CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

CEBI WORKING PAPER SERIES

Working Paper 01/25

PEER EFFECTS ON WELL-BEING AND PERFORMANCE IN ELEMENTARY SCHOOL

Isabel Skak Olufsen

Jesper Fries

ISSN 2596-447X

CEBI
Department of Economics
University of Copenhagen
www.cebi.ku.dk

Peer Effects on Well-Being and Performance in Elementary School*

Jesper Fries
EduQuant, University of Copenhagen

Isabel Skak Olufsen
CEBI, University of Copenhagen

Abstract

We study the effect of having high socioeconomic status (SES) peers on pupils' well-being, absence rate, and academic performance in elementary school. We compare pupils in the same school who started school in different years and, consequently, were exposed to different shares of high-SES peers. We use a unique combination of administrative, survey, and test data on pupils in Danish public schools. We find that a higher share of high-SES peers increases well-being and performance while lowering absence rates slightly. Our results imply that educational inequalities may increase due to the growing concentration of high-SES pupils in certain schools.

Keywords: peer effects, well-being, academic performance, primary school

JEL Codes: I210, I240, I310

*Acknowledgments: We are grateful for comments from Mette Ejrnæs, Fane Groes, Claus Thustrup Kreiner, Søren Leth-Petersen, Hans Henrik Sievertsen, and Miriam Wüst as well as comments from CEBI seminar participants. We thank participants at the Copenhagen Education Network 2024 and the Nordic PhD workshop in the Economics of Education 2024 for useful comments and discussions. Center for Economic Behavior and Inequality (CEBI) is a center of excellence at the University of Copenhagen financed by grant DNRF134 from the Danish National Research Foundation. Contact information: jesper.fries@econ.ku.dk (Jesper Fries) and isabel@olufsen.dk (Isabel Skak Olufsen).

1 Introduction

In recent decades, Western countries have experienced growing socioeconomic segregation (Fischer and Mattson, 2009; Smith et al., 2014; Berkes et al., 2022). This trend has led to growing imbalances in pupil composition across schools, with pupils from high socioeconomic status (SES) families concentrating in certain schools (Owens et al., 2016; Caspersen, 2024). Consequently, schools' pupil compositions are changing, with the share of high-SES pupils rising in some schools and falling in others. This change affects the learning environment. More high-SES pupils may improve the learning environment by being academic role models and fostering a positive classroom dynamic that can improve pupils' well-being and academic level. Yet, more high-SES peers might not benefit all pupils and could even leave some feeling marginalized or left behind.

Existing literature on peer effects in education generally finds that having high-SES peers improves pupils' academic performance.[1] Performance alone does not fully capture peer effects on the learning environment, as it neglects pupils' well-being. Pupils' well-being is important because it captures the social aspects of the learning environment. Furthermore, pupils' well-being likely matters for their incentive to invest in current and future education (Boneva et al., 2022). However, to the best of our knowledge, there is no evidence of the effect of high-SES peers on pupils' well-being.

In this paper, we investigate the effect of high-SES peers on the learning environment in elementary school. Specifically, we estimate the causal effect of the share of high-SES peers on well-being, absence rates, and academic performance from grade 0 to grade 3, where pupils are between 5 and 9 years old. To estimate the causal effect, we compare pupils in the same school who started school in different years and, as a consequence, were exposed to different shares of high socioeconomic status (SES) peers in the first year of schooling.[2] Our main identifying assumption is that given the choice of school,

[1] See Sacerdote (2011) and Barrios-Fernandez (2023) for a review of the literature on peer effects in education.

[2] By comparing pupils in the same school, we remove the concern for selection into schools. Furthermore, to overcome the concern that trends in pupil composition affect parental enrollment decisions, we also control for school-specific trends in pupil composition. This identification strategy was pioneered by Hoxby (2000).

the share of high-SES peers in the cohort is exogenous. We use a unique combination of administrative, survey, and test data, which covers all pupils and their peers in Danish public schools from 2010 to 2018. An important advantage of our data is the ability to link administrative data on pupils' parents' income to pupils' responses to a well-being survey, performances on standardized tests, and their school-reported illness-related absences. We define high-SES peers based on combined parental income prior to school start. Our data enables us to estimate the effect of high-SES peers on a novel set of outcomes.

We find that having a higher share of high-SES peers in elementary school positively impacts the learning environment. Increasing the share of high-SES peers by a standard deviation increases well-being by around 1 pct. of a standard deviation and academic performance by around 2-3 pct. of a standard deviation. This corresponds to around 10 pct. of the effect attributed to pupils' own SES. The effects on well-being and performance are persistent until at least grade 6. Our estimates also suggest that increasing the share of high-SES peers slightly reduces illness-related absence rates in elementary school. Our estimated effect sizes are relatively modest compared to existing research on peer effects in education, which often finds effect sizes between 5 to 10 pct. of a standard deviation (Ammermueller and Pischke, 2009). However, our estimates are likely lower bounds for two reasons: (i) To avoid endogeneity concerns, we proxy pupils' classroom peers based on their cohort peers in the first year of schooling, which potentially attenuates our results. (ii) Our study estimates the effect on pupils in Denmark, which is characterized by low levels of inequality compared to other countries (Causa et al., 2016). Thus, differences between high- and low-SES pupils are likely smaller, resulting in smaller peer effects. This could imply that the positive effect of high-SES peers is larger in countries with higher inequality.

Multiple mechanisms may drive the positive effect of high-SES peers on the learning environment. For example, high-SES peers may contribute to fostering a good classroom dynamic or their parents may invest more in improving the school environment. The quality of teaching could also be improved if, for example, high-SES peers need less assistance, leaving more time for teachers to help other pupils. To hint at the potential

mechanisms, we estimate the effect on the individual questions used to compute pupils' average well-being. There is no effect of the share of high-SES peers on questions concerning teaching, which suggests that the quality of teaching does not improve in response to the peer composition. In contrast, questions about whether pupils like their class, like to be in their classroom, and think their classmates like them are the most positively affected. This suggests that the improvement in the learning environment stems from high-SES peers having a positive effect on the classroom dynamics.

Next, we investigate whether some pupils benefit more from having high-SES peers than others. We find that pupils with, on average, lower well-being and performance benefit more from the presence of high-SES peers. In particular, the effect on low-SES pupils' performance is larger than the effect on high-SES pupils' performance. Interestingly, the effect on well-being is the same for both low- and high-SES pupils, which suggests that a higher share of high-SES peers does not make low-SES pupils feel more marginalized. Pupils whose parents do not cohabit, and who thus may have less support at home, also benefit more from a higher share of high-SES peers compared to pupils whose parents cohabit. The fact that both low-SES pupils and pupils whose parents do not cohabit benefit more from a higher share of high-SES peers suggests that the school environment is more important for pupils with fewer resources available at home. Additionally, boys have significantly lower well-being and performance than girls and benefit significantly more from high-SES peers. We also find that a higher share of high-SES peers among girls positively affects the performance of both boys and girls, while a higher share of high-SES peers among boys only benefits boys. Our heterogeneity analysis suggests that the presence of high-SES peers can lift pupils with lower well-being and performance and, consequently, reduce the gaps in outcomes in elementary schools.

We contribute to the existing literature on the effect of peers on mental health by being the first to study the effect of high-SES school peers on well-being. Existing research finds that a higher ability and higher SES rank among one's peers in high school leads to improved depression scores (Kiessling and Norris, 2023; Paffenholz, 2023). We contribute by analyzing the effect on well-being, a broader measure of pupils' mental health, allowing

us to capture more subtle changes to mental health due to pupil composition. Furthermore, in contrast to existing literature, we find that it is the average characteristics of peers that matter for well-being in elementary school and not the pupils' relative rank. This discrepancy could be due to the existing literature studying the effect of peers on mental health among adolescents. In contrast, we study the effect in elementary school, where SES differences may be less pronounced. It could also be due to existing studies studying pupils in the United States, where inequality is higher and SES differences are more pronounced.

Additionally, we contribute to the extensive literature on peer effects in education. Existing research has found significant effects of peers' ability and SES on academic performance, educational attainment, and labor market outcomes (Sacerdote, 2011; Bertoni et al., 2020; Barrios-Fernandez, 2023). Closest to our work is Ammermueller and Pischke (2009), who find that peers' SES has a positive effect on reading performance in grade 4. We contribute by showing that peers' SES already matters for performance in grade 2 when pupils are only 8 years old. Understanding how peers affect the elementary school environment is particularly important because evidence suggests that i) the early childhood environment matters for later life outcomes and ii) the effect of peers' SES may increase with the length of exposure (Phillips and Shonkoff, 2000; Chetty et al., 2016). We also contribute by finding that peers' SES not only affects performance but also has a positive impact on well-being in elementary school. The positive effect of peers' SES on well-being could be one of the mechanisms underlying the positive effect of high-SES peers on academic performance if, for example, higher well-being increases the willingness to apply effort to improve performance.

The remainder of the paper is structured as follows: Section 2 introduces the institutional setting and our data, section 3 outlines our identification strategy, section 4 presents our results and robustness analysis, and section 5 concludes.

2 Institutional Setting and Data

2.1 Danish School System

Our analysis focuses on pupils in grades 0 to 3 in the Danish public school system, where pupils are between 5 and 9 years old. In Denmark, children usually start school in grade 0 in August of the year they turn 6.[3] Parents can enroll their child in the public or private school system. All public schools are free of charge and administered at the municipal level. By law, parents have the right to enroll their child in the district school associated with their residential address. In other words, if parents want to enroll their child in the public district school, they are guaranteed a spot free of charge. If parents wish to enroll their child in another public school, enrollment in that school is conditional on sufficient free capacity. Unlike the public school system, the private school system offers no guaranteed admission, as private schools reserve the right to select their pupils and typically cost between 130 and 270 euros per month. This means that private schools may not be as easily accessible due to varying admission criteria and admission costs. About 80 percent of a school cohort are enrolled in public schools, while 18 percent opt for the private school system.[4]

The specific enrollment process into public schools is managed at the municipal level and, thus, varies slightly across municipalities. Parents can usually enroll their child online between October and January if the child starts school in August. Once the number of incoming pupils is determined, it is the individual school's responsibility to allocate pupils to classes. There is no law dictating how pupils should be assigned to classes. Instead, it is up to the municipality to create a framework for class assignment and the school boards to set principles for the division of pupils into classes. In other words, the division of pupils

[3]From August in the calendar year a child turns 6, Danish children are by law required to receive education. Some parents postpone their child's school enrollment to the year they turn 7 (approx. 6 percent), while others choose to enroll their children a year early (approx. 1 percent). For further details on the statistics as well as school starting procedures, see `https://uddannelsesstatistik.dk/Documents/Grundskole/Notater/Boernehaveklasse.pdf` and `https://www.uvm.dk/folkeskolen/fag-timetal-og-overgange/skolestart-og-boernehaveklassen/skolestart`.

[4]For further details on the Danish school system and the enrollment procedures, see `https://uddannelsesstatistik.dk/Documents/Grundskole/Notater/Boernehaveklasse.pdf` and Bjerre-Nielsen and Gandil (2024).

into classes varies across municipalities and schools. For the school years 2010 to 2018, the classes must have no more than 28 pupils. The schools are also required to finalize the class assignment by the end of grade 0 at the latest and aspire to keep the classes fixed throughout primary school. This means that pupils' classmates remain roughly constant throughout elementary school, depending on the degree of school switching.

The first year of schooling, grade 0, acts as a transitional year where children can acclimate to the school system. The goal is to prepare the pupils for subject-specific teaching starting in grade 1, and usually, only one teacher is associated with each class. In grades 1 to 3, pupils have eight subjects (ten in grade 3), and the same set of teachers usually teach pupils from grades 1 to 3. This suggests that the educational setting, including both teachers and the curriculum, changes from grade 0 to grade 1, where after it is more stable.

In the Danish public school system, parents have the opportunity to play a significant role in shaping the learning environment, both at the school and class level. At the school level, parents can be on the school board. All public schools must have a board consisting of representatives for the parents, the teaching personnel, and the pupils. The school board is responsible for setting principles for the school's operations, including establishing rules and values to ensure pupil well-being and a good learning environment.[5] At the class level, many schools have a tradition of forming parental councils. These councils unify parental engagement, serve as forums for addressing class-related issues, and organize social and academic activities for the pupils. Ultimately, despite formal expectations from municipalities and schools, it is the parents' choice how much they wish to engage in the school environment.

[5]The principles also cover how to organize the teaching, cooperation between the school and parents, events organized by the school, etc. Additionally, the board approves the school budget. For further details on the responsibilities and organization of the school boards, please see `https://www.uvm.dk/folkeskolen/organisering-og-ledelse/skolens-ledelse/skolebestyrelsen`.

2.2 Data

For our analysis, we use four different data sources with information on pupils in public schools between 2010 and 2018: Danish administrative data, data on pupils' absences reported by schools, data on pupils' well-being from a national well-being survey, and data on pupils' performance on national tests. We use Danish administrative data to link pupils to their parents along with information on their parents' income. We use parental income as a proxy for pupils' socioeconomic status (SES).[6] Income is third-party reported by their parents' employer to the Tax Authorities. Our income measure includes wage income, government transfers, and capital income. We define parental income as the sum of both the mother's and father's income, averaged over three years when the pupil is aged 2 to 4.[7] We define a pupil as *high SES* if the parental income is above the 75$^{\text{th}}$ percentile among parents with children born in the same year. This implies that our definition of pupils' SES is constant throughout elementary school.

