1 further displays the distribution of the between-classroom differences in the proportion of girls within school-grade. Six out of 107 school-grades have only one class, and three out of 107 school-grades have missing information on the proportion of girls in one of the two classrooms. Among the rest of the 98 school-grades, 97 (99%) have within school-grade between-class variations in the proportion of girls. The average within school-grade variation is 7.5 percentage points and the median is 6.3 percentage points, indicating sufficient variations within school-grade to support our identification.

### 3. Data

We use data from the 2014 China Education Panel Survey—the first and largest education survey in China.<sup>13</sup> The survey applies a stratified sampling design and is nationally representative. It covers 112 middle schools from 28 counties and city districts. The original sample consists of 19,487 students from 438 classes. The data contain detailed information on the characteristics of students, parents, teachers, and schools.

To address students' self selection into classes, we restrict our sample to schools that randomly assign students to classes.<sup>14</sup> Specifically, we choose schools that satisfy all of the three criteria: (1) The school principal reports that the school randomly assigns newly enrolled students (in Grade 7) to classes. (2) The same principal reports that the school does not rearrange the classes in Grades 8 and 9. (3) All the head teachers in the same grade report that students are not assigned to classes based on their test scores.<sup>15</sup> According to the three criteria, 19, 15, and 11 schools are excluded, respectively. As a result, our baseline sample consists of 67 schools (in 26 cities), 208 classrooms, and 8,988 students.

#### 3.1. Measures of educational and occupational expectations

We construct the measures of educational and occupational expectations based on the survey questions. In the survey, students were asked to report the highest level of education that they expected to achieve. The choices are as follows: (1) drop out right now; (2) middle school; (3) high school; (4) three-year college degree; (5) Bachelor's degree; (6) graduate degree; and (7) indifferent (I do not care).<sup>16</sup> The outcome variables are dummies which indicate whether the students choose the categories. Fig. 2(a) shows the distribution of students' educational expectations by gender. We can see that most students expect to attend university or graduate school, and more girls than boys expect to do so.

Besides, students were asked to report the occupation that they expected to pursue. There are ten choices: (1) civil servant; (2) corporate manager; (3) scientist/engineer; (4) teacher/doctor/lawyer; (5) designer; (6) art performer; (7) athlete; (8) technician (including driver); (9) others;<sup>17</sup> (10) indifferent (I do not care). Our outcome variables are dummies which indicate whether the students choose the categories. Fig. 2(b) shows the distribution of students' occupational expectations by gender. Teacher/doctor/

<sup>12</sup> One may concern that the classes with extreme share of girls are special. In our sample, three classes from three different schools have extreme low share of girls (less than 20%). The three classes have a small number of students, and the three schools are located in urban areas and are younger than the other 64 schools. But the three schools have similar total number of classrooms and proportions of local students, and their principals have similar level of education to the others.

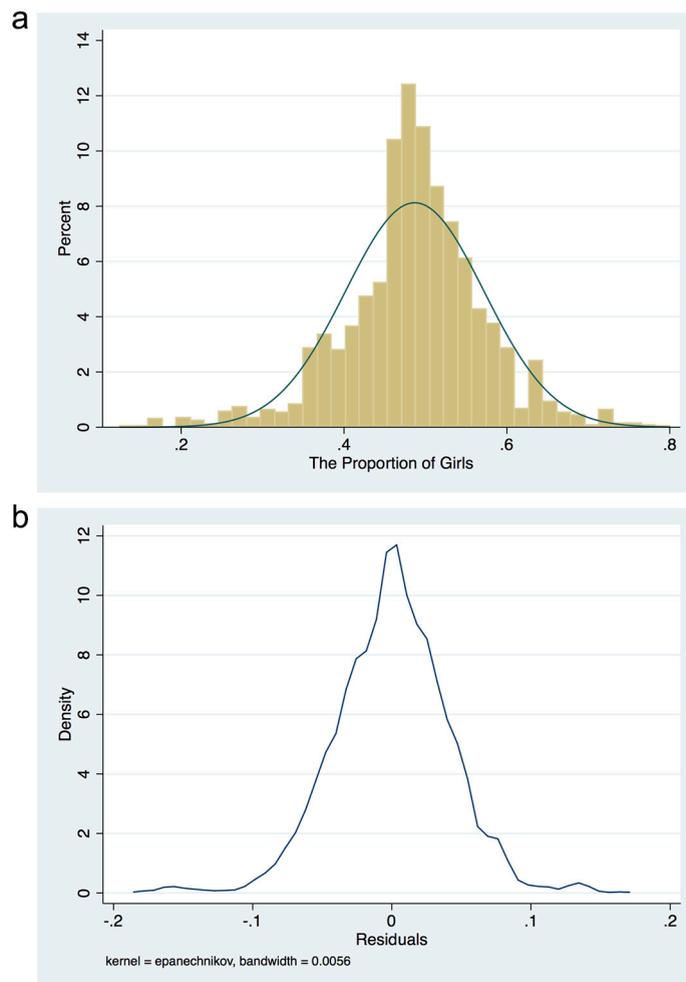
<sup>13</sup> The data have been used by previous studies to investigate the effects of teacher's gender on students' academic and non-cognitive outcomes (e.g., Gong, Yi, & Song, 2018; Xu & Li, 2018), to examine the impacts of migrant peers on the local students' academic performance (e.g., Hu, 2018; Wang, Cheng, & Smyth, 2018), to study the effects of low-ability peers on classmates' academic performance and non-cognitive outcomes (e.g., Huang & Zhu, 2020; Xu et al., 2022).

<sup>14</sup> In China, not all middle schools assign students to classes randomly. For example, some schools organize enrollment exams and assign students to classes according to their test scores.

<sup>15</sup> Some head teachers may misreport the actual assignment rule, so we retain only the schools in which all the head teachers in the same grade report the same assignment rule.

<sup>16</sup> Actually, there are ten categories in total in the questionnaire. For convenience, we have put three kinds of high schools together, and have put master's degree and Ph.D. together, so we have seven categories in total.

<sup>17</sup> Choosing the "others" category is not treated as an outcome variable in the regression analysis, since the information contained in the category is ambiguous.



**Fig. 1.** The distribution of the proportion of girls across classes. *Notes:* Figure (a) presents the original distribution of the proportion of girls across classes, together with a normal distribution. Figure (b) displays the distribution of the proportion of girls conditional on school-grade fixed effects and a full set of controls.