In the absence data, we observe pupils monthly, allowing us to identify their school, grade, and peers at the beginning of each school year. All public schools must record pupils' absences daily to check whether the criteria of compulsory education are being met.[8] Hence, the accuracy of reporting is important. Our measure of each pupil's share of high-SES peers is calculated as the share of high-SES pupils in their grade 0 school cohort, excluding themselves. We link pupils to their responses on a well-being survey and their performance on national tests in the respective grades. This leaves us with three main outcomes to study: pupils' well-being, absence rates, and academic performance. For our empirical analysis, we standardize all three outcomes and the share of high-SES peers to have a mean of zero and a standard deviation of one nationally within year and grade.

[6] Our results remain consistent when defining SES based on parental wealth and education, see Appendix Figure A.9.

[7] We use this definition of parental income regardless of whether the pupil lives with both or only one parent.

[8] If a pupil's unexplained absence rate equals or exceeds 15 percent in a given quarter (6-9 school days), the school must report it to the municipality, and the parents may lose their child and youth benefits. For further details, see: `https://www.uvm.dk/folkeskolen/organisering-og-ledelse/foraeldrenes-rolle/fravaersregler-i-folkeskolen/baggrund`.

Well-being The well-being survey is conducted annually in all Danish public schools. The survey is mandatory for public schools and is conducted at all grade levels between January 20 and March 20 each year. It was first introduced in the school year 2014/15. The survey is conducted digitally as part of the regular classroom activities. Pupils access the survey using their own unique login, allowing us to link their responses to administrative data. The survey interface allows questions to be read aloud, and the teacher is also present to answer clarifying survey-related questions. Pupils in grades 0 to 3 answer 20 questions with three response categories.[9] For example, pupils are asked "Do you like your school?" and are given the response options, "No", "Yes, a little", or "Yes, a lot" (the full set of questions can be found in Appendix Table A.1). This translates into a recorded answer of either 1, 2, or 3. We align all questions such that a higher numeric value is associated with higher well-being. We calculate pupils' well-being as the average of the first 19 questions.[10]

As a general rule, all pupils have to complete the well-being survey annually, and only absent pupils are exempted.[11] 91 pct. of our sample responds to the well-being survey each year, and 97 pct. of pupils have responded to the well-being survey at least once in our sample period. The likelihood of participating in the well-being survey does not correlate with the share of high-SES peers in pupils' cohort, cf. Appendix Figure A.3. Appendix Figure A.1a shows the distribution of pupils' average well-being. The distribution is left-skewed, with a mean of 2.5 out of 3. This suggests that pupils in elementary school generally have high well-being.

Absence rate The absence data includes the number of days the pupil attended a given school and the number of days the pupil was absent. The days absent are divided into

[9]The questions are developed based on recommendations from an expert group appointed by the Ministry of Education in 2013. For further details, see: `https://www.uvm.dk/folkeskolen/laering-og-laeringsmiljoe/trivsel-og-undervisningsmiljoe/ekspertgruppen-om-elevernes-trivsel`. For additional information on the survey in general, see: `https://www.uvm.dk/folkeskolen/test-evaluering-og-skoleudvikling/trivselsmaaling`.

[10]Question 20 is related to how clean the toilets are at the school. We do not find that relevant in order to assess the pupils' well-being and therefore exclude it from the mean.

[11]Parents can also ask for their child's responses to remain anonymous, which means that we cannot link their responses to the administrative data. However, less than 2 pct. of parents ask for their child's responses to be anonymous.

legal, illegal, and illness-related absences. We focus on illness-related absences because legal absences are likely predominately due to vacation outside of school holidays or family events, while illegal absences are rare among pupils in elementary school. Therefore, we compute pupils' absence rates as the number of days absent due to illness divided by the total number of days at school in the given year. Appendix Figure A.1b shows the distribution of the absence rates. The absence rates are right-skewed, with the average absence rate being less than 3 pct.

Performance The National Tests are a mandatory testing program covering all Danish public schools. The national tests were introduced in the school year 2009/10, and the tests are carried out each spring.[12] The program consists of subject-specific tests spanning grades 2 to 8. Our analysis focuses on the Danish reading test in grade 2 and the Math test in grade 3. Pupils access the test by using their our unique login. All tests are computerized adaptive tests, meaning that the questions adjust based on the pupil's previous answers. The test algorithm aims for a 50 percent success rate by the end of the test. Pupils must spend 45 minutes on the test. Each test consists of three domains, each covering different aspects of the given subject. A final score within each subject is calculated automatically.[13]

All pupils are expected to complete the national tests. However, pupils can be exempted if school representatives, in agreement with parents, believe that the pupil will not obtain a result that is beneficial for tracking their progress. Only 2 pct. of pupils do not complete the national test in a given year. The likelihood of completing the national test is uncorrelated with the share of high-SES peers, cf. Appendix Figure A.4. Appendix Figure A.1c and A.1d show the distribution of the raw scores for our sample, which is close to symmetrically distributed. We follow Beuchert and Nandrup (2017)'s approach and

[12]The tests have recently been adapted, but for our sample period, the tests have had the same format. For more information about the national tests and the procedure, see Beuchert and Nandrup (2017) as well as `https://www.uvm.dk/statistik/grundskolen/karakterer-og-test/nationale-test`.

[13]The score is computed based on an underlying psychometric model named the Rasch model that guides the adaptive test algorithm. The pupil scores are calculated on the logit scale, which ranges from minus to plus infinity, with values commonly between -7 and +7. For more details on how the scores are calculated, see Beuchert and Nandrup (2017).

standardize pupils' scores within each test domain and year to mean zero and standard deviation one. We then compute a simple average of each pupil's standardized scores and standardize the average score to mean zero and standard deviation one within each year and test.

2.3 Sample Restrictions and Summary Statistics

We focus on pupils in grades 0 to 3 from the school year 2014/2015 to 2018/2019. To be included in our main sample, pupils must have attended a public school in grade 0, which ensures that we have information on the share of high-SES peers at the beginning of school. We focus on general public schools, removing independent schools and schools for children with special needs.[14] At the pupil level, we restrict the sample to pupils with data on parental income prior to starting school, which is required to define their SES.

Our restrictions leave us with a final sample of 336,615 pupils, who we observe in grade 0 and who attend elementary school between 2014/15 and 2018/19. Table 1 shows summary statistics for our main sample and the sub-sample of pupils who completed the well-being survey and the national tests, respectively (see Appendix Table A.2 for more detailed summary statistics at each grade level). The well-being sample is based on fewer pupils due to attrition from the survey, and the reading and math samples are smaller because they exclude pupils who entered grade 0 in 2017 and 2018. This is because we do not observe these pupils in grades 2 and 3, where the national tests are conducted.

Table 1 shows that for the average pupil, the grade 0 cohort consists of 63 pupils, and 24.5 pct. of the peers are from high-SES families. This is in line with 25 pct. of the population being defined as high SES and some parents opting out of the public school system, reducing the share of high-SES peers. The share of high-SES peers is roughly

[14] Additionally, we exclude schools with data missing for at least a year, which is quite restrictive. However, as our identification strategy partly relies on controlling for school trends in pupil enrollment, we want to observe enrollment at the school level in all years. We also exclude schools that have an extremely low pupil enrollment. In particular, we discard observations from schools with less than 40 pupils enrolled across grades 0 to 3 in a given year in the period 14/15-18/19. With a high probability, this includes schools within the special needs education system that are not coded as such. We are not interested in including these schools as classroom dynamics are likely quite different from general public schools.

constant across the four samples. Further, the share of parents living together, mom's age at birth, and parental income are also roughly constant across the samples. In contrast, the share of immigrants and the share of pupils whose parents have no more than primary education is lower in the reading and math samples. This is likely due to pupils with immigrant backgrounds or from low-SES families being more likely to be exempted from the national tests. Note that exemptions from the national tests or attrition from the well-being survey do not appear to affect our results. When we weight our main estimates by the likelihood of completing the national tests or the likelihood of responding to the well-being survey, the results remain unchanged, cf. Section 4.3.

Table 1: Summary Statistics, Grade 0

	Main sample	Survey sample	Reading sample	Math sample
Age, grade 0	6.1	6.1	6.1	6.1
	(0.3)	(0.3)	(0.3)	(0.3)
Female (%)	48.7	48.8	49.2	49.1
	(50.0)	(50.0)	(50.0)	(50.0)
Birth order	1.8	1.8	1.8	1.8
	(0.9)	(0.9)	(0.9)	(0.9)
Number of siblings	1.4	1.4	1.4	1.4
	(0.9)	(0.9)	(0.9)	(0.9)
Immigrant/descendant (%)	9.5	9.4	8.5	8.2
	(29.4)	(29.2)	(27.9)	(27.4)
Parents live togehter (%)	76.8	77.0	77.1	77.3
	(42.2)	(42.1)	(42.0)	(41.9)
Absence rate (%)	2.7	2.6	2.6	2.6
	(2.9)	(2.8)	(2.8)	(2.8)
Cohort Size	62.5	62.4	63.8	63.0
	(26.7)	(26.6)	(26.9)	(26.0)
Class Size	23.2	23.3	23.4	24.1
	(9.0)	(9.0)	(8.9)	(9.8)
High SES (%)	24.8	24.9	25.3	25.4
	(43.2)	(43.3)	(43.5)	(43.5)
High SES peers, grade 0 (%)	24.5	24.5	24.7	24.8
	(17.4)	(17.4)	(17.3)	(17.3)
Mom age at birth	30.7	30.7	30.8	30.7
	(4.9)	(4.9)	(4.9)	(4.8)
Parental income (DKK), before school start	718,322	720,044	720,594	707,809
	(481,373)	(482,007)	(506,652)	(475,094)
Parental wealth (DKK), before school start	28,473	24,638	5,414	88,521
	(2,412,192)	(2,403,525)	(2,122,073)	(2,117,260)
Primary as highest parental education (%)	8.2	8.1	7.7	7.6
	(27.5)	(27.2)	(26.7)	(26.5)
University as highest parental education (%)	24.8	24.8	24.7	23.6
	(43.2)	(43.2)	(43.1)	(42.5)
Observations (No. of pupils)	336,615	325,596	202,114	196,756

Notes: The table reports summary statistics for our four samples when the pupils are in grade 0. It spans the school years 2010/11 to 2018/19. Pupils are defined as *high SES* if their parents' income, when the pupil is 2-4 years old, is above the 75^{th} percentile in their birth cohort. Each cell contains the mean and standard deviation in parentheses below.

3 Empirical Strategy

To identify the effect of having high-SES peers in elementary school on well-being, absence rates, and academic performance, we need exogenous variation in peer composition (Manski, 1993). Without exogenous variation in peer composition, the estimated effect of peers' SES on pupils' outcomes may be due to peers' SES influencing pupils' outcomes (social effects) or due to peers being similar and exposed to similar environments leading to similar outcomes (correlated effects). In this setting, correlated effects can arise due to parents selecting into neighborhoods, schools, and classes within schools, as well as pupils being exposed to shocks that affect both well-being and pupil composition. Thus, we need exogenous variation in peer composition to disentangle the social effects from the correlated effects.

To estimate the social effects, we use variation in the share of high-SES peers within schools across cohorts, which is an identification strategy pioneered by Hoxby (2000). We compare pupils in the same school who started school in different years and, consequently, were exposed to different shares of high-SES peers. This allows for variation in the share of high-SES peers while accounting for selection into a given school. The basis for selection into a school may change over time. For example, a school may exhibit a positive trend in pupil outcomes, which some parents may notice. If high-SES parents are more likely to choose schools based on these trends, it could lead to a higher concentration of high-SES pupils in schools with better outcomes. This, in turn, could create an upward bias in our estimates. To account for selection based on school trends, we control for school-specific linear trends.

We define the share of high-SES peers based on the peer composition in pupils' school cohort in grade 0 because as pupils progress through the school system, the composition of each cohort is observed, which may affect selection in and out of the school. We believe the share of high-SES peers in their grade 0 to be a good proxy for peers throughout elementary school as only a few pupils switch schools, which means that the differences in pupil composition between grade 0 and grade 3 peers are small, cf. Table 5 and

Appendix Figure A.2 panel (b). Our identifying variation comes from deviations from the linear school trend in the share of high-SES peers in grade 0 across cohorts within the same school. Consequently, our main identifying assumption is that given parent's school choice the share of high-SES peers in their child's grade 0 cohort is exogenous. This implies that for our identification to break down, we need school-specific factors that are not constant or follow a trend that affects the number of high-SES pupils and pupils outcomes.

Our main empirical model is

$$Y_{icks} = \beta_0 + \beta_1 HighSES_{icks} + \beta_2 PeerHighSESShare_{icks} + \alpha_{cks} + year \times \delta_s + \gamma_X X_{icks} + \epsilon_{icks}, \tag{1}$$

where Y_{icks} is the outcome for pupil i from cohort c in grade k in school s, $HighSES_{icks}$ is an indicator for whether pupil i is high-SES, and $PeerHighSESShare_{icks}$ is the share of high-SES peers in pupils' school cohort in grade 0. α_{cks} includes cohort and school-by-grade fixed effects. Cohort fixed effects capture time-invariant differences in the outcome across birth cohorts. School-by-grade fixed effects capture time-invariant differences across schools, for example, sorting into schools, and time-invariant confounding factors at the school level affecting all students in a specific grade. When estimating the effect in specific grades, α_{cks} only includes cohort and school fixed effects. $year \times \delta_s$ are school-specific linear trends, which capture time-variant school characteristics correlated with both the outcome and cohort composition. X_{icks} is a vector of individual level controls, including age, immigration status, gender, parental education, whether parents cohabit, birth order, number of siblings, mom age at birth, and class size. We cluster the standard errors, ϵ_{icks}, at the school cohort level to allow pupils' outcomes to correlate among those starting in the same school in the same year (Angrist and Pischke, 2009).

β_2 is our coefficient of interest, and it captures the effect of a higher share of high-SES peers in grade 0 on the outcome. As pupils are likely exposed to the same peers throughout elementary school, β_2 estimates the effect of exposure to high-SES peers throughout elementary school. β_2 captures both the endogenous social effects, i.e., the effect of high-

SES peers' behavior on pupils' outcomes, and the exogenous social effects, i.e., the effect of high-SES peers' background on the pupils' outcomes (Manski, 1993). Both effects are important to fully capture the effect of high-SES peers on pupils' outcomes. Lastly, as we standardize the outcomes and the share of high-SES peers, β_2 should be interpreted as the standard deviation change in the outcome from a one standard deviation increase in the share of high-SES peers.

3.1 Validation of the Identification Strategy

For our identification strategy to succeed: (i) we need sufficient variation in the share of high-SES peers to obtain precise estimates, and (ii) the share of high-SES peers needs to be exogenous across cohorts within the same school. First, we follow Bifulco et al. (2011) and show that we have sufficient variation in the share of high-SES peers when including school-by-grade fixed effects and school-specific trends. Table 2 row 1 shows the raw variation in the share of high-SES peers in grade 0. The standard deviation is 0.174. The residual variance from regressing the share of high-SES peers on school-by-grade fixed effects is 0.056, and it decreases to 0.048 when including school-specific linear trends. Thus, we exploit very small changes in the share of high-SES peers, and our estimated effects should be interpreted as such. This implies that we must be cautious when extending our results to settings with large changes in the share of high-SES peers.

Table 2: Variation in the Share of High-SES Peers in Grade 0

	Obs.	Mean	Standard deviation
Peer High-SES share, grade 0	336,615	0.245	0.174
- Removing school FE	336,615	0.000	0.056
- Removing school-specific linear trend	336,615	0.000	0.048

Notes: The table shows the variation in the share of high-SES peers in grade 0. The first row shows the raw variation, the second row shows the variation once including school FE, and the third row shows the variation once controlling for school-specific linear trends.

Second, we test the exogeneity of the share of high-SES peers in pupils' grade 0 cohort. First, we estimate whether the share of high-SES peers predicts pupils' own SES.[15] Table 3 shows estimates of pupils' own SES regressed on the share of high-SES peers. In column (1), there is a positive correlation between the share of high-SES peers and pupils' SES. Including school fixed effects reduces the coefficient by two-thirds. In column (3), we include school-specific linear trends, which leads to the coefficient on the share of high-SES peers becoming insignificant and negligible in magnitude. This means that when accounting for both selection into schools and school trends, the share of high-SES peers is not correlated with pupils' own SES. Second, we carry out a series of balance tests. Figure 1 shows coefficient estimates on the share of high-SES peers when regressing pupils' characteristics against the share of high-SES peers, own SES, cohort-fixed effects, school-fixed effects, and school-specific linear trends. The estimates suggest that the share of high-SES peers in pupils' grade 0 cohort is not correlated with any of the pupil's characteristics, except for mom's age at birth. This supports the assumption that the share of high-SES peers within in a school is exogenous. To be certain that differences in mom age at birth do not drive the results, we include the list of variables as controls in our main regressions. Overall, the two balance tests suggest that the share of high-SES peers in the pupil's grade 0 cohort is exogenous, suggesting that our identifying assumption holds.

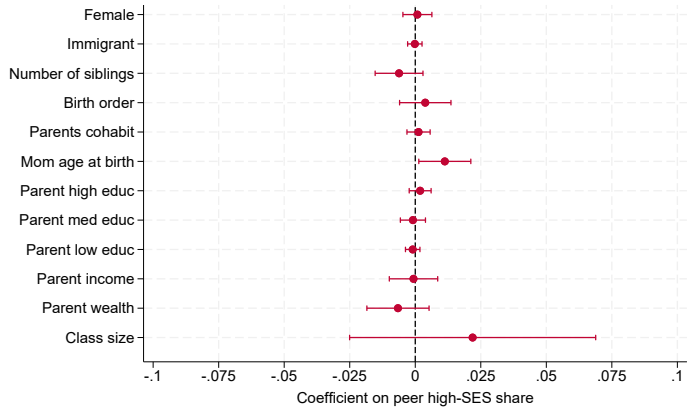
[15]Simply regressing pupils' own SES on the share of high-SES peers will return estimates that are negatively biased. The estimates are negatively biased because as the share of high-SES peers increases, the likelihood of pupil i being high-SES decreases. Guryan et al. (2009) solve this problem by controlling for the population mean, which in our case is the share of high-SES peers in grades 0 to 3 in each school. See Guryan et al. (2009) for more information on the problem.

Table 3: Balancing Test: Pupil High-SES Against the Share of High-SES Peers in Grade 0

	(1) High SES	(2) High SES	(3) High SES
Peer high-SES share	0.022***	0.007***	0.002
	(0.003)	(0.002)	(0.002)
Constant	0.029***	367.357***	367.720***
	(0.004)	(2.676)	(2.674)
School high-SES share	Yes	Yes	Yes
School F.E.	No	Yes	Yes
Cohort F.E.	No	Yes	Yes
School trend, linear	No	No	Yes
Observations	336,615	336,615	336,615
R^2	0.146	0.825	0.827

Notes: The table shows coefficient estimates from regressing pupils' own SES status against the cohort share of high-SES peers in grade 0. High SES is an indicator equal to one if a pupil's parents' combined income is above the 75th percentile in the pupil's birth cohort prior to school start. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort. The regressions include the share of high-SES pupils in elementary school from 2010 to 2018 to control for negative bias as highlighted by Guryan et al. (2009). Standard errors clustered at the school cohort level are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: Balancing Test in Grade 0



Notes: The figure shows coefficient estimates on the share of high-SES peers in grade 0. The coefficient estimates are obtained by regressing the variables on the y-axis against the share of high-SES peers and a dummy for pupils' own SES, including cohort-fixed effects, school-fixed effects, and school-specific linear trends. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort, where pupils are defined as high SES if combined parental income is above the 75th percentile in the pupils' birth cohort prior to school start. Female, immigrant status, parent high, med, and low educ are dummy variables, while the remaining variables are standardized within birth cohorts at the national level. Parent high educ is a dummy equal to one if the parents' highest educational achievement is a university degree, and parent low educ is a dummy equal to one if the parents' highest educational achievement is completing primary school. Parent med educ is a dummy equal to one if the parents' highest educational achievement is above completing primary school but below a university degree. The bars represent 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

4 Results

4.1 The Average Effect of High-SES Peers on the Learning Environment

Table 4 presents estimates of the effect of the share of high-SES peers on the learning environment in elementary school from estimating equation (1). Panel A shows the estimates for well-being. We find a significant gap in well-being across SES, with high-SES pupils having roughly 10 pct. of a standard deviation higher well-being than non-high-SES pupils.[16,17] Turning to the coefficient on the share of high-SES peers in column (1), a one standard deviation increase in the share of high-SES peers is associated with a 3.3 pct. of a standard deviation increase in well-being. The coefficient is halved when including school and cohort fixed effects in column (2) and roughly unchanged when including school-specific linear trends and controls in columns (3) and (4).[18] In our preferred specification, column (4), increasing the share of high-SES peers by one standard deviation increases the well-being of pupils by 1.3 pct. of a standard deviation. This implies that increasing the share of high-SES peers by a standard deviation can improve pupils' well-being by around 13 pct. of the difference in well-being attributed to their own SES.[19]

The estimated effect on well-being is based on pupils in grades 0 to 3. When estimating equation (1) at the grade level, we find that the effect of high-SES peers on well-being increases slightly throughout elementary school, cf. Appendix Figure A.6. In grade 0, there is no effect of high-SES peers on well-being, while in grades 1, 2, and 3, a standard deviation increase in the share of high-SES peers leads to an increase in well-being of approximately 1.8 pct. standard deviations.

[16]Note, the coefficient on high SES decreases to 6 pct. of a standard deviation in column (4). This is because we include controls, such as parental education, which capture part of the difference across SES, reducing the difference attributed to our SES definition.

[17]This is in line with Loft and Waldfogel (2021) who also find a significant SES-gap in well-being in Danish elementary school.

[18]In unreported regressions, we test the sensitivity of our estimates to non-linear school-specific trends, and we find that including a squared-trend does not affect our results.

[19]The difference in well-being attributed to their own SES is the coefficient on high SES in Table 4 column (3) before we include additional controls that also capture SES. Thus, the 13 pct. stems from $0.013/0.101 * 100 = 12.87$.

Table 4: Main Results: Peer Effect Estimates by Pupil Outcomes

	(1)	(2)	(3)	(4)
Panel A	**Average Well-being**			
High SES	0.110***	0.105***	0.101***	0.059***
	(0.003)	(0.004)	(0.004)	(0.004)
Peer high-SES share, grade 0	0.033***	0.014**	0.015***	0.013**
	(0.003)	(0.006)	(0.006)	(0.006)
Observations	761,917	761,917	761,917	761,917
R^2	0.005	0.057	0.066	0.076
Panel B	**Absence**			
High SES	-0.200***	-0.200***	-0.194***	-0.155***
	(0.003)	(0.003)	(0.003)	(0.004)
Peer high-SES share, grade 0	-0.010***	-0.013**	-0.010**	-0.007
	(0.003)	(0.005)	(0.005)	(0.005)
Observations	830,599	830,599	830,599	830,599
R^2	0.008	0.051	0.059	0.072
Panel C	**Reading (grade 2)**			
High SES	0.300***	0.286***	0.271***	0.099***
	(0.005)	(0.006)	(0.006)	(0.005)
Peer high-SES share, grade 0	0.106***	0.047***	0.039***	0.024***
	(0.005)	(0.008)	(0.008)	(0.008)
Observations	202,114	202,114	202,114	202,114
R^2	0.038	0.097	0.121	0.183
Panel D	**Math (grade 3)**			
High SES	0.349***	0.335***	0.322***	0.158***
	(0.006)	(0.006)	(0.006)	(0.006)
Peer high-SES share, grade 0	0.097***	0.043***	0.048***	0.033***
	(0.005)	(0.008)	(0.007)	(0.007)
Observations	196,756	196,756	196,756	196,756
R^2	0.043	0.101	0.127	0.171
School(-by-grade) FE		Yes	Yes	Yes
Cohort FE		Yes	Yes	Yes
School trend, linear			Yes	Yes
Controls, individual level				Yes
Controls, family level				Yes

Notes: The table shows coefficient estimates of β_1 and β_2 from estimating equation (1) separately for each outcome. Peer high-SES share, well-being, absence, reading, and math performance are all standardized to mean 0 and std. dev. 1 nationally within year and grade. High SES is an indicator equal to one if a pupil's parents' combined income is above the 75th percentile in the pupil's birth cohort prior to school start. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort. Regressions in Panels A and B include school-by-grade fixed effects, while regressions in Panels C and D only include school-fixed effects. The controls include dummies for gender, immigration status, parental education, whether parents cohabit, and continuous controls for mom age, birth order, number of siblings, and class size. Standard errors in parentheses are clustered at the school cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4 Panel B shows the coefficient estimates for absence. We find a small negative effect of high-SES peers on illness-related absence rates in elementary school. However, the effect becomes insignificant when we include individual- and family-level controls. Estimating the effect of high-SES peers at the grade level also suggests that high-SES peers may have a negative effect on absence rates, cf. Appendix Figure A.6. In contrast, the share of high-SES peers has a significant positive effect on both reading and math performance in grades 2 and 3. A standard deviation increase in the share of high-SES peers leads to a 2.4 pct. of a standard deviation increase in reading performance and a 3.3 pct. of standard deviation increase in math performance, cf. column (4) in Table 4 Panel C and D. The effect of a standard deviation increase in the share of high-SES peers increases performance by roughly 10 pct. of the SES-gap in performance, similar to the effect of high-SES peers on well-being.

To investigate the persistence of the effects, we estimate the impact of high-SES peers on a sub-sample of pupils in grades 4 to 6. The share of high-SES peers has a positive effect on well-being until at least grade 6, cf. Appendix Figure A.7.[20] There is a borderline significant negative effect of high-SES peers on absence rates in grades 4 and 6. Additionally, the share of high-SES peers has a significant positive effect on reading performance in grade 4 and math performance in grade 6.[21] These findings indicate that the positive impact of high-SES peers on well-being and academic performance extends at least until grade 6.