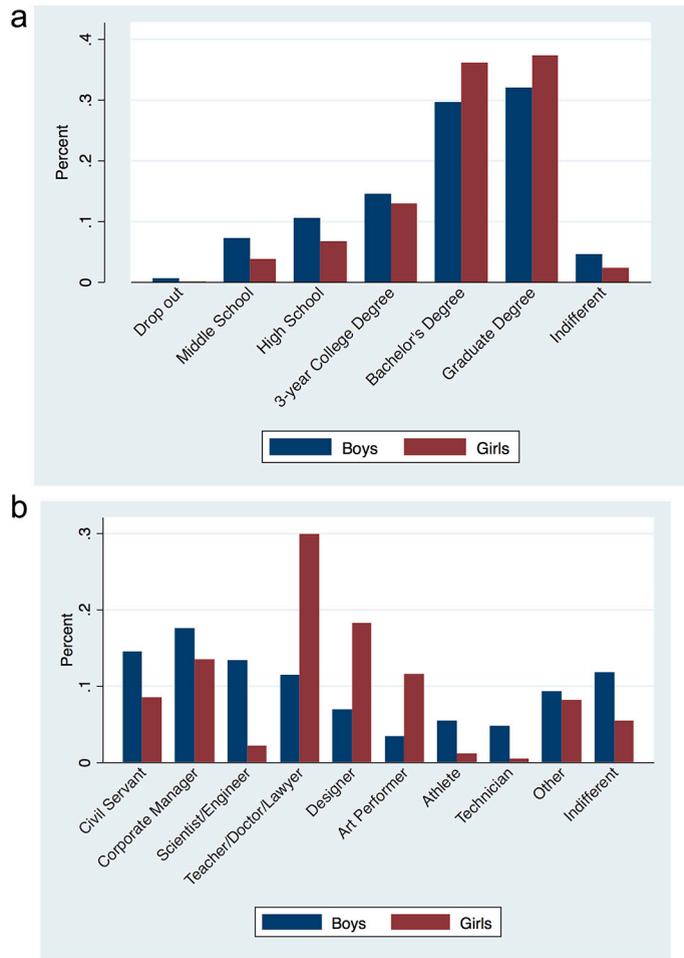
lawyer is the most popular occupation category among girls, whereas manager is the most popular one among boys. We can see that five occupation categories gain more popularity from boys than from girls: civil servant, manager, scientist/engineer, athlete, and technician. Three occupation categories are more favored by girls than by boys: teacher/doctor/lawyer, designer, and art performer.<sup>18</sup>

### 3.2. Summary statistics of the regressors

Table 1 presents the summary statistics of the regressors.<sup>19</sup> Panel A shows that the regressor of interest—the proportion of female peers—has a mean of 48.7% and a standard deviation of 8.5%. Panel B reports the summary statistics of students' and parents' characteristics. About 48.7% of the students are female. The students are about 14 years old on average. About 89.0% of them are Han ethnicity, about 50.9% are only-child in their families, and about 80.4% are local residents. For students' baseline academic ability,

<sup>18</sup> It will be interesting to explore the link between students' educational (occupational) expectations and their actual academic (career) development in the future. But we are unable to do so, since there are no available data on the students' actual academic (career) outcomes. To illustrate, our analysis is based on the first wave of the CEPS data, which took place in 2013–2014. The CEPS survey has only released one follow-up survey in 2014–2015, which has a low follow-up rate for the Grade 7 students and loses track of all of the Grade 9 students. Thus, we are unable to obtain information on students' actual academic or career development. Besides, as required by scientific research ethics, the CEPS keeps in strict confidence the names, zip codes and geographical locations of the sampled schools. Hence, we are unable to link the CEPS data with other external data sets to obtain the students' actual educational or career outcomes. This is a limitation of our study.

<sup>19</sup> To save space, we do not report the summary statistics of the main outcome variables in Table 1. Instead, we report them in the regression tables (Tables 3–5).



**Fig. 2.** The distribution of students' expectations by gender. *Notes:* The proportions of girls who choose the ten categories are 8.7%, 13.7%, 2.4%, 30.0%, 18.5%, 11.4%, 1.1%, 0.4%, 8.3%, and 5.5%, respectively. The proportions of boys who choose the ten categories are 14.7%, 17.7%, 13.9%, 11.6%, 7.1%, 3.5%, 5.4%, 4.8%, 9.7%, and 11.6%, respectively.

81.7% had attended kindergarten, and 11.2% had ever repeated a grade and 1.6% had ever skipped a grade in primary school. For parents' education, about 20.8% of the fathers and 17.7% of the mothers have a bachelor's degree or higher. Panel C suggests that there are slight differences between male and female peers' academic abilities. Panel D reports the statistics of the teachers. About 64.9% of the teachers are female. On average, the teachers have 16 years of teaching experience and 12 years of education. About 94.6% of them have a degree from a normal university that specializes in teacher training.

### 3.3. Evidence on the validity of the identification strategy

In this subsection, we use several methods to verify that the students in our sample are indeed assigned to classes randomly. If the students are randomly assigned to classes, we should observe insignificant differences in the predetermined characteristics of students from classes with different proportions of girls, i.e., the correlation between students' characteristics and the proportion of girls in a class should be insignificant. First, we test the validity of random assignment by regressing students' characteristics on the proportion of girls without including any controls and report the results in Panel A of Table 2. The results in Panel A suggest that the proportion of girls is significantly correlated with the probabilities of being a girl, being an only child, being a grade repeater, and having a father or mother with a college degree. But most of the correlations become statistically insignificant after we control for school-grade fixed effects, as shown below.

We include school-grade fixed effects in all regressions and report the results in Panel B of Table 2. The results show that all variables are balanced, except for the probability of being an only child (column (4)). Although the estimated coefficient in column (4) is statistically significant, the magnitude is very small: it means that a one-percentage-point increase in the proportion of girls is related to only a 0.277-percentage-points increase in student's probability of being an only child. In particular, there is a mechanical bias when we test whether gender is balanced across classes with different girl ratios (Guryan, Kroft, & Notowidigdo, 2009). To illustrate, because

**Table 1**  
Summary statistics of the regressors.

Variables	Mean	Std. Dev.	Observations
<i>Panel A: Regressor of interest</i>			
Girl proportion	0.487	0.085	8910
<i>Panel B: Student and parent characteristics</i>			
Female	0.487	0.500	8910
Age	14.045	1.231	8815
Han ethnicity	0.890	0.313	8968
Only child	0.509	0.500	8986
Local residence	0.804	0.397	8811
Kindergarten attendance	0.817	0.387	8912
Grade repeater	0.112	0.316	8965
Grade skipper	0.016	0.125	8966
Father: bachelor's degree or higher	0.208	0.406	8966
Mother: bachelor's degree or higher	0.177	0.382	8966
<i>Panel C: Peer ability</i>			
Male peers' grade repetition	0.125	0.155	8988
Female peers' grade repetition	0.104	0.155	8988
Male peers' grade skipping	0.020	0.035	8988
Female peers' grade skipping	0.013	0.030	8988
<i>Panel D: Teacher characteristics</i>			
Female teacher	0.649	0.477	8988
Teaching experience	16.020	7.961	8898
Teacher's years of schooling	12.068	0.446	8942
Normal university degree	0.946	0.227	8942
Job title	2.688	0.955	8894
Teacher's marital status	1.969	0.381	8942

individuals cannot be their own peers, defining the proportion of female peers by excluding oneself can lead to a negative relationship between the probability of being a girl and the proportion of female peers even in a random assignment setting. Due to this bias, random assignment can appear nonrandom, and positively matched peers can appear to be randomly assigned. We can correct the bias by adding additional controls for the mean of the sampling pool, since the bias is decreasing in the size of the population from which peers are drawn (Guryan et al., 2009). Hence, we also control for the proportion of girls in the same grade-school excluding student  $i$  when we test whether gender is balanced across classes in column (3). The estimate indicates that the relationship between the probability of being a girl and the proportion of female peers is small and insignificant. We further conduct an F-test to test the joint significance of those predetermined characteristics of students. Conditional on the school-grade fixed effects, we find that the ten included variables are jointly insignificant (F statistic = 0.63, p value = 0.79). Overall, the results show that students' characteristics are not associated with the proportion of female peers, implying that the proportion of female peers is as good as random.

Moreover, we examine whether students are randomly assigned to classes by performing Monte Carlo simulations.<sup>20</sup> Specifically, we randomly designate the gender of a student as female in each class using a binomial distribution function with  $p$  equal to the average proportion of females in the school-grade. We then compute the within school-grade standard deviation of the proportion of females. We repeat this process 1,000 times to obtain a 90% confidence interval for the standard deviations of the proportion of females for each school-grade. Fig. 3 shows that the observed standard deviation of the proportion of females is within the 90% empirical confidence intervals for 96% of the school-grade units. To summarize, we find that the within school-grade variation in the proportion of girls resembles the variation that we would get by a random process, which provides further evidence that students in our sample are really assigned to classrooms randomly.

## 4. Results

### 4.1. Gender peer effects on students' educational expectations

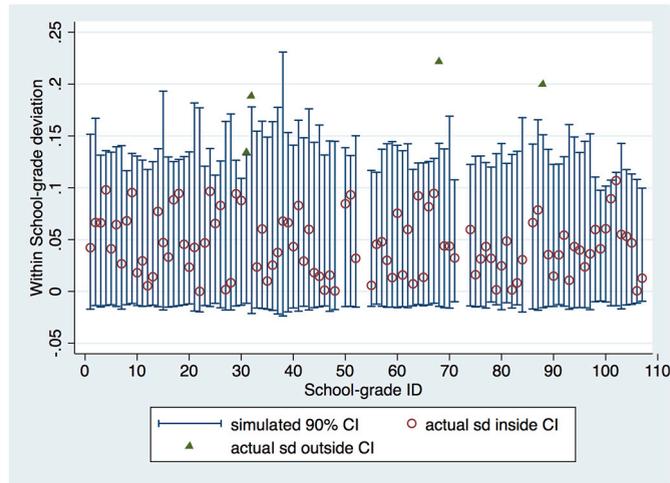
We examine the effects of the proportion of female peers on students' educational expectations and report the results in Table 3. The results in column (1) indicate that the proportion of female peers has little effects on either girls' or boys' dropout intentions. The results in column (2) suggest that a 10-percentage-points increase in the proportion of female peers reduces girls' probability of expecting their highest level of education to be middle school by about 1.55 percentage points, corresponding to a 41.9% reduction relative to the baseline. For boys, the negative impacts are bigger—2.59 percentage points (36.0%). The estimates in column (3) show that a higher proportion of female peers lowers boys' probability of expecting their highest level of education to be high school, whereas it has insignificant impacts on that of girls. The results in column (4) imply that the proportion of female peers has insignificant effects on either girls' or boys' probability of expecting their highest level of education to be 3-year college. The results in column (5) indicate that a 10-percentage-points increase in the proportion of female peers increases girls' and boys' probabilities of

<sup>20</sup> Our method is similar to that used by Lavy and Schlosser (2011).

**Table 2**  
Random assignment test for predetermined characteristics.

	Student Age (1)	Han Ethnicity (2)	Female Student (3)	Only Child (4)	Local Residence (5)	Kindergarten Attendance (6)	Grade Repeater (7)	Grade Skipper (8)	Father College (9)	Mother College (10)	Family Income (11)
<i>Panel A: OLS</i>											
Girl ratio	0.043 [0.918]	0.183 [0.307]	-0.487*** [0.179]	0.579** [0.238]	0.299 [0.204]	0.052 [0.145]	-0.342*** [0.131]	-0.023 [0.027]	0.376** [0.155]	0.311** [0.140]	-0.026 [0.205]
Observations	8742	8891	8910	8908	8735	8835	8888	8889	8888	8888	8257
R-squared	0.000	0.002	0.006	0.010	0.004	0.000	0.009	0.000	0.006	0.005	0.000
<i>Panel B: School-grade FE</i>											
Girl ratio	0.126 [0.128]	0.007 [0.037]	0.010 [0.031]	0.277*** [0.104]	0.003 [0.116]	0.148 [0.099]	0.022 [0.061]	0.001 [0.018]	0.081 [0.091]	0.025 [0.088]	-0.102 [0.089]
School-grade FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	8742	8891	8910	8908	8735	8835	8888	8889	8888	8888	8257
R-squared	0.787	0.515	0.869	0.302	0.237	0.097	0.197	0.025	0.277	0.263	0.229

Notes: Panel A presents OLS estimates of regressing the predetermined characteristics on the proportion of female peers. Panel B includes school-grade fixed effects in all regressions. Column (3) of Panel B also includes controls for the proportion of girls in the same grade-school, excluding student  $i$ . The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.



**Fig. 3.** Monte Carlo estimates of the proportion of girls. *Notes:* The figure presents the simulated and actual standard deviations of the proportion of girls for all school-grade units. Each vertical line represents the simulated 90% confidence intervals (CIs) for a school-grade unit. Six school-grade units have a standard deviation of zero, which are denoted by gaps in the figure. The circles represent the actual standard deviations that lie inside the CIs, whereas the triangles represent the actual standard deviations that lie outside the CIs.

**Table 3**  
Gender peer effects on educational expectations.

	Drop Out (1)	Middle School (2)	High School (3)	3-Year College (4)	Bachelor’s Degree (5)	Graduate Degree (6)	Indifferent (7)
Girl*Proportion girls	-0.010 [0.015]	-0.155** [0.074]	0.014 [0.108]	-0.079 [0.092]	0.320** [0.131]	0.097 [0.188]	-0.188*** [0.046]
Boy*Proportion girls	-0.010 [0.014]	-0.259*** [0.085]	-0.207** [0.105]	-0.010 [0.094]	0.361*** [0.113]	0.309* [0.175]	-0.184*** [0.053]
Girl	-0.004 [0.008]	-0.084** [0.037]	-0.144*** [0.042]	0.022 [0.050]	0.081 [0.058]	0.150** [0.060]	-0.021 [0.025]
Mean dep. var. girls	0.001	0.037	0.065	0.128	0.364	0.382	0.024
Mean dep. var. boys	0.006	0.072	0.107	0.141	0.303	0.325	0.046
Student controls	Y	Y	Y	Y	Y	Y	Y
Parent controls	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y
Peer ability controls	Y	Y	Y	Y	Y	Y	Y
School-grade FE	Y	Y	Y	Y	Y	Y	Y
Observations	8290	8290	8290	8290	8290	8290	8290
R-squared	0.021	0.105	0.078	0.044	0.056	0.145	0.030

*Notes:* Student controls include age and indicators for *Han* ethnicity, being an only child in the family, local *hukou* status, whether attended kindergarten, and whether skipped or repeated a grade in primary school. Parent controls include mother’s and father’s education. Teacher controls include head teacher’s gender, teaching experience, years of education, job title, indicator for graduating from a normal university, and marital status. Peer ability controls include female and male peers’ average performance in grade repetition and grade skipping. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.

expecting their highest level of education to be university by about 3.20 (8.8%) and 3.61 percentage points (11.9%), respectively. The results in column (6) imply that the proportion of female peers has insignificant effects on girls’ probability of expecting their highest level of education to be graduate school, whereas a 10-percentage-points increase in the proportion of female peers increases boys’ corresponding probability by 3.09 percentage points (9.5%). In addition, the estimates in column (7) suggest that a higher proportion of female peers reduces both girls’ and boys’ probabilities of not caring about which level of education to achieve.