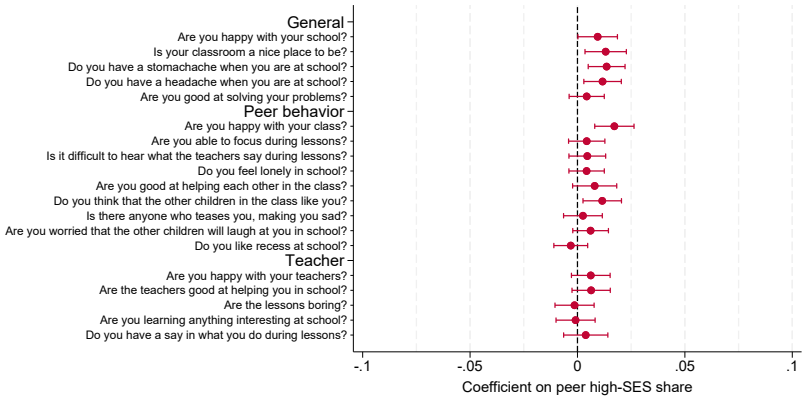
The positive effect of high-SES peers on the learning environment may operate through various channels. For instance, high-SES peers may contribute to fostering a good classroom dynamic, high-SES parents may engage more in improving the school environment, or high-SES peers may give teachers more time to focus on each pupil. With our data, we cannot determine the exact mechanisms behind the improvement in the learning environment. Yet, to explore the potential mechanisms, we investigate how the

[20]Note, for pupils in grades 4 to 6, the well-being survey consists of 40 questions instead of 20, which pupils answer on a scale from 1 to 5. 29 of the questions are used to construct a general well-being measure. The questions are shown in Appendix Table A.3.

[21]Note, pupils in grades 4 to 6 complete a national test in reading in grade 4 and both reading and math in grade 6.

share of high-SES peers affects the response to each individual question underlying the average well-being. Figure 2 shows the coefficient on the share of high-SES peers from estimating equation (1) separately for each question. There is no effect of the share of high-SES peers on questions concerning teaching, which suggests that changes to teaching are unlikely to drive the improvement in the learning environment. Conversely, questions about whether pupils like their class, like to be in their classroom, and think their classmates like them are affected the most. This suggests that a higher share of high-SES peers has a positive effect on the classroom atmosphere, which could be due to either high-SES peers fostering good classroom dynamics or parental initiatives to ensure inclusiveness in the classroom.

Figure 2: Peer Effect Estimates on Individual Well-Being Questions



Notes: The figure shows coefficient estimates of β_2 from estimating equation (1) with the outcome being each of the 19 questions in the well-being survey, respectively. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort, where pupils are defined as high SES if combined parental income is above the 75th percentile in the pupils' birth cohort prior to school start. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Overall, we show that a higher share of high-SES peers has a positive effect on the learning environment. A standard deviation increase in the share of high-SES peers improves well-being and performance by 1-3 pct. of a standard deviation, which persists until at least grade 6. We show that the effect of high-SES peers likely stems from improvements in classroom dynamics and not from improvements in teaching. Our findings complement the existing literature on peer effects in education by finding that high-SES peers not only positively affect academic performance but also well-being. The positive effect on well-being could be one of the mechanisms behind the positive effect on academic

performance.

Our estimates are in the lower end compared to the existing literature on peer effects, which finds effects in the range of 5-10 pct. of a standard deviation (Ammermueller and Pischke, 2009). Our estimates are similar in size to Ammermueller and Pischke (2009)'s estimates for the effect of high-SES peers on reading performance in grade 4 in Norway, which has a similar level of inequality. However, our estimates are likely lower-bound estimates of the effect of high-SES peers on educational outcomes for two reasons. First, we define peers as pupils in the school cohort rather than pupils in the class. Second, our peer measure is based on pupils' peers in grade 0, which does not capture changes in pupils' peers throughout elementary school. Both mean that our measure of peers is only a proxy for actual peers, which adds noise to our estimates and likely attenuates them. Estimating the effect with either current peers or peers based on class definitions gives slightly higher estimates, cf. section 4.3.

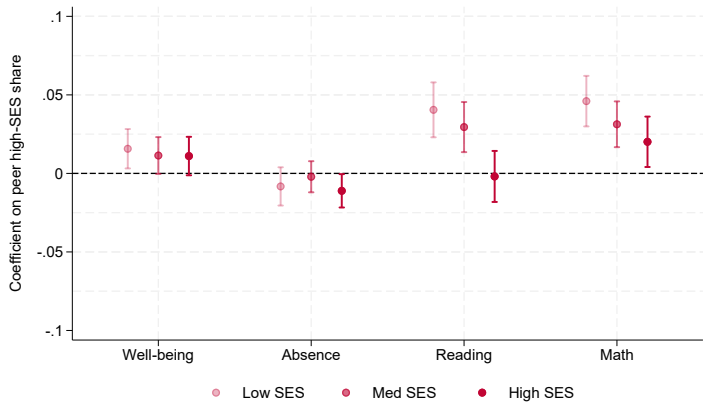
4.2 Heterogeneous Effects

Effect by SES The share of high-SES peers may impact pupils differently depending on their own SES. For example, an increased presence of high-SES peers could cause low-SES pupils to feel marginalized. Contrarily, if the effect goes through parental engagement in the school environment, the effect may benefit all pupils. To investigate whether the effect differs across pupils' own SES, we split pupils into three categories based on parental income prior to school start: high-SES pupils, middle-SES pupils, and low-SES pupils. High-SES pupils are pupils with parental income above the 75th percentile in their cohort, middle-SES pupils are pupils with parental income between the 75th and 25th percentile, and low-SES pupils are pupils with parental income below the 25th percentile. We include two interaction terms to test whether the effect differs by SES: one interaction term between the share of high-SES peers and a dummy for low SES and one interaction term between the share of high-SES peers and a dummy for high SES.

Figure 3 shows the effect of the share of high-SES peers by pupils' own SES. The effect

of peer high-SES share on well-being does not differ across pupils' SES. This suggests that a higher share of high-SES peers benefits all pupils and does not cause low-SES pupils to feel more marginalized. Turning to the effect on absence, the small negative average effect seems to be driven by high- and low-SES pupils, while middle-SES pupils' absence rates are unaffected by the share of high-SES peers. In contrast, low- and middle-SES pupils improve their performance on the reading and math tests more than high-SES pupils when the share of high-SES peers increases. The larger improvement in academic performance for low-SES pupils implies that a higher share of high-SES peers can reduce the performance gap between low- and high-SES pupils. These results also hold when estimating equation (1) separately for low-, middle- and high-SES pupils, cf. Appendix Figure A.13. The greater performance gain for low-SES pupils could be due to teachers having more time to help low-ability pupils when the share of high-SES peers increases. This, however, goes against the evidence from analyzing the effect on the individual well-being questions, which suggests that teaching is unchanged.

Figure 3: Peer Effect Estimates by Pupil SES

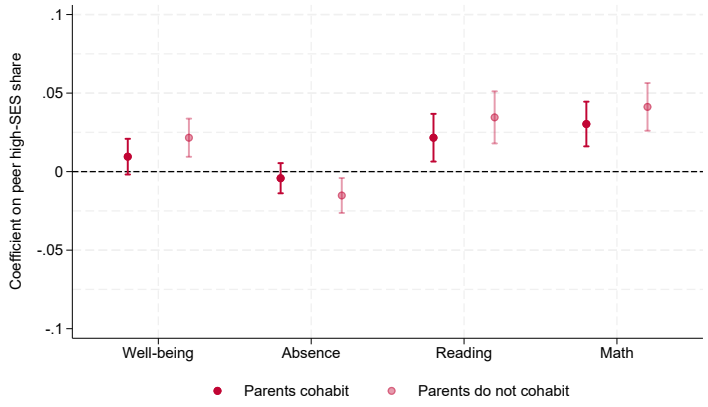


Notes: The figure shows coefficients estimates from estimating equation (1), where we include an indicator for the pupil being low-SES and two interaction terms between the share of high-SES peers and a dummy for high- and low-SES, respectively. The estimated effects are also shown in table format in Appendix Table A.4. The effect for low-SES is the sum of β_2 and the interaction term between the share of high-SES peers and the dummy for low-SES, and the effect for high-SES is the sum of β_2 and the interaction term between the share of high-SES peers and the dummy for high-SES. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Effect by parental cohabitation Another potential channel for differing effects across pupils is the level of support provided at home, as the school environment may impact

well-being and performance less if the pupil has a supportive environment at home. To assess this, we estimate whether the effect of having high-SES peers differs between pupils whose parents cohabit and those whose parents do not. Pupils whose parents do not cohabit may have a less stable home environment than pupils whose parents cohabit. This is also suggested by pupils whose parents do not cohabit having lower well-being, worse performance, and higher absence rates than pupils whose parents cohabit, cf. Appendix Table A.5. Figure 4 shows the estimated effects of high-SES peers split by whether pupils' parents cohabit. The effect on well-being, reading, and math performance is significantly higher for pupils whose parents do not cohabit. Further, pupils with non-cohabiting parents are less likely to be absent as the share of high-SES peers increases, while pupils whose parents cohabit are unaffected. These findings suggest that the classroom environment is more important for pupils who are arguably more vulnerable and may have less support at home.

Figure 4: Peer Effect Estimates by Parental Cohabitation Status

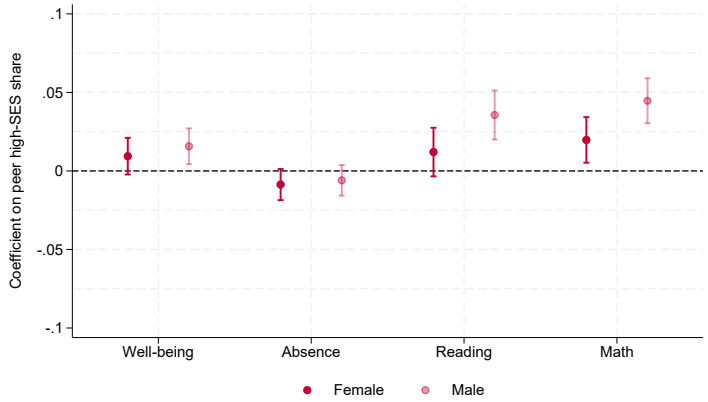


Notes: The figure shows coefficient estimates from estimating equation (1) with an interaction term between the share of high-SES peers and a dummy indicating if pupil i's parents cohabit or not. The estimates are shown in Appendix Table A.5. The estimated effect for pupils whose parents cohabit is the sum of β_2 and the coefficient on the interaction term between the share of high-SES peers and a dummy indicating if the pupils' parents cohabit. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Effect by gender Lastly, we look at whether the effects differ by gender as well as whether the effects depend on the share of boys who are high-SES and the share of girls who are high-SES. We find that girls generally have higher well-being, absence, and

performance in reading than boys, cf. Appendix Table A.6. Their performance in math is significantly lower than boys', but the difference is very small compared to the gap in reading performance. When looking at the effect of high-SES peers, Figure 5 shows that girls benefit significantly less than boys. This is especially true for reading and math, where the effect is approximately halved for girls, and the effect on reading is even insignificant. This could be because girls generally are more self-sufficient than boys, so their well-being and performance are less dependent on their peers.

Figure 5: Peer Effect Estimates by Gender



Notes: The figure shows coefficient estimates from estimating equation (1) with an interaction term between the share of high-SES peers and a gender dummy. The estimates are shown in Appendix Table A.6. The estimated effect for female pupils is the sum of β_2 and the coefficient on the interaction term between the share of high-SES peers and a gender dummy. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Appendix Table A.7 reports estimates from estimating equation (1), where the share of high-SES peers is split into the share of girls that are high SES and the share of boys that are high SES. We also include two interaction terms between a gender dummy and the gender-specific shares of high-SES peers. The share of high-SES girls does not significantly affect well-being, but it does affect the performance of all pupils. A standard deviation increase in the share of high-SES girls increases performance by 2-3 pct. of a standard deviation. Girls do not benefit significantly more than boys. In contrast, a standard deviation increase in the share of high-SES boys increases well-being by 1.3 pct. of a standard deviation for boys and has no effect on girls' well-being. Likewise, the effect on performance is approximately 2 pct. of a standard deviation for boys, but the estimates are only borderline significant. The effect among girls is significantly lower than

among boys. This suggests that the share of girls that are high-SES benefits the entire cohort, while the share of boys only benefits other boys.

4.3 Robustness

School switching and attrition One concern is that the estimated peer effects are driven by pupils systematically switching schools based on the share of high-SES peers in their grade 0 cohort. Table 5 shows descriptive statistics for school switching and attrition. Only 10 pct. of pupils in our sample switch schools between grade 0 and grade 3, with approx. 4.5 pct. of pupils switching between each grade. Notably, low-SES pupils are significantly more likely to switch schools than high-SES pupils. If these school switches depend on pupils' grade 0 composition, the school switches could affect our results. To investigate whether school switches are systematic, we estimate equation (1) separately for each grade, using a dummy equal to one if the pupil switched school the following year as the outcome. This includes both school switches to other public schools and switches to private schools. Estimates of β_2 are close to zero and insignificant, cf. Appendix Figure A.5. This implies that the share of high-SES peers in pupils' grade 0 cohort does not correlate with school switches.