Overall, we find that a higher proportion of female peers in the classroom reduces students’ probability of expecting to complete only middle school (high school as well for boys) and increases their probability of expecting to attend university (graduate school as well for boys), and the effects are relatively larger for boys.

**4.2. Gender peer effects on students’ occupational expectations**

We estimate the effects of the proportion of female peers on students’ occupational expectations and report the results in [Table 4](#). The estimates in columns (1), (3), (5), (6) and (8) are statistically insignificant, which indicate that the proportion of female peers may

**Table 4**  
Gender peer effects on occupational expectations.

	Civil Servant (1)	Corporate Manager (2)	Scientist/Engineer (3)	Teacher/Doctor/Lawyer (4)	Designer (5)	Art Performer (6)	Athlete (7)	Technician (8)	Indifferent (9)
Girl*Proportion girl peers	0.085	0.180**	-0.032	-0.269***	0.056	0.061	0.059	0.024	-0.014
	[0.075]	[0.088]	[0.052]	[0.099]	[0.076]	[0.062]	[0.037]	[0.035]	[0.070]
Boy*Proportion girl peers	0.074	0.172*	0.052	-0.191**	-0.050	0.072	0.103**	-0.016	-0.120*
	[0.075]	[0.089]	[0.062]	[0.094]	[0.072]	[0.056]	[0.050]	[0.049]	[0.068]
Girl	-0.063	-0.044	-0.078**	0.215***	0.062	0.085**	-0.019	-0.060**	-0.110**
	[0.040]	[0.053]	[0.033]	[0.054]	[0.045]	[0.036]	[0.026]	[0.028]	[0.043]
Mean dep. var. girls	0.087	0.137	0.024	0.300	0.185	0.114	0.011	0.004	0.055
Mean dep. var. boys	0.147	0.177	0.139	0.116	0.071	0.035	0.054	0.048	0.116
Student controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Parent controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Peer ability controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
School-grade FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	8258	8258	8258	8258	8258	8258	8258	8258	8258
R-squared	0.041	0.030	0.069	0.081	0.045	0.043	0.036	0.054	0.048

Notes: Student controls include age and indicators for Han ethnicity, being an only child in the family, local hukou status, whether attended kindergarten, and whether skipped or repeated a grade in primary school. Parent controls include mother's and father's education. Teacher controls include head teacher's gender, teaching experience, years of education, job title, indicator for graduating from a normal university, and marital status. Peer ability controls include female and male peers' average performance in grade repetition and grade skipping. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.

have little effects on either girls' or boys' probability of expecting to pursue a career as a civil servant, a scientist (or an engineer), a designer, an art performer or a technician. The results in column (2) suggest that a 10-percentage-points increase in the proportion of female peers increases girls' and boys' probabilities of expecting to pursue a career as a manager by about 1.80 (13.1%) and 1.72 percentage points (9.7%), respectively. The results in column (4) indicate that a 10-percentage-points increase in the proportion of female peers reduces girls' and boys' probabilities of expecting to pursue a career as a teacher, doctor, or lawyer by about 2.69 (9.0%) and 1.91 percentage points (16.5%), respectively. The results in column (7) indicate that a higher proportion of female peers increases students' probability of expecting to pursue a career as an athlete, but the effects are significant for only boys: a 10-percentage-points increase in the proportion of female peers increases boys' probabilities of expecting to pursue a career as an athlete by about 1.03 percentage points (19.1%), respectively. Additionally, girls tend to pay more attention to occupational expectations than boys, and the

**Table 5**  
Effects on educational and occupational expectations: alternative measures.

	Educational Expectations		Occupational Expectations	
	Expected Years of Education (1)		Prevalently Female (2)	Prevalently Male (3)
Girl*Proportion girl peers	1.318		-0.152	0.330***
	[1.266]		[0.111]	[0.126]
Boy*Proportion girl peers	3.498***		-0.165	0.408***
	[1.286]		[0.107]	[0.135]
Girl	1.491***		0.362***	-0.255***
	[0.385]		[0.073]	[0.078]
Mean dependent var girls	16.707		0.595	0.261
Mean dependent var boys	16.198		0.220	0.560
Student controls	Y		Y	Y
Parent controls	Y		Y	Y
Teacher controls	Y		Y	Y
Peer ability controls	Y		Y	Y
School-grade FE	Y		Y	Y
Observations	8000		8328	8328
R-squared	0.186		0.171	0.118

Notes: The prevalently female occupation consists of three occupation categories (art performer/teacher, doctor or lawyer, and designer) with share of girls above 70%. In contrast, the prevalently male group includes five occupation categories (corporate manager, civil servant, athlete, scientist/engineer, and technician) with share of girls below 45%. Student controls, parent controls, teacher controls, and peer ability controls are defined the same as before. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.

proportion of female peers slightly decreases boys' probabilities of not caring about which occupation to pursue (column (9)).

To summarize, we find that a higher proportion of female peers increases both girls' and boys' probabilities of expecting to pursue a career as a manager, and reduces their probabilities of expecting to pursue a career as a teacher, doctor, or lawyer. Besides, a higher proportion of female peers increases students' probability of expecting to pursue a career as an athlete (significant for only boys). Lastly, the effects on girls' and boys' probabilities of expecting to pursue the other occupations are all insignificant.

#### 4.3. Alternative outcome measures

For educational expectations, our main regressions examine the effects of gender peers on students' expected level of education. Now we use expected years of education as an alternative measure and re-run the regressions. Column (1) of Table 5 shows that the proportion of female peers has insignificant impacts on girls' expected years of education, but the impacts on boys' expected years of education are significant. A 10-percentage-points increase in the proportion of female peers increases girls' and boys' expected years of education by about 0.13 (0.8%) and 0.35 (2.2%) years, respectively.

For occupational expectations, we explore whether exposure to more female peers increases gender segregation in occupational choice. To do so, we divide the occupations into two broad groups according to the share of females. Specifically, we rank the occupations according to the share of girls in a descending order (Fig. 4), following Anelli and Peri (2019). The shares of girls among art performer, teacher/doctor/lawyer, designer, corporate manager, civil servant, athlete, scientist/engineer, and technician are 76.1%, 71.3%, 71.3%, 42.3%, 35.8%, 17.1%, 13.7%, and 8.3%, respectively. Then we divide the occupations into prevalently female (PF) and prevalently male (PM) groups. The PF group includes occupations (art performer, teacher/doctor/lawyer, and designer) with the share of girls all above 70%; and the PM group includes occupations (corporate manager, civil servant, athlete, scientist/engineer, and technician) with the share of girls all below 45%.

One may concern that whether there are enough within school-grade variations in the outcomes. To address this concern, we plot the within-school variation in the outcomes and report the results in Fig. A2. As suggested by the figure, there are sufficient within-school variations in the outcomes.

Columns (2) and (3) of Table 5 present the effects of female peers on students' probability of expecting to pursue a career in the two occupation groups. The estimates in column (2) are statistically insignificant, but the magnitudes are not negligible. The estimates in column (3) are large and statistically significant. The estimates indicate that for both girls and boys, exposure to more female peers may reduce their probabilities of choosing PF occupations and increase their probabilities of choosing PM occupations.<sup>21</sup> For girls, the peer effect would reduce gender segregation in occupational choice, whereas for boys the peer effect would increase gender segregation. Overall, the estimates in columns (2) and (3) suggest that exposure to more female peers may have ambiguous effects on gender segregation in occupational choice, depending on which effect dominates.