Another concern is attrition from the sample due to pupils not participating in the well-being survey or the national tests. 18 pct. of the sample do not participate in at least one of the four well-being surveys in elementary school, cf. Table 5. Yet, 97 pct. of the sample participate in the well-being survey at least once, suggesting that the vast majority participate in the survey. Low-SES pupils are also more likely to not complete the well-being survey at least once, which could be due to a higher absence rate among low-SES pupils. Only 2 pct. of the sample do not complete the national tests, which again is higher for low-SES than high-SES pupils. This is likely explained by low-SES pupils generally having higher absence rates and being more likely to be exempted from the test. We test whether the lack of participation in either the well-being survey or the national tests is correlated with the share of high-SES peers, and we find that the share

of high-SES peers does not predict attrition, cf. Appendix Figure A.3 and A.4.

The descriptive statistics in Table 5 suggest that high-SES pupils are over-represented compared to low-SES pupils. To analyze whether the results are affected by the over-representation of high-SES pupils, we estimate our main regressions, where we weight observations by the likelihood of responding to the well-being survey or completing the national test, given that they attended a public school in grade 0.[22] The estimates are shown in Appendix Figure A.8. The estimates are largely unchanged when weighting the estimates. Thus, school switching and attrition does not affect our results.

Table 5: Descriptive Statistics on School Switching and Attrition

	Main sample	Low SES	Middle SES	High SES
Switched school between grade 0 and grade 3	0.10	0.16	0.09	0.06
Did not participate in well-being survey in grades 0-3	0.18	0.22	0.17	0.17
Did not participate in reading test in grade 2	0.02	0.04	0.02	0.01
Did not participate in math test in grade 3	0.02	0.04	0.02	0.01
Observations (No. of pupils)	336,615	81,970	171,067	83,578

Notes: The table shows the average of a dummy for whether pupils switched school at least once between grade 0 and grade 3, whether they did not participate in the well-being survey at least once, whether they did not participate in the reading test or the math test. SES is defined based on combined parental income prior to school start. High-SES pupils have combined parental income above the 75th percentile in their cohort, middle-SES pupils have combined parental income between the 75th and 25th percentile, and low-SES pupils have combined parental income below the 25th percentile. Note that the average for the reading test is based on 206,808 pupils observed in grade 2, and the average for the math test is based on 201,204 pupils observed in grade 3.

Definition of SES We define high-SES pupils as pupils whose parents' combined income, when the pupil is 2-4 years old, is above the 75^{th} percentile in the pupil's birth cohort. This definition of SES may be correlated with being the firstborn as having younger siblings means that mothers may be on maternity leave prior to school start, reducing combined parental income and the likelihood of being classified as high-SES. To overcome this, we try defining pupils as high SES based on father income prior to school start, as fathers are less likely to take parental leave. When defining SES based on father

[22]We estimate the likelihood of being in the absence data, participating in the well-being survey, and completing the national test separately for each grade and outcome. We estimate it for a sample, who went to grade 0 in a public school. It is important to restrict on being observed in 0 grade so that we can compute the grades for pupils switching to the private school system, where we do not have information on grades. The probability of participating is predicted by SES, gender, age, immigration status, municipality fixed effects, parental education dummies, mom age, birth order, number of siblings, and whether parents cohabit.

income, the share of high-SES peers still has a positive and significant effect on well-being and math, cf. Appendix Figure A.9. The effect on reading performance is still positive but only borderline significant.

To evaluate how sensitive our estimated effect sizes are to our chosen definition of high SES, we test additional definitions of SES. Appendix Figure A.9 includes coefficient estimates from regressions, where high-SES pupils are pupils with combined parental income above the 80^{th} percentile, combined parental income above the 70^{th} percentile, combined parental wealth above the 75^{th} percentile, or with at least one parent who has a university degree. The estimates are roughly unchanged across the different definitions, with larger effects when high-SES is defined based on education. Thus, the results remain qualitatively robust to different definitions of SES.

Defining pupils' peers As aforementioned, our estimates are likely a lower bound for the effect of high-SES peers on the learning environment due to our peer definition. Throughout our analysis, we define peers at the cohort level in grade 0, which comes with two weaknesses. First, defining the share of high-SES peers at the cohort level does not fully capture who the pupils interact with during teaching. Alternatively, we could define the share of high-SES peers at the class level. There are primarily only small differences between the share of high-SES peers at the class and cohort level, cf. Appendix Fig A.2a, but it still means that there is noise in our peer measure. We do not define peer composition at the class level because we are concerned that class composition within a grade is endogenous. For example, parents may ask the school to place their child in a certain class, or the school may design classes based on information from the kindergartens. This will lead to a positive bias if more engaged parents ensure their children attend classes with a high share of high-SES peers and have children with higher well-being and better academic performance. In line with this, when we define the share of high-SES peers at the class level instead of the cohort level, we obtain effect sizes that are slightly larger in magnitude for well-being and absence, cf. Appendix Figure A.10. In contrast, the effect is smaller for performance. Note, when we estimate the effect based on

the share of high-SES peers at the class level, we use variation across classes in the same school and grade in a given year and not variation across school cohorts across years.

Second, defining the share of high-SES peers in grade 0 does not capture changes in the cohort composition throughout elementary school. The differences between grade 0 and grade 3 share of high-SES peers are generally small, cf. Figure. A.2b. 18 pct. of pupils experience less than 0.5 pct. point change in the share of high-SES peers from grade 0 to grade 3, and 90 pct. of pupils experience less than a 7 pct. point change. The changes may, however, add noise, which could attenuate our estimates. We do not define the peer composition based on the current grade as it is likely endogenous because parents observe the peer composition and may move their child accordingly. When we define the share of high-SES peers based on the current grade, the estimates are slightly larger in magnitude, especially the effect on performance, cf. Appendix Figure. A.11. However, there is no effect on absence rates.

The Effect of Pupils' SES Rank In our main equation, the coefficient on the share of high-SES peers, β_2, captures the effect of average peer characteristics on pupils' outcomes. However, pupils may also be affected by their SES relative to their peers. For example, Paffenholz (2023) finds that a higher SES rank within a pupils' cohort improves pupils' mental health in high school, while Inoue and Tanaka (2024) finds that a higher SES rank increases absence and the likelihood of being a victim of school bullying in grade 8. We investigate the effect of pupils' relative rank by estimating a regression similar to Paffenholz (2023). We estimate,

$$Y = \beta Rank_{icks} + f(SES_{icks}) + \alpha_{cks} + year \times \gamma_s + X_{icks} + \epsilon_{icks}, \tag{2}$$

where $Rank$ is pupil i's parents' rank in the income distribution within their grade 0 school cohort and $f(SES)$ includes decile dummies for parental income prior to school start. We include the same fixed effects and controls as in equation (1). Pupils' rank does not have a significant effect on well-being, absence, or performance, cf. Appendix Figure A.12. This suggests that it is the share of high-SES peers that is important in

elementary school and not pupils' relative position. This could be because pupils are still very young in elementary school, and the SES rank is not yet as apparent as later in the school system.

5 Concluding Remarks

Sparked by growing income segregation across schools and its consequences for pupil compositions, we provide new causal evidence on the effect of high-SES peers on the learning environment in elementary school. To identify the causal effect, we compare pupils who started in the same school in different years and, consequently, were exposed to different shares of high-SES pupils. We use a unique combination of Danish data, allowing us to link pupils' parents' income to pupils' well-being, academic performances, and illness-related absence rates. We find that a higher share of high-SES peers increases well-being and performance in elementary school, while reducing absence rates slightly. We show that the share of high-SES peers matters more for pupils who have lower well-being and academic performance, specifically low-SES pupils, pupils whose parents do not cohabit, and boys. This implies that more high-SES peers can potentially reduce educational gaps within the classroom. Our data does not allow us to pin down the specific mechanisms underlying the positive effect of high-SES peers on the learning environment. However, when investigating the effect on individual components of pupils' well-being, we find suggestive evidence that the improvement in well-being stems from an improvement in classroom dynamics.

Our estimated effect sizes are relatively modest compared to existing research on peer effects in education. However, our estimates are likely a lower bound for two reasons: (i) We define pupils' peers based on the pupils in their grade 0 cohort to avoid endogeneity concerns. This definition of peers likely attenuates our estimates. (ii) Our study estimates the effect on pupils in Denmark, which is characterized by low levels of inequality compared to other countries. This could imply that the differences between pupils are smaller, resulting in smaller peer effects in comparison with existing studies.

Ammermueller and Pischke (2009) find similar sized peer effects in Norway, where the level of inequality is also low, while other studies generally find peer effects between 5 and 10 pct. of a standard deviation depending on the setting. Thus, the effect of high-SES peers could be larger in countries with higher inequality.

Our results suggest that high-SES peers have a positive impact on the learning environment in elementary school. Consequently, increased income segregation across schools, which reduces the share of high-SES pupils in some schools and increases the share in others, may widen differences in well-being and performance across young pupils. This trend can exacerbate inequality in education. Our results cannot guide policies aiming to reduce segregation across schools, for example, by distributing pupils based on their SES, as we only estimate the partial effect of small changes in pupil composition within a school. Thus, we do not capture the general equilibrium effects of distributing pupils across schools.[23] Still, our results could imply that more resources should be invested in schools located in less affluent neighborhoods to compensate for a low share of high-SES pupils. However, more research is needed to understand the mechanisms behind the documented peer effects and whether school resources can indeed compensate for a low share of high-SES pupils (Barrios-Fernandez, 2023).

[23]For such evaluations, we refer to the numerous studies that attempt to evaluate how desegregation policies affect pupil outcomes (see, for example, Angrist and Lang (2004); Guryan (2004); Bergman (2018); Abdulkadiroğlu et al. (2018); Damm et al. (2021)). However, evaluating the general equilibrium effects of desegregation policies is difficult due to behavioral responses among affected pupils and households. For example, Bjerre-Nielsen and Gandil (2024) shows that altering pupil compositions by redesigning school districts is inefficient as high-SES households tend to defy reassignment to low-SES schools.

References

Abdulkadiroğlu, Atila, Parag A. Pathak, and Christopher R. Walters, "Free to Choose: Can School Choice Reduce Student Achievement?," *American Economic Journal: Applied Economics*, 2018, *10* (1), 175–206.

Ammermueller, Andreas and Jörn-Steffen Pischke, "Peer Effects in European Primary Schools: Evidence from the Progress in International Reading Literacy Study," *Journal of Labor Economics*, 2009, *27* (3), 315–348.

Angrist, Joshua D. and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press, 2009.

_ **and Kevin Lang**, "Does School Integration Generate Peer Effects? Evidence from Boston's Metco Program," *American Economic Review*, December 2004, *94* (5), 1613–1634.

Barrios-Fernandez, Andrés, "Peer Effects in Education," in "Oxford Research Encyclopedia of Economics and Finance" 2023.

Bergman, Peter, "The Risks and Benefits of School Integration for Participating Students: Evidence from a Randomized Desegregation Program," 2018.

Berkes, Jan, Frauke Peter, C. Katharina Spiess, and Felix Weinhardt, "Information Provision and Postgraduate Studies," *Economica*, 2022, *89* (355), 627–646.

Bertoni, Marco, Giorgio Brunello, and Lorenzo Cappellari, "Who benefits from privileged peers? Evidence from siblings in schools," *Journal of Applied Econometrics*, 2020, *35* (7), 893–916.

Beuchert, Louise and Anne Nandrup, "The Danish National Tests at a Glance," 2017.

Bifulco, Robert, Jason M Fletcher, and Stephen L Ross, "The Effect of Classmate Characteristics on Post-Secondary Outcomes: Evidence from the Add Health," *American Economic Journal: Economic Policy*, February 2011, *3* (1), 25–53.

Bjerre-Nielsen, Andreas and Mikkel Høst Gandil, "Attendance Boundary Policies and the Limits to Combating School Segregation," *American Economic Journal: Economic Policy*, 2024, *16* (1), 190–227.

Boneva, Teodora, Marta Golin, and Christopher Rauh, "Can Perceived Returns Explain Enrollment Gaps in Postgraduate Education?," *European Association of Labour Economists, World Conference EALE/SOLE/AASLE, Berlin, Germany, 25 – 27 June 2020*, 2022, *77*, 101998.

Caspersen, Sune, "Skoletiden Er Meget Forskellig for Børn På Tværs Af Sociale Lag," *Arbejderbevægelsens Erhvervsråd analyse*, 2024.

Causa, Oresetta, Mikkel Hermansen, Nicolas Ruiz, Caroline Klein, and Zuzana Smidova, "Inequality in Denmark through the Looking Glass," *OECD Economics Department Working Papers, No. 1341*, 2016.

Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz, "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment," *American Economic Review*, 2016, *106* (4), 855–902.

Damm, Anna Piil, Elena Mattana, Helena Skyt Nielsen, and Benedicte Rouland, "Academic Achievement and Wellbeing of Dual Language Learners: Evidence from a Busing Program," *Journal of Urban Economics*, 2021, *126*, 103358.

Fischer, Claude S. and Greggor Mattson, "Is America Fragmenting?," *Annual Review of Sociology*, 2009, *35* (Volume 35, 2009), 435–455.

Guryan, Jonathan, "Desegregation and Black Dropout Rates," *American Economic Review*, 2004, *94* (4), 919–943.

_ , Kory Kroft, and Matthew J. Notowidigdo, "Peer Effects in the Workplace: Evidence from Random Groupings in Professional Golf Tournaments," *American Economic Journal: Applied Economics*, 2009, *1* (4), 34–68.

Hoxby, Caroline, "Peer Effects in the Classroom: Learning from Gender and Race Variarition," *NBER Working Paper 7867*, 2000.

Inoue, Atsushi and Ryuichi Tanaka, "The Rank of Socioeconomic Status within a Class and the Incidence of School Bullying and School Absence," *Economics of Education Review*, 2024, *101*, 102545.

Kiessling, Lukas and Jonathan Norris, "The Long-Run Effects of Peers on Mental Health," *The Economic Journal*, 2023, *133* (649), 281–322.

Loft, Lisbeth and Jane Waldfogel, "Socioeconomic Status Gradients in Young Children's Well-Being at School," *Child Development*, 2021, *92* (1).

Manski, Charles F., "Identification of Endogenous Social Effects: The Reflection Problem," *The Review of Economic Studies*, 1993, *60* (3), 531.

Owens, Ann, Sean F. Reardon, and Christopher Jencks, "Income Segregation Between Schools and School Districts," *American Educational Research Journal*, 2016, *53* (4), 1159–1197.

Paffenholz, Michaela, "Adolescents' Mental Health and Human Capital: The Role of Socioeconomic Rank," CESifo Working Paper 10248, Center for Economic Studies and ifo Institute (CESifo), Munich 2023.

Phillips, Deborah A. and Jack P. Shonkoff, *From Neurons to Neighborhoods: The Science of Early Childhood Development*, National Academies Press, 2000.

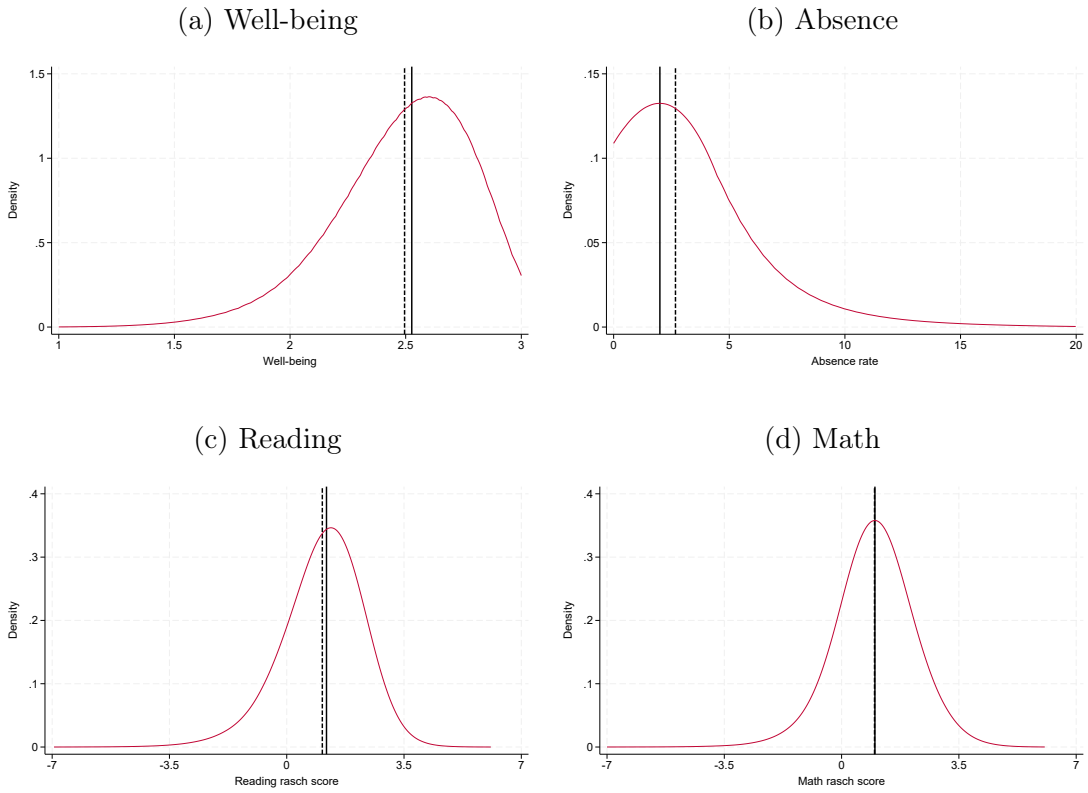
Sacerdote, Bruce, "Chapter 4 - Peer Effects in Education: How Might They Work, How Big Are They and How Much Do We Know Thus Far?," in Eric A. Hanushek, Stephen Machin, and Ludger Woessmann, eds., *Handbook of the Economics of Education*, Vol. 3, Elsevier, 2011, pp. 249–277.

Smith, Jeffrey A., Miller McPherson, and Lynn Smith-Lovin, "Social Distance in the United States: Sex, Race, Religion, Age, and Education Homophily among Confidants, 1985 to 2004," *American Sociological Review*, 2014, *79* (3), 432–456.

Appendices

A Appendix

Figure A.1: Density Plots of the Four Outcome Measures



Notes: Each graph plots the distribution of the given outcome measure. The solid line marks the average, and the dotted line marks the median. The distributions are obtained using kernel density estimation (Epanechnikov kernel) with a bandwidth of 0.1 in Graph (a), 2 in Graph (b), and 0.5 in Graphs (c) and (d). In Graphs (c) and (d), the score is computed based on an underlying psychometric model named the Rasch model that guides the adaptive test algorithm. The pupils' scores are calculated on the logit scale, which ranges from minus to plus infinity, with values commonly between -7 and +7. For more details on how the scores are calculated, see Beuchert and Nandrup (2017).

Table A.1: Well-being Questions, Grades 0 to 3

Question #	Questions text
Q1	Are you happy with your school?
Q2	Are you happy with your class?
Q3	Do you feel lonely in school?
Q4	Do you like recess at school?
Q5	Are you happy with your teachers?
Q6	Do you have a stomachache when you are at school?
Q7	Do you have a headache when you are at school?
Q8	Are you good at solving your problems?
Q9	Are you able to focus during lessons?
Q10	Are you good at helping each other in the class?
Q11	Do you think the other children in the class like you?
Q12	Are the teachers good at helping you in school?
Q13	Is there anyone who teases you, making you sad?
Q14	Are you worried that the other children will laugh at you in school?
Q15	Do you have a say in what you do during lessons?
Q16	Are the lessons boring?
Q17	Are you learning anything interesting at school?
Q18	Is it difficult to hear what the teachers say during lessons?
Q19	Is your classroom a nice place to be?

Notes: The table states each question that compromises our measure of average well-being among pupils in grades 0 to 3. In total, this includes 19 questions out of the 20 questions asked in the well-being survey. For each question, the pupils face three response options: "Yes, a lot/often/most," "Yes, a little/sometimes/some," or "No." For each question, the pupils can also indicate that they do not wish to answer it. The entire survey with response options can be found at `https://www.uvm.dk/-/media/filer/uvm/udd/folke/pdf19/nov/191120-spoergeskema-til-trivselsmaaling-0-3-klasse-ua.pdf`

Table A.2: Summary Statistics by Grade

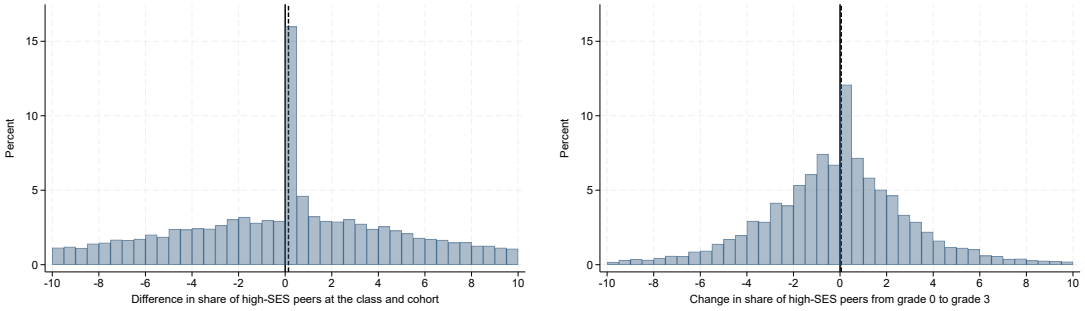
	Main Sample				Survey Sample				Reading Sample	Math Sample
Grade level	0	1	2	3	0	1	2	3	2	3
Age	6.1	7.1	8.1	9.1	6.1	7.1	8.1	9.1	8.1	9.1
	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)
Female (%)	48.7	48.9	48.8	48.8	49.0	49.1	49.1	49.0	49.2	49.1
	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)
Birth order	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)
Number of siblings	1.4	1.4	1.4	1.5	1.4	1.4	1.4	1.5	1.4	1.5
	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)
Immigrant/descendant (%)	10.3	9.3	8.6	8.3	10.0	9.2	8.5	8.2	8.5	8.2
	(30.4)	(29.1)	(28.0)	(27.5)	(30.0)	(28.9)	(27.9)	(27.4)	(27.9)	(27.4)
Parents live togehter (%)	76.7	74.9	73.0	71.4	77.1	75.3	73.5	71.8	73.3	71.7
	(42.3)	(43.4)	(44.4)	(45.2)	(42.0)	(43.1)	(44.1)	(45.0)	(44.2)	(45.0)
Absence rate (%)	2.7	2.6	2.6	2.7	2.6	2.6	2.6	2.7	2.6	2.7
	(2.8)	(2.9)	(3.1)	(3.3)	(2.7)	(2.7)	(2.8)	(3.0)	(2.9)	(3.0)
Cohort Size	62.7	61.9	62.4	61.5	62.5	61.7	62.2	61.4	62.5	61.6
	(27.6)	(26.3)	(25.8)	(24.5)	(27.6)	(26.3)	(25.8)	(24.6)	(25.8)	(24.6)
Class Size	22.9	21.8	21.8	22.2	22.9	21.8	21.9	22.2	22.0	22.3
	(9.0)	(5.6)	(5.5)	(5.2)	(8.7)	(5.5)	(5.4)	(5.0)	(5.2)	(4.9)
High SES (%)	24.7	24.9	25.0	25.1	24.9	25.0	25.1	25.3	25.3	25.4
	(43.1)	(43.2)	(43.3)	(43.4)	(43.2)	(43.3)	(43.4)	(43.5)	(43.5)	(43.5)
High SES peers, grade 0 (%)	24.3	24.4	24.6	24.7	24.2	24.4	24.5	24.6	24.7	24.8
	(17.6)	(17.4)	(17.3)	(17.2)	(17.6)	(17.4)	(17.3)	(17.2)	(17.3)	(17.3)
Mom age at birth	30.8	30.8	30.7	30.7	30.8	30.8	30.8	30.7	30.8	30.7
	(5.0)	(5.0)	(4.9)	(4.8)	(5.0)	(4.9)	(4.9)	(4.8)	(4.9)	(4.8)
Parental income (DKK)	734,236	726,736	717,831	705,273	737,753	729,714	719,618	707,342	720,594	707,809
before school start	(508,269)	(496,544)	(503,026)	(473,029)	(519,457)	(506,795)	(477,846)	(468,904)	(506,652)	(475,094)
Parental wealth (DKK)	-53,881	-46,226	3,112	84,973	-55,021	-44,789	3,540	81,689	5,414	88,521
before school start	(2,609,755)	(2,012,556)	(2,107,059)	(2,114,264)	(2,674,098)	(2,007,498)	(2,109,497)	(2,057,591)	(2,122,073)	(2,117,260)
Primary as highest	8.3	8.1	8.0	7.9	8.0	7.9	7.7	7.6	7.7	7.6
parental education (%)	(27.7)	(27.3)	(27.1)	(26.9)	(27.2)	(26.9)	(26.7)	(26.5)	(26.7)	(26.5)
University as highest	26.1	25.3	24.5	23.4	26.1	25.3	24.5	23.4	24.7	23.6
parental education (%)	(43.9)	(43.5)	(43.0)	(42.4)	(43.9)	(43.4)	(43.0)	(42.3)	(43.1)	(42.5)
Observations (No. of pupils)	213,654	208,933	206,808	201,204	194,506	191,004	190,789	185,618	202,114	196,756

Notes: The table reports summary statistics by grade level for our four samples. It spans the school years 2010/11 to 2018/19. The units of observation are pupils. Pupils are defined as *high-SES* if their parents' income, when the pupil is 2-4 years old, is above the 75^{th} percentile in their birth cohort. Each cell contains the mean and standard deviation in parentheses below.