Our findings are in contrast to those of the previous studies that investigate gender peer effects on students' major choice and labor market outcomes. The previous studies find that exposure to more female peers may have little effects on students' major choice and future incomes (e.g., Anelli & Peri, 2019), may increase students' gender segregation in major choice (e.g., Brenoe & Zölitz, 2020; Hill, 2017; Zölitz & Feld, 2021), or may reduce students' gender segregation in school choice (Schneeweis & Zweimüller, 2012). There may be several reasons that our findings are different from the previous studies. First, we examine gender peer effects at an earlier life stage—in middle school, whereas the previous studies examine the effects in high school or college. Second, we examine the effects on occupational expectations, whereas the previous studies typically examine the effects on major choice. Lastly, the definition of peer group is different. We investigate the classroom peers, whereas the previous studies investigate different peer groups, such as the course section peers (Zölitz & Feld, 2021) and the college cohort (Hill, 2017).

## 5. Discussion

In this section, we discuss the potential mechanisms through which gender peers may affect students' educational and occupational expectations. Students' expectations about the future may be affected by their peers through daily social interactions, given that students normally spend a huge amount of time with their peers inside and outside the classroom. For instance, students may gain information from their peers about the value of a bachelor's degree. Therefore, they are more likely to expect to attend university and less likely to expect to finish only middle school. But due to data limitation, in this section we can provide only some suggestive evidence for the mechanisms. In addition, we cannot measure all relevant mechanisms and cannot rule out that other mechanisms may also play a role.

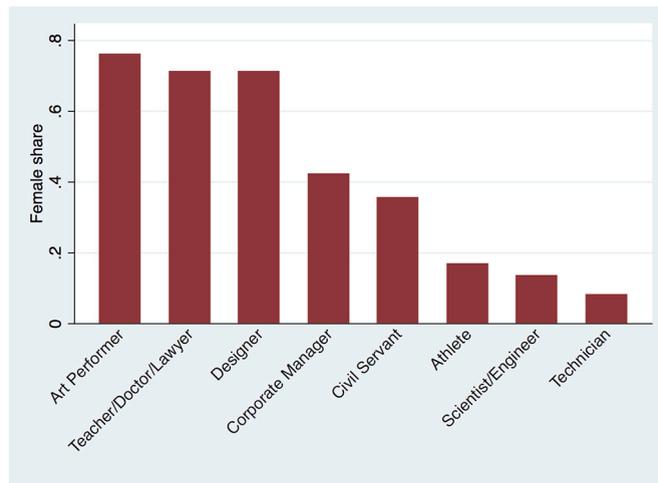
### 5.1. Educational expectations

Female peers can affect students' educational expectations by improving their school enjoyment and academic performance.

#### 5.1.1. Students' school enjoyment

Students' school enjoyment may affect their educational expectations. If students enjoy school, they may want to stay in school for

<sup>21</sup> Our results are consistent with Schneeweis and Zweimüller (2012), who also find that girls are more likely to choose a male dominated school type if they are exposed to a higher share of girls.



**Fig. 4.** The rank of occupations by the share of females. *Notes:* The figure displays the occupations according to the share of girls in a descending order. The shares of girls in the eighth categories are 76.1%, 71.3%, 71.3%, 42.3%, 35.8%, 17.1%, 13.7%, and 8.3%, respectively. The prevalently female group includes occupations (art performer, teacher/doctor/lawyer, and designer) with the share of girls all above 70%; and the PM group includes occupations (corporate manager, civil servant, athlete, scientist/engineer, and technician) with the share of girls all below 45%.

a longer time, i.e., they may expect to obtain more years of education. To test this possibility, we examine whether the proportion of female peers affects students’ school enjoyment and report the results in Table 6. The estimates in columns (1) indicate that a higher proportion of female peers increases both girls’ and boys’ probabilities of feeling that their classroom has a good atmosphere. The estimates in column (2) suggest that a higher proportion of female peers reduces both girls’ and boys’ probabilities of feeling bored in school. If students enjoy school, they are less likely to be late for classes or skip classes. Indeed, we find that a higher proportion of female peers reduces girls’ probability of being late to classes and reduces boys’ probability of skipping classes (columns (3) and (4)). Also, we find that a higher proportion of female peers increases students’ time allocated to study (column (5)). In addition, a higher proportion of female peers increases both girls’ and boys’ probabilities of feeling that their teachers are responsible and patient (columns (6) and (7)). Overall, the estimates suggest that a higher proportion of female peers can improve students’ school enjoyment, which may encourage them to obtain a higher level of education, e.g., to obtain a bachelor’s degree.

**Table 6**  
Mechanism: students’ school enjoyment.

	Good classroom atmosphere (1)	Feel bored (2)	Late for class (3)	Skip class (4)	Time allocated to study (5)	Teacher is responsible (6)	Teacher is patient (7)
Girl*Proportion girls	0.378**	-0.321***	-0.186***	-0.053	1.851***	0.199**	0.320***
	[0.148]	[0.106]	[0.063]	[0.038]	[0.332]	[0.090]	[0.116]
Boy*Proportion girls	0.422***	-0.301***	-0.021	-0.111***	1.748***	0.173*	0.375***
	[0.153]	[0.096]	[0.064]	[0.040]	[0.414]	[0.096]	[0.119]
Girl	0.086	-0.027	0.065	-0.039**	0.183	-0.011	0.038
	[0.053]	[0.048]	[0.042]	[0.019]	[0.212]	[0.048]	[0.043]
Student controls	Y	Y	Y	Y	Y	Y	Y
Parent controls	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y
Peer ability controls	Y	Y	Y	Y	Y	Y	Y
School-grade FE	Y	Y	Y	Y	Y	Y	Y
Observations	8257	8222	8295	8289	7506	7997	7985
R-squared	0.088	0.064	0.048	0.038	0.210	0.090	0.102

*Notes:* Student controls include age and indicators for Han ethnicity, being an only child in the family, local hukou status, whether attended kindergarten, and whether skipped or repeated a grade in primary school. Parent controls include mother’s and father’s education. Teacher controls include head teacher’s gender, teaching experience, years of education, job title, indicator for graduating from a normal university, and marital status. Peer ability controls include female and male peers’ average performance in grade repetition and grade skipping. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.

### 5.1.2. Students' academic performance and course evaluation

On average, students with better academic performance are more likely to have higher educational expectations. Hence, female peers can affect students' educational expectations by improving their academic performance. We examine whether the proportion of female peers affects students' test scores and display the results in Table 7. The estimates indicate that a higher proportion of female peers significantly increases girls' and boys' test scores (except for girls' Chinese scores). Our results are comparable to those of the previous studies, which also find that a higher proportion of female peers increases students' test scores (Hu, 2015; Gong et al., 2021).

Moreover, we examine whether the proportion of female peers affects students' evaluation of the courses they learn at school. If they believe that the courses they learn at school are useful for their future, they may want to get more years of education. Overall, the estimates in columns (4) to (6) of Table 7 suggest that a higher proportion of female peers significantly increases girls' and boys' probabilities of believing that the courses are helpful for their future (except for the math course).

To summarize, we find that a higher proportion of female peers increases both girls' and boys' test scores and perceived importance of the subjects, which can in turn encourage them to achieve a higher level of education, e.g., to obtain a bachelor's degree.

## 5.2. Occupational expectations

Gender peers can affect students' occupational expectations through two channels: information acquisition and extracurricular activities.

### 5.2.1. Information acquisition

Gender peers can affect students' occupational expectations by affecting their information about occupations. To illustrate, girls care more about the occupational choice, as indicated by the estimates in column (9) of Table 4. Hence, girls may be more likely to collect information about the pros and cons of different occupations. As a result, students exposed to a higher proportion of girls are likely to get more information about the pros and cons of different occupations from their female peers. Students exposed to a higher proportion of girls have a higher probability of expecting to become a manager, possibly because they get more information from their female peers about the high income and high socioeconomic status associated with a manager.

It may seem surprising that a higher proportion of female peers reduces students' probability of expecting to become a teacher, doctor, or lawyer, since these occupations are all high professional. But these occupations also have important disadvantages, especially in contemporary China. For instance, teachers and doctors have very heavy workloads and have to work overtime very often. Sometimes doctors are even subject to risks of violent attacks from insane patients or their families, due to medical disputes between patients and doctors (see, e.g., Huang & Ding, 2011; Lancet, 2010; Sun & Wang, 2011). These information can change students' perception of career risks and affect their occupational choices. Consistent with this interpretation, a recent study finds that one additional newspaper article on violence against doctors leads to a 0.6% decrease in the number of students enrolled in medicine-related majors, and this effect is more pronounced for physician and nursing majors (Bo, Chen, Song, & Zhou, 2020). In our setting, if students get more information about the disadvantages of doctors (teachers, or lawyers) from their female peers, they are less likely to choose these occupations. But from the data we do not know whether students get such information from their female peers, so we cannot test this hypothesis directly. This is a limitation of this study.

**Table 7**  
Mechanism: students' academic performance and course evaluation.

	Test scores			Course helpful		
	Math (1)	Chinese (2)	English (3)	Math (4)	Chinese (5)	English (6)
Girl*Proportion girl peers	0.899** [0.350]	0.258 [0.309]	0.879*** [0.311]	0.085 [0.096]	0.133** [0.060]	-0.171* [0.089]
Boy*Proportion girl peers	1.322*** [0.367]	1.176*** [0.355]	1.603*** [0.347]	0.127 [0.091]	0.175** [0.071]	0.045 [0.090]
Girl	0.341* [0.175]	1.029*** [0.142]	0.906*** [0.138]	0.015 [0.051]	0.084** [0.040]	0.224*** [0.050]
Student controls	Y	Y	Y	Y	Y	Y
Parent controls	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y
Peer ability controls	Y	Y	Y	Y	Y	Y
School-grade FE	Y	Y	Y	Y	Y	Y
Observations	8106	8107	8105	8291	8290	8282
R-squared	0.055	0.124	0.129	0.068	0.054	0.111

Notes: Student controls include age and indicators for Han ethnicity, being an only child in the family, local hukou status, whether attended kindergarten, and whether skipped or repeated a grade in primary school. Parent controls include mother's and father's education. Teacher controls include head teacher's gender, teaching experience, years of education, job title, indicator for graduating from a normal university, and marital status. Peer ability controls include female and male peers' average performance in grade repetition and grade skipping. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.

5.2.2. Extracurricular activities

Gender peers can affect students' extracurricular activities, which can in turn affect their preferences toward occupations. To illustrate, a higher proportion of female peers increases students' frequency of visiting museums, seeing movies, or watching sports games, as indicated by estimates displayed in columns (1) and (2) of Table 8. These activities may cultivate students' preferences for becoming an art performer or an athlete. Consistent with this interpretation, we find that a higher proportion of female peers increases students' probability of having a hobby of doing sports and increases their time spent on doing sports (columns (3) and (4)). These results may help to explain the finding that students (especially boys) exposed to a higher proportion of female peers are more likely to pursue a career as an athlete. To sum up, gender peers can affect students' occupational expectations by affecting their extracurricular activities.

5.3. Decomposition analysis

To quantify how much each mechanism explains the gender peer effects, we employ a decomposition method following Heckman, Pinto, and Saveliev (2013), Gelbach (2016), and Gong et al. (2018). We first use the exploratory factor analysis to reduce the dimensions of mechanisms and mitigate the potential correlations between mechanisms. The relevant mechanisms for educational expectations are students' report of good classroom atmosphere, feeling bored at school, being late to classes, skipping classes, study effort, evaluation of teachers, academic performance in main subjects and course evaluation. The factor analysis discards three mechanisms and identifies four factors which we interpret as academic performance in main subjects, evaluation of teachers, course evaluations and disruptive behaviors. The relevant mechanisms for occupational expectations are students' information acquisition,<sup>22</sup> and participation in extracurricular activities (frequency of visiting museums and zoos, frequency of watching movies and shows, having a hobby of doing sports and time spent on doing sports). The application of factor analysis produces two factors which we interpret as participation in recreational activities and sports. The derived factors are consistent with our discussions and previous literature in peer effects. We then decompose the gender peer effects into each factor. Our factor estimation specification is described as follows:

$$M_{icgs}^j = \alpha_1^j Girl_i \times Peergirl_{-icgs} + \alpha_2^j Boy_i \times Peergirl_{-icgs} + \alpha_3^j Girl_i + \tau X_{icgs} + \lambda P_{-icgs} + \xi T_{cgs} + \theta_{gs} + \epsilon_{icgs}^j \tag{2}$$

where  $M_{icgs}^j$  denotes the  $j$ th derived factor.

We then consider a specification that includes all derived factors into (1):

$$Y_{icgs} = \gamma_1 Girl_i \times Peergirl_{-icgs} + \gamma_2 Boy_i \times Peergirl_{-icgs} + \gamma_3 Girl_i + \tau X_{icgs} + \lambda P_{-icgs} + \xi T_{cgs} + \sum_j \phi^j M_{icgs}^j + \theta_{gs} + \epsilon_{icgs} \tag{3}$$

Gelbach (2016) shows that the decomposition is based on an omitted variable bias formula that links the estimates of the base- and full-specification coefficients on the interaction terms:

$$\widehat{\beta}_1 = \widehat{\gamma}_1 + \sum_j \widehat{\phi}^j \widehat{\alpha}_1^j \tag{4}$$

$$\widehat{\beta}_2 = \widehat{\gamma}_2 + \sum_j \widehat{\phi}^j \widehat{\alpha}_2^j \tag{5}$$

Eq. (4) suggests that the factor  $j$ 's explanatory power for female peer effect on girls and boys are  $\widehat{\phi}^j \widehat{\alpha}_1^j / \widehat{\gamma}_1$  and  $\widehat{\phi}^j \widehat{\alpha}_2^j / \widehat{\gamma}_2$ , respectively. Fig. 5 shows the decomposition result of female peer effects on educational expectations for girls and boys, respectively. We find that for the overall gender peer effects on girls, students' test scores in main subjects explain about 27.3%; responsible and patient teacher explains around 3.0%; finding main subjects useful explains about 1.8%; being late to classes and skipping classes explain around 2.4%. Overall, they explain 34.5% of the female peer effects on girls' educational expectations. The remaining unexplained part of the female peer effects is about 65.5%. For the overall gender peer effects on boys, we find that students' academic performance in main subjects explains about 27.5%; responsible and patient teacher explains around 0.8%; finding main subjects useful explains about 1.7%; being late to classes and skipping classes explain around 0.8%. Overall, they explain 30.8% of the female peer effects on boys' educational expectations, and the remaining unexplained part of the female peer effects is about 69.2%.