Figure A.2: Difference in the Share of High-SES Peers between Class and School Cohort and between Grade 0 and Grade 3

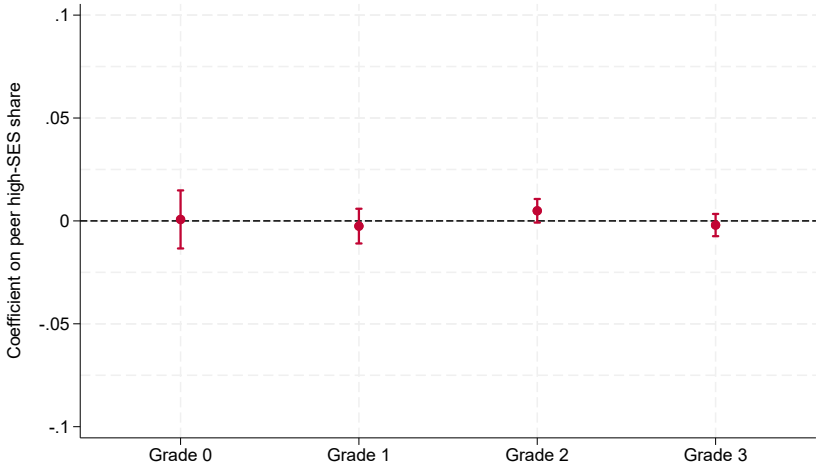
(a) Difference in share between class and school cohort

(b) Difference in share between grade 0 and grade 3



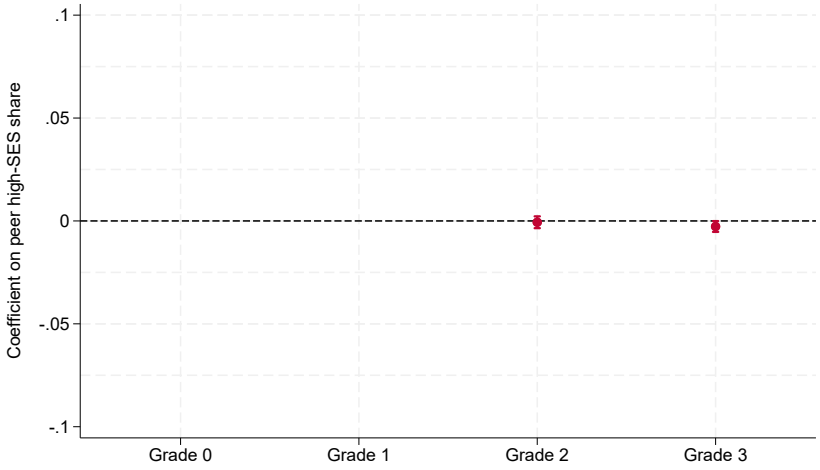
Notes: Panel (a) shows the distribution of the difference in the share of high-SES peers measured at the class-level compared to the school cohort-level. Panel (b) shows the distribution of the difference in the share of high-SES peers between the pupils' school cohort in grade 0 and grade 3. The density is based on the rolling mean across five observations to ensure that individual observations are not identifiable. The solid line marks the average, and the dotted line marks the median. The distributions are cut at -10 and 10 pct. points. In panel (a), the distribution is cut at the 9th percentile and the 92th percentile, and in panel (b) the distribution is cut at the 2.5th percentile the 97th percentile.

Figure A.3: Share of High-SES Peers does not Predict Participation in Well-being Survey



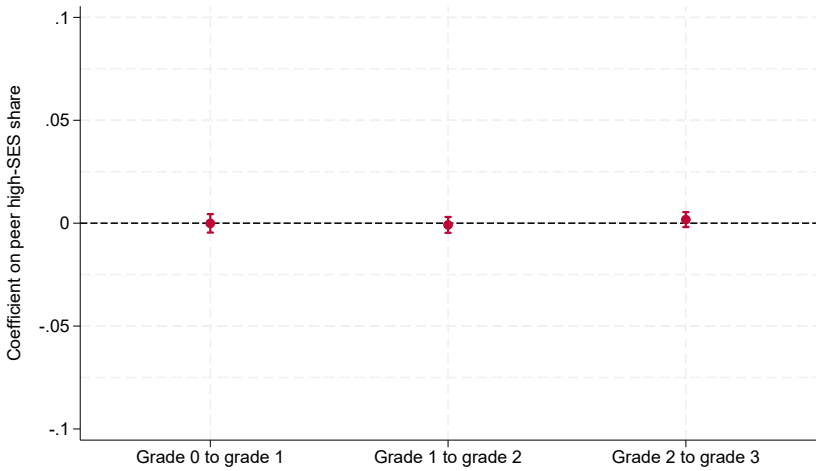
Notes: The figure shows coefficients estimates of β_2 from estimating equation (1) at the grade-level with a dummy for participating in the well-being survey in the given year as the outcome. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.4: Share of High-SES Peers does not Predict Participation in the National Tests



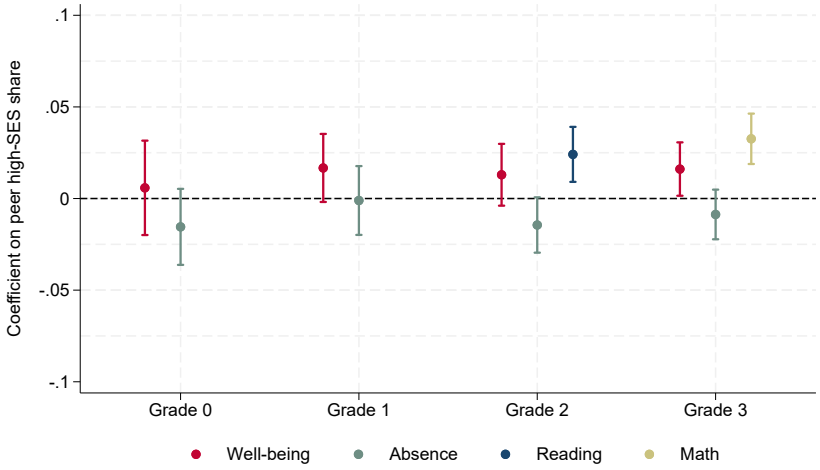
Notes: The figure shows coefficients estimates of β_2 from estimating equation (1) at the grade-level with a dummy for participating in the national tests in the given year as the outcome. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.5: Share of High-SES Peers does not Predict School Switching



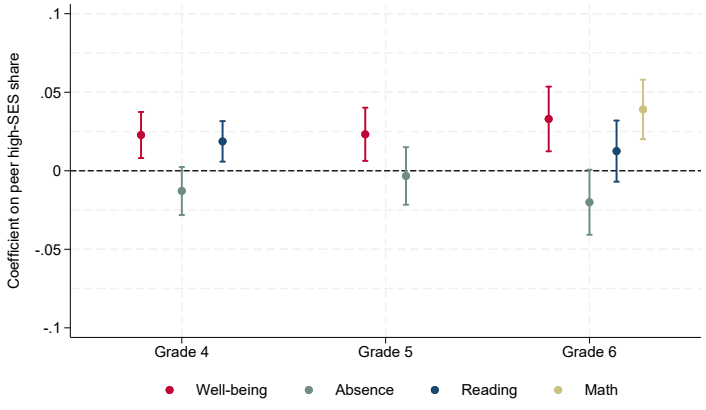
Notes: The figure shows coefficients estimates of β_2 from estimating equation (1) at the grade-level with a dummy for switching school the following year as the outcome. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.6: Peer Effect Estimates by Grade



Notes: The figures shows coefficient estimates of β_2 from estimating equation (1) separately for each grade in elementary school. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.7: Peer Effect Estimates for Grades 4 to 6



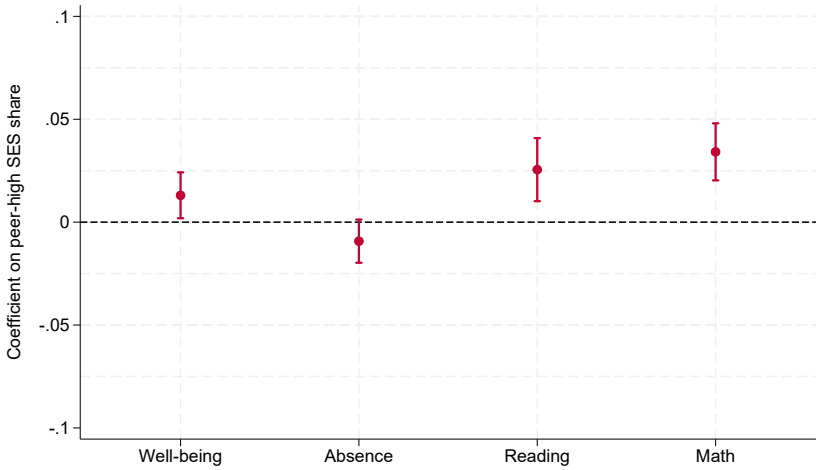
Notes: The figure shows coefficient estimates of β_2 from estimating equation (1) separately for each grade for a sub-sample attending grades 4 to 6 between 2014 and 2018. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Table A.3: Well-being Questions, Grades 4 to 6

Question #	Questions text
Q1	Are you happy with your school?
Q2	Are you happy with your class?
Q6	How often can you come up with a solution to a problem if you try hard enough?
Q7	How often do you succeed with what you set out to do?
Q8	Are you able to focus in class?
Q9	Do you feel lonely?
Q12	Are you worried about being mocked?
Q13	How often do you feel calm in school?
Q14	Have you been bullied in this school-year?
Q16	Are you and your classmates involved in the decision-making regarding subjects in class?
Q17	I am good at refocusing after being disturbed in class.
Q18	If there is a lot of noise in the classroom, my teachers are good at reestablishing a quiet atmosphere.
Q19	Is the teaching boring?
Q20	Is the teaching interesting?
Q23	Are your teachers punctual?
Q24	Do you find it easy to follow what the teacher says in class?
Q25	Do you find it easy to follow what the other students say in class?
Q26	Have you succeeded in learning what you find important in school?
Q27	Do you think the way your teachers teach works well for you?
Q28	What do your teachers think of your progress in school?
Q29	I do well academically in school.
Q30	I show good academic progress in school.
Q31	The teaching makes me want to learn more.
Q32	The teachers are good at helping and supporting me in school when needed.
Q33	I feel like I belong at my school.
Q34	I like recess time in school.
Q35	Most of the kids in my class are kind and helpful.
Q36	The other kids accept me as who I am.
Q37	The teachers ensure that the student's ideas are included and implemented in the teaching.

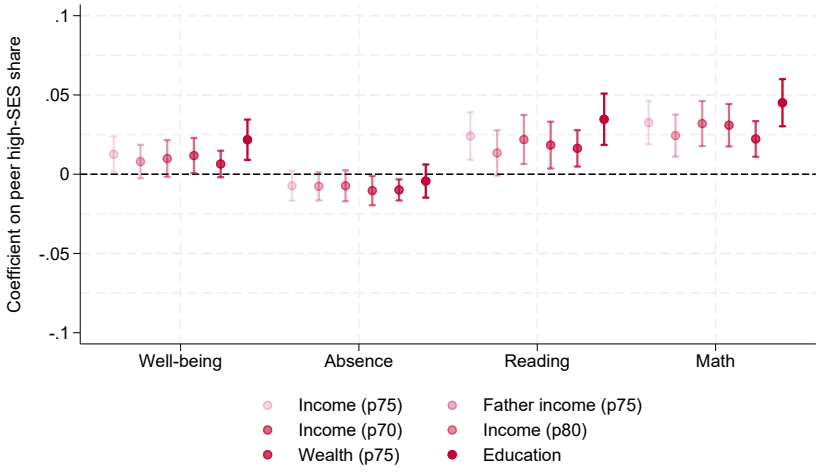
Notes: The table states each question that compromises our measure of average well-being among pupils in grades 4 to 6. In total, this includes 29 questions out of the 40 questions asked in the well-being survey. For each question, the pupils face five response options: "Very often/strongly agree," "Often/agree," "Sometimes/Neither agree or disagree," "Rarely/Disagree," and "Never/Strongly disagree (question 28 only have four response options). For each question, the pupils can also indicate that they do not wish to answer it. The entire survey with response options can be found at `https://www.uvm.dk/-/media/filer/uvm/udd/folke/pdf19/nov/191120-spoergeskema-til-trivselsmaaling-4-9-klasse-ua.pdf`.