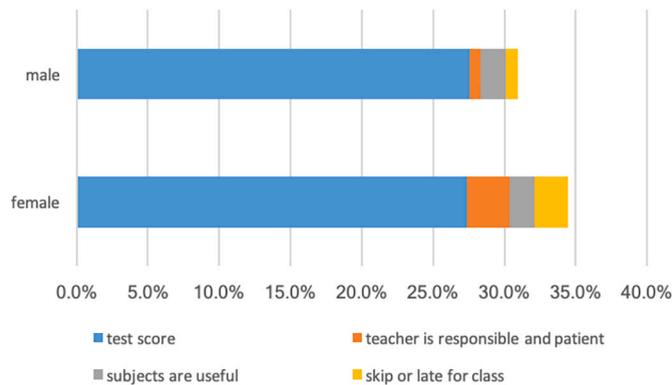
Panels (a) and (b) of Fig. 6 show the decomposition result of female peer effects on students' expectations for PF and PM occupations, respectively. We find that for the overall gender peer effects on girls' (boys') expectation to pursue a career in the PF occupation, students' participation in recreational activities explains around 0.5% (0.3%); participation in doing sports explain approximately 1.3% (1.7%). In general, they explain 1.8% (2.0%) of the female peer effects on girls' (boys') expectation to pursue a career in the PF occupation. For the overall gender peer effects on girls' (boys') expectation to pursue a career in the PM occupation, Panel (b) of Fig. 6 shows that students' participation in recreational activities explains around 2.1% (1.0%); participation in doing sports explain approximately 4.6% (4.9%). In general, they explain 6.8% (5.8%) of the female peer effects on girls' (boys') expectation to pursue a career in the PM occupation.

<sup>22</sup> Unfortunately, due to lack of data, we cannot examine the information acquisition channel directly.

**Table 8**  
Mechanism: extracurricular activities.

	Museums/Zoos (1)	Movies/Sports Games (2)	Hobby Doing sports (3)	Time allocated to do sports (4)
Girl*Proportion girl peers	0.228** [0.114]	0.444*** [0.127]	0.197* [0.119]	1.220*** [0.453]
Boy*Proportion girl peers	0.067 [0.110]	0.227** [0.110]	0.290** [0.134]	1.607*** [0.488]
Girl	-0.052 [0.047]	-0.071 [0.055]	-0.197*** [0.064]	-0.034 [0.284]
Student controls	Y	Y	Y	Y
Parent controls	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y
Peer ability controls	Y	Y	Y	Y
School-grade FE	Y	Y	Y	Y
Observations	8077	8049	8309	7847
R-squared	0.169	0.219	0.120	0.084

Notes: Student controls include age and indicators for Han ethnicity, being an only child in the family, local hukou status, whether attended kindergarten, and whether skipped or repeated a grade in primary school. Parent controls include mother’s and father’s education. Teacher controls include head teacher’s gender, teaching experience, years of education, job title, indicator for graduating from a normal university, and marital status. Peer ability controls include female and male peers’ average performance in grade repetition and grade skipping. The standard errors are clustered at the class level. \*\*\*, \*\*, and \* denote the 1%, 5%, and 10% significance levels, respectively.



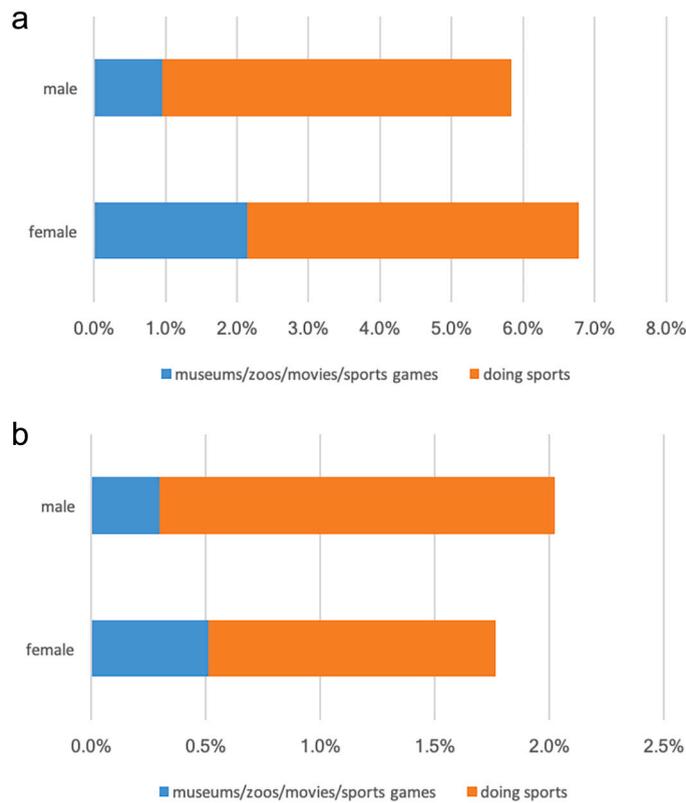
**Fig. 5.** Decomposing gender peer effects on the educational expectation by channel. Notes: This figure presents the estimated decomposition of gender peer effect on educational expectations.

## 6. Robustness checks

In this section we do some robustness checks. We test whether teachers are randomly assigned to classrooms, examine whether our results change dramatically when we randomly drop some schools, check whether our results are likely to be biased due to sample attrition, investigate whether our results are sensitive to an alternative specification, examine whether our estimates are robust for newly formed peer groups, check whether our results remain consistent when additional controls are added into the regressions, and explore whether our estimates are robust to the multiple choice model.

### 6.1. Random assignment of teachers

Our estimates will be biased if educational resources, particularly teachers, are assigned to classrooms in a way that is correlated with classroom gender composition or students’ characteristics. To verify that student–teacher matches are random, we conduct two balancing tests at the class level and report the results in Table A1. The first one examines the correlation between teacher’s pre-determined characteristics and the proportion of girls in the class, conditional on school-grade fixed effects. The results are displayed in Panel A, which shows that there is no significant correlation between the proportion of girls and teachers’ gender, teaching experience, years of education, job title, academic qualification (whether graduated from a normal university), and marital status. The second one regresses the head teachers’ characteristics on average characteristics of students at the class level. The results are presented in Panel B, which suggests that in general there are no significant correlations between students’ characteristics and the head teachers’ characteristics. Overall, the results suggest that teachers are not assigned in a way that is correlated with the classroom gender composition or students’ characteristics.



**Fig. 6.** Decomposing gender peer effects on occupational expectations by channel. *Notes:* This figure presents the estimated decomposition of gender peer effect on expecting to pursue a prevalently female (PF) occupation (Panel a), and on expecting to pursue a prevalently male (PM) occupation (Panel b).

### 6.2. Estimates from reduced samples

In the baseline estimation, we use a sample of schools that randomly assign students to classes. One concern is that some schools claimed they randomly assigned students to classes but in fact they disobeyed the rule, which would contaminate our sample and bias our estimates. To address this concern, we randomly drop some schools from the baseline sample and check whether the results change dramatically.<sup>23</sup> Specifically, each time we randomly drop seven schools (about 10% of the 67 schools) and estimate the coefficient using the remaining schools. We repeat this process 1,000 times. The estimates obtained from the 1,000 reduced samples give us a distribution of the coefficients.