Figure A.8: Main Results Weighted by Probability of Participation



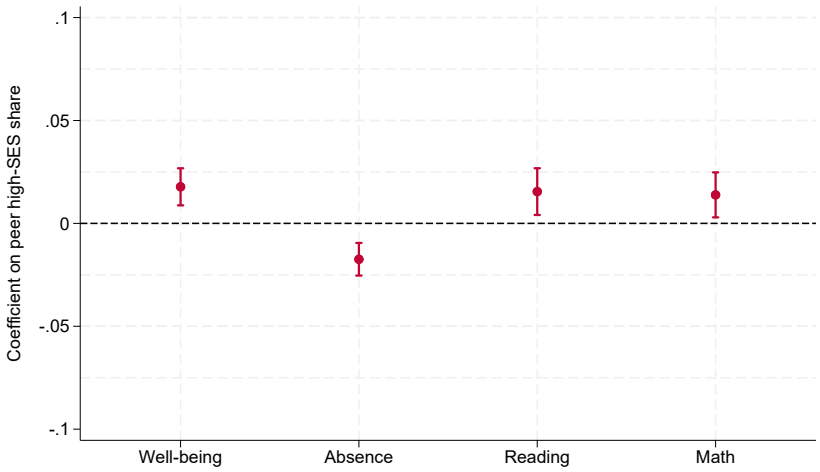
Notes: The figure shows coefficient estimates of β_2 from estimating equation (1) where the observations are weighted by the likelihood of being in the absence data, completing the well-being survey and national test, respectively given the pupil attended grade 0 in a public school. The probability of participating is predicted by SES, gender, age, immigration status, municipality fixed effects, parental education dummies, mom age, birth order, number of siblings, and whether parents cohabit. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.9: Peer Effect Estimates with Different Definitions of High-SES



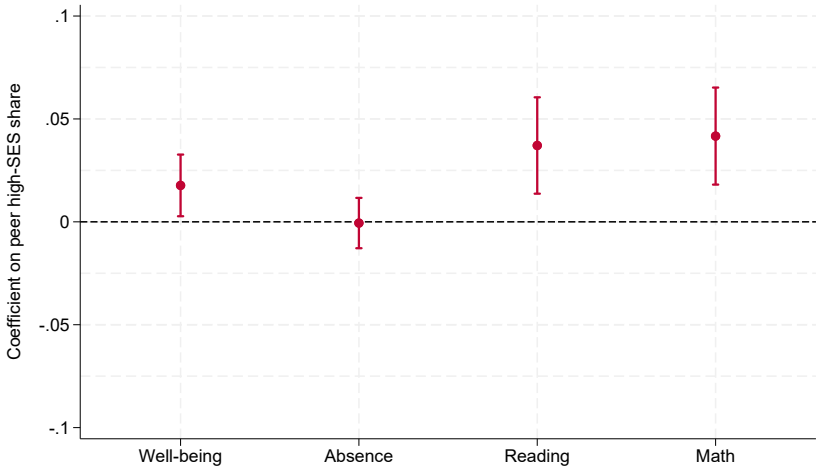
Notes: The figure shows coefficients estimates of β_2 from estimating equation (1) with different measures of high-SES. Income (p75) is our main definition of high-SES, where pupils are defined as high-SES if combined parental income is above the 75th percentile in the pupils' birth cohort. For Income (p80), pupils are defined as high-SES if combined parental income is above the 80th percentile, and for Income (p70), pupils are defined as high-SES if combined parental income is above the 70th percentile. For Wealth (p75), pupils are defined as high-SES if combined parental wealth is above the 75th percentile, and for Education, pupils are defined as high-SES if at least one of the parents has a university degree. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.10: Main Results with Share of High-SES Peers Defined at the *Class* Level



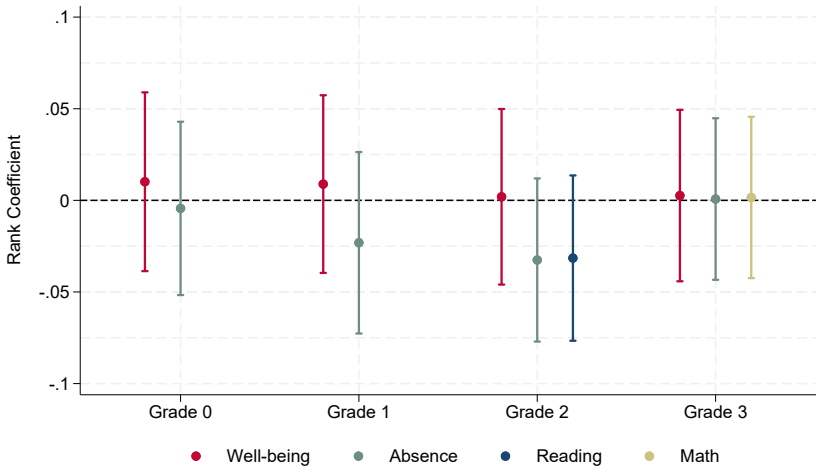
Notes: The figure shows coefficient estimates of β_2 from estimating equation (1), where instead of calculating the share of high-SES peers at the cohort level, we calculate it at the class-level. Therefore, we use school-by-grade-by-year fixed effects and exploit variation in peer high-SES share within a school grade in the same year. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.11: Main Results with Share of High-SES Peers Defined at the *Current* School-Grade Level



Notes: The figure shows coefficient estimates of β_2 from estimating equation (1), where instead of calculating the share of high-SES peers in grade 0, we calculate it as the share of high-SES peers in the current grade. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Figure A.12: SES-Rank Estimates



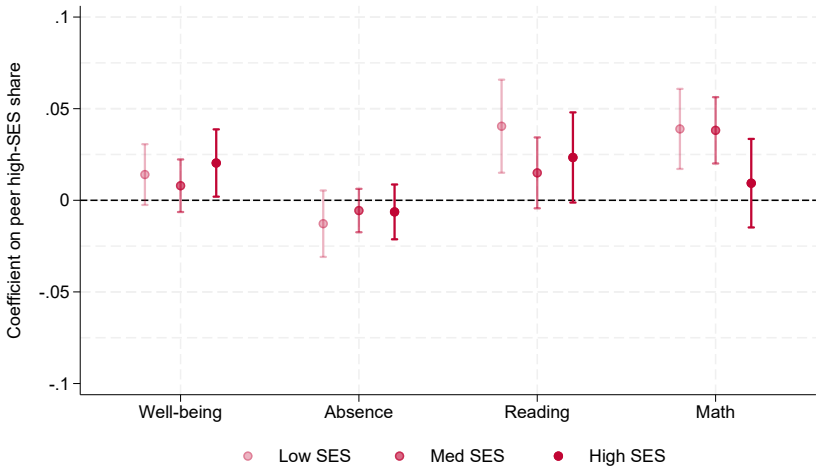
Notes: The figure shows coefficient estimates of β from estimating equation (2) separately for each grade. Pupils' ranks are based on their placement in the income distribution within their grade 0 school cohort. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Table A.4: Peer Effect Estimates with SES Interaction

	(1) Well-being	(2) Absence	(3) Reading	(4) Math
Low SES	-0.043***	0.192***	-0.095***	-0.098***
	(0.004)	(0.005)	(0.006)	(0.006)
High SES	0.052***	-0.118***	0.092***	0.144***
	(0.004)	(0.004)	(0.006)	(0.006)
Peer high-SES share, grade 0	0.011*	-0.002	0.029***	0.031***
	(0.006)	(0.005)	(0.008)	(0.007)
Low SES × Peer high-SES share, grade 0	0.004	-0.006	0.011*	0.015**
	(0.004)	(0.005)	(0.007)	(0.006)
High SES × Peer high-SES share, grade 0	-0.000	-0.009**	-0.031***	-0.011**
	(0.004)	(0.004)	(0.005)	(0.006)
Observations	761,917	830,599	202,114	196,756
R^2	0.076	0.077	0.184	0.172
School-by-grade FE	Yes	Yes		
School FE			Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
School trend, linear	Yes	Yes	Yes	Yes
Controls, individual level	Yes	Yes	Yes	Yes
Controls, family level	Yes	Yes	Yes	Yes

Notes: The table shows coefficient estimates from estimating: $Y_{icks} = \beta_0 + \beta_1 HighSES_{icks} + \beta_2 HighSESshare_{icks} + \beta_3 LowSES_{icks} + \beta_4 HighSES \times HighSESshare_{icks} + \beta_5 LowSES \times HighSESshare_{icks} + \alpha_{cks} + year \times \gamma_s + X_{icks} + \epsilon_{icks}$, where Y_{icks} denotes our four outcome measures, $LowSES_{icks}$ is an indicator for being low-SES, and the remaining variables are as defined by eq. (1). Peer high-SES share, well-being, absence, reading, and math performance are all standardized to mean 0 and std. dev. 1 nationally within year and grade. High SES (low SES) is an indicator equal to one if a pupil's parent's combined income is above (below) the 75th (25th) percentile in the pupil's birth cohort prior to school start. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort. The controls include dummies for gender, immigration status, parental education, and continuous controls for mom age, birth order, number of siblings, and class size. Standard errors in parentheses are clustered at the school cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A.13: Peer Effect Estimates by SES



Notes: The figure shows coefficients estimates from estimating equation (1) separately for low-, middle- and high-SES pupils. The bands show 95 pct. confidence intervals based on standard errors clustered at the school cohort level.

Table A.5: Peer Effect Estimates with Parental Cohabitation Interaction

	(1) Well-being	(2) Absence	(3) Reading	(4) Math
High SES	0.060***	-0.155***	0.100***	0.159***
	(0.004)	(0.004)	(0.005)	(0.006)
Parents cohabit	0.160***	-0.114***	0.103***	0.124***
	(0.004)	(0.004)	(0.005)	(0.005)
Peer high-SES share, grade 0	0.022***	-0.015***	0.035***	0.041***
	(0.006)	(0.006)	(0.008)	(0.008)
Parents cohabit × Peer high-SES share, grade 0	-0.012***	0.011***	-0.013***	-0.011**
	(0.004)	(0.004)	(0.005)	(0.005)
Observations	761,917	830,599	202,114	196,756
R^2	0.076	0.072	0.182	0.170
School-by-grade FE	Yes	Yes		
School FE			Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
School trend, linear	Yes	Yes	Yes	Yes
Controls, individual level	Yes	Yes	Yes	Yes
Controls, family level	Yes	Yes	Yes	Yes

Notes: The table shows coefficient estimates from estimating an extended version of equation (1) with an interaction term between the share of high-SES peers and a dummy indicating if pupil i's parents cohabit or not. Peer high-SES share, well-being, absence, reading, and math performance are all standardized to mean 0 and std. dev. 1 nationally within year and grade. High SES is an indicator equal to one if a pupil's parent's combined income is above the 75th percentile in the pupil's birth cohort prior to school start. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort. Parents cohabit is an indicator equal to one if the pupils' parents cohabit. The controls include dummies for gender, immigration status, parental education, and continuous controls for mom age, birth order, number of siblings, and class size. Standard errors in parentheses are clustered at the school cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.6: Peer Effect Estimates with Gender Interaction

	(1) Well-being	(2) Absence	(3) Reading	(4) Math
High SES	0.059***	-0.155***	0.099***	0.158***
	(0.004)	(0.004)	(0.005)	(0.006)
Female	0.039***	0.023***	0.242***	-0.019***
	(0.003)	(0.003)	(0.005)	(0.005)
Peer high-SES share, grade 0	0.016***	-0.006	0.036***	0.045***
	(0.006)	(0.005)	(0.008)	(0.007)
Female × Peer high-SES share, grade 0	-0.006**	-0.003	-0.024***	-0.025***
	(0.003)	(0.003)	(0.004)	(0.004)
Observations	761,917	830,599	202,114	196,756
R^2	0.076	0.072	0.183	0.171
School-by-grade FE	Yes	Yes		
School FE			Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
School trend, linear	Yes	Yes	Yes	Yes
Controls, individual level	Yes	Yes	Yes	Yes
Controls, family level	Yes	Yes	Yes	Yes

Notes: The table shows coefficient estimates from estimating equation (1) when including an interaction term between a dummy for being female and the share of high-SES peers. Peer high-SES share, well-being, absence, reading, and math performance are all standardized to mean 0 and std. dev. 1 nationally within year and grade. High SES is an indicator equal to one if a pupil's parent's combined income is above the 75th percentile in the pupil's birth cohort prior to school start. Peer high-SES share is the share of high-SES peers in pupils' grade 0 school cohort. Female is an indicator equal to one if the pupil is female. The controls include dummies for immigration status, parental education, whether parents cohabit, and continuous controls for mom age, birth order and number of siblings. Standard errors in parentheses are clustered at the school cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.7: Gender-Specific Peer Effects Estimates

	(1) Well-being	(2) Absence	(3) Reading	(4) Math
High SES	0.059***	-0.155***	0.099***	0.158***
	(0.004)	(0.004)	(0.005)	(0.006)
Female	0.039***	0.023***	0.242***	-0.019***
	(0.003)	(0.003)	(0.005)	(0.005)
Female peer high-SES share, grade 0	0.004	-0.002	0.023***	0.030***
	(0.006)	(0.005)	(0.008)	(0.008)
Female × Female peer high-SES share, grade 0	0.006	-0.002	-0.006	-0.013
	(0.006)	(0.005)	(0.008)	(0.008)
Male peer high-SES share, grade 0	0.013**	-0.003	0.015*	0.018**
	(0.006)	(0.005)	(0.008)	(0.008)
Female × Male peer high-SES share, grade 0	-0.012**	-0.001	-0.019**	-0.013*
	(0.005)	(0.005)	(0.008)	(0.008)
Observations	761,722	830,380	202,075	196,703
R^2	0.076	0.072	0.183	0.171
School-by-grade FE	Yes	Yes		
School FE			Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
School trend, linear	Yes	Yes	Yes	Yes
Controls, individual level	Yes	Yes	Yes	Yes
Controls, family level	Yes	Yes	Yes	Yes

Notes: The table shows coefficient estimates from estimating an extended version of equation (1), where the share of high-SES peers is replaced by the share of high-SES peers among boys and girls separately. High SES is an indicator equal to one if a pupil's parent's combined income is above the 75th percentile in the pupil's birth cohort prior to school start, and female is an indicator equal to one if the pupil is female. Female (male) peer high-SES share is the share of high-SES peers among girls (boys) in pupils' grade 0 school cohort. The controls include dummies for immigration status, parental education, whether parents cohabit, and continuous controls for mom age, birth order and number of siblings. Standard errors in parentheses are clustered at the school cohort level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.