If our baseline results are mostly driven by randomized samples, then the estimates obtained from the reduced samples should be similar to the baseline estimates. Fig. A1 shows that all distributions of the coefficients obtained from the reduced samples are centered around the baseline coefficients, and the upper and lower bounds of the distributions share the same sign as the baseline estimates, suggesting that our baseline estimates are unlikely to be biased by the possible inclusion of schools that actually did not assign students randomly.<sup>24</sup>

### 6.3. Sample attrition

Our outcome and control variables have missing values, as shown in Tables 1 and 2. If the likelihood of missing values is systematically correlated with the proportion of female peers, our estimates would be biased. To address this concern, we define attrition dummies as indicators for missing values of outcome variables, and then regress each attrition dummy on the proportion of female peers, student gender, and school-grade fixed effects. Table A2 shows that all of the coefficients on the proportion of female peers are small and insignificant, suggesting that the likelihood of missing values is not correlated with the proportion of female peers. The results indicate that our baseline estimates are unlikely to be biased due to sample attrition.

<sup>23</sup> This method is similar to that used by Gong et al. (2021) and Huang and Zhu (2020).

<sup>24</sup> To save space, we present the distributions of the estimated coefficients for only two outcomes: the probabilities of expecting to achieve a bachelor's degree and expecting to become a manager. The distributions of the other coefficients are available upon request.

#### 6.4. An alternative specification

To examine whether our results are sensitive to the regression specification, we re-run our regressions using an alternative regression equation as follows:

$$Y_{icgs} = \delta_0 + \delta_1 Girl_i + \delta_2 Peergirl_{-icgs} + \delta_3 Girl_i \times Peergirl_{-icgs} + \tau X_{icgs} + \lambda P_{-icgs} + \xi T_{cgs} + \theta_{gs} + \epsilon_{icgs} \quad (6)$$

where  $\delta_2$  captures the peer effects on boys,  $\delta_3$  captures gender asymmetry in peer effects, and the peer effects on girls are given by  $\delta_2 + \delta_3$ . Here,  $\delta_2$  corresponds to  $\beta_2$ , and  $\delta_2 + \delta_3$  corresponds to  $\beta_1$  in Eq. (1). Table A3 shows that the interaction between girl proportion and girl dummy is statistically significant for educational expectations, but insignificant for occupational expectations. Column (1) indicates that a 10-percentage-points increase in the proportion of female peers increases boys' expected years of education by about 0.35 years and increases girls' expected years of education by about 0.13 years. In general, we find the results are comparable to the baseline estimates reported in Table 5, suggesting that our results are not sensitive to the regression specification.

#### 6.5. Sub-sample analysis

In our setting, the 7th graders were newly enrolled, and some of them were surveyed in the fall semester when they may not know each other well. One may concern that there may not be significant peer effects among the newly formed peer groups. To address this concern, we run the regressions using the 7th graders only, and we further split this sample into two groups: one was surveyed in the fall semester, and the other was surveyed in the spring semester in the following year. The results are reported in Table A4. Although the results are slightly different from the baseline estimates, we do find significant peer effects among the 7th graders, even among those who were surveyed in the fall semester. The results indicate that middle school students become acquainted with each other quickly and are influenced by their classmates (at least some of the classmates) very soon.

#### 6.6. Additional controls

One may concern that students' socio-economic status, especially *hukou* status (agricultural or non-agricultural *hukou*), will affect their educational and occupational expectations substantially. To address this concern, we additionally control for student's family income status in primary school and whether the student has an agricultural *hukou*. In our sample, there are three types of *hukou* status: agricultural (45%), non-agricultural (33%) and resident *hukou* (22%). Because it is difficult to classify resident *hukou* as agricultural or non-agricultural, we drop the students who have resident *hukou*.<sup>25</sup> We also drop students who have missing information on family income status. We re-run our regressions using this restricted sample and report the results in Table A5. The estimates are slightly different from the baseline estimates displayed in Table 5, possibly because the sample size is smaller here. Overall, the results suggest that our estimates are not sensitive to including additional controls for students' socio-economic status.

#### 6.7. Multiple choice models

In the baseline regressions, we use the binary choice model. To examine whether our results are robust to using the multiple choice model, we re-run the regressions, using ordered response models for educational expectations and multinomial response models for occupational expectations. The results are shown in Tables A6 and A7. We find that the results are generally comparable to the baseline estimates, suggesting that our results are not sensitive to using multiple choice models.<sup>26</sup>

### 7. Conclusion

Although many studies investigate the effects of gender peers on students' academic performance, few studies investigate the effects on students' educational and occupational expectations. To fill the gap in the literature, this study investigates the effects of gender peers on students' educational and occupational expectations, using a representative sample of middle school students from China. We find that classroom gender composition can affect students' educational and occupational expectations. For educational expectations, we find that a higher proportion of female peers reduces students' probability of expecting to achieve a low level of education (middle school) and increases their probability of expecting to achieve a high level of education (university or graduate school). For occupational expectations, we find that a higher proportion of female peers increases students' probability of expecting to pursue a career as a manager, and reduces their probability of expecting to pursue a career as a teacher, doctor, or lawyer. Also, we find that a higher proportion of female peers increases students' probability of expecting to pursue a career as an athlete, but the effect is

<sup>25</sup> Traditionally, in China there were only two types of *hukou*: agricultural and non-agricultural. In 2014, the State Council initiated a reform of the household registration system, which aimed at abolishing the distinction between agricultural *hukou* and non-agricultural *hukou* and establishing a unified household registration system in urban and rural areas. That is to say, in the future there will be only one type of *hukou*: resident *hukou*. Because this reform has not been completed yet, there are three types of *hukou* status in our sample.

<sup>26</sup> There are some differences in statistical significance between Tables 4 and A7, possibly because there are fewer observations in Table A7. We have to drop the observations who choose the "others" category of occupations when we use the multinomial model, so the number of observations drops by 738.

significant for only boys. Overall, the findings imply that classroom gender composition is an important social factor that can shape individuals' educational and occupational expectations, which helps to understand the variations in individuals' educational and occupational choices.

Furthermore, to explore the mechanisms, we find that a higher proportion of girls improves classroom environment and benefits students' academic performance. These findings have important policy implications for resource allocation in schools. For instance, schools can compensate classes with a high proportion of boys by assigning more experienced teachers to these classes. Also, schools can allocate cohorts with a high proportion of boys into smaller classes to offset the negative impact of having more boys in a classroom. In addition, our findings shed light on the hot debate about single-sex versus mixed-gender education among policy makers and researchers (e.g., Booth, Cardona-Sosa, Lina, Nolen, & Patrick, 2013; Halpern et al., 2011; Jackson, 2012; Jackson, 2019). We find that classroom gender composition not only affects students' academic performance but also shapes their educational and occupational expectations, which implies that social interactions between genders are important in educational production. Hence, a complete analysis on the benefits or losses of single-sex versus mixed-gender education should take into account these findings.

### Compliance with ethical standards

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### Declaration of Competing Interest

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

### Data availability

The authors do not have permission to share data.

### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.chieco.2022.101898>.

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