Korea and the World Economy
Vol. 25, No. 2 (August 2024) 89-111
http://doi.org.10.46665/kwe.2024.08.25.2.89

The Impact of Misbehaving Peers: Behavioral Consequences in Classrooms

Byeung-Kuk Oh*

This paper examines the spillover effects of misbehaving boys and girls on others' behavioral problems, leveraging the random assignment of students into classrooms in South Korean middle schools. Peers with single parents are more likely to misbehave in class, providing a proxy for peers' misbehavior to overcome the reflection problem. By using the composite index of class misbehaviors, I find that boys with single parents lead to an increase in the intensity of other students' misbehaviors in class, whereas girls with single parents have a negative but statistically insignificant effect on others.

JEL Classification: D91, I20, I26, I28
Keywords: Class Misbehavior, Peer Effects, Gender

* Research Fellow, Korea Insurance Research Institute, Email: bkoh@kiri.or.kr. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Allremaining errors are my own.

1. INTRODUCTION

Behavioral problems among adolescents are common at school. On average across OECD countries, in 2012, about 14% of students skip classes once or twice, and 4% skip classes three times or more during the two weeks before the PISA test (OECD, 2012). In particular, there is a well-documented gender gap in behavioral problems, especially with boys performing worse than girls on behavioral factors in the classroom (Beaman et al., 2006). Boys are more likely to engage in aggressive behavior than girls in school (Orpinas et al., 2015). This gender disparity is revealed in school suspension statistics in the US: during 20132014, more than twice as many male students (7.3%) than female students (3.2%) received one or more school suspensions (U.S. National Center for Education Statistics, 2019). In South Korea, male students are more likely to exhibit delinquent behaviors than female students (Chung et al., 2016).

Peer behavior can have an influence on individual behavior through social interactions (Chambers et al., 2023). However, there are relatively few works documenting that misbehaving male peers have causal spillover effects on other students' behavioral outcomes more likely than those of girls. Boys with female sounding names are more likely to engage in misbehaviors, thereby increasing classmates' disciplinary problems (Figlio, 2007). Male students who are exposed to domestic violence also lead male classmates to violate school rules (Carrell and Hoekstra, 2010). These studies suggest that those students' behavioral problems eventually generate negative externalities in the classrooms, thereby reducing other classmates' academic performance.

Disentangling "true" peer effects from other confounding factors can be a significant challenge in peer effects studies. Addressing non-random sorting (or the "selection problem") is important for identification. If individuals with similar personal and family backgrounds self-select into a peer group, then students' outcomes across classrooms or schools might not be truly attributable to the effect of their peers. Two major strategies have been put forth to tackle the problem of self-selection. The first one exploits the random assignment of individuals into peer group (Sacerdote, 2001; Lyle, 2007; Carrell et al., 2011; Chetty et al., 2011; Lim and Meer, 2018; Anelli and Peri, 2019; Huang and Zhu, 2020; Gong et al., 2021; Zhao and Zhao, 2021). The second one, introduced by Hoxby (2000), relies on the comparison of cohort-to-cohort variation in peer measure across time within a given school. This strategy has since been used in several peer effect papers (Gould et al., 2009; Carrell and Hoekstra, 2010; Lavy and Schlosser, 2011; Carrell et al., 2018; Mouganie and Wang, 2020) by defining the peer group as student in the same grade level (within the same school and year) and controlling for a series of fixed effects in the empirical specification.

This paper investigates how misbehaving boys and girls affect other students' behavioral problems in class by adopting the first strategy: students in middle schools are randomly assigned to a physical homeroom classroom in which they interact with the same classmates throughout the entire school day. This setting offers ideal

circumstances for avoiding concerns of endogenous sorting and differences in factors that might be correlated with peer composition. In addition, I use a dataset that includes a record of the students' misbehaviors in the class. These misbehaviors are reported by the students and represent how frequently they misbehave in the class. The method of Anderson (2008) allows computation of a single misbehavior composite index (MCI) that captures the common variation in those misbehaviors and to estimate the peer effects in a straightforward way.

In addition, I overcome the reflection problem – in which the direction of peer effects is opaque (Manski, 1993) – by linking the reasons for classroom peers' misbehavior to family trouble like a single-parent household. This is supported by the literature (Pearl et al., 2014; Daryanani et al., 2016; Comeau and Boyle, 2018) showing that children raised in a single-parent household are more likely to experience a number of emotional and behavioral problems such as depression, violence, and externalizing behavior. Because single-parent status of randomly assigned peers cannot directly affect other children's misbehavior, I proxy for peers' average MCI using peers' having single-parent households to obtain exogenous variation in the peer measure.

I find that male peers with single parents statistically significantly increase the intensity of others' misbehaviors in the classroom, whereas female peers with single parents do not. Specifically, the increase of one single male student with a single-parent household among 30 students in the classroom leads to an increase of other students' MCI by 3.3% of a standard deviation. It also increases other students' tendency to defy teachers in class. These results are robust to the inclusion of student, teacher, and peer characteristics, and class size, providing plausible evidence on as good as random assignment. My heterogeneity analysis shows that the spillover effects of male peers with single parents appear to primarily impact class misbehaviors of male students and students in smaller classes.

This paper connects to the literature on misbehaving peer effects. The earlier works mainly investigate the effects of misbehaving peers on students' academic achievement and their adult outcomes. For example, Figlio (2007) shows that disruptive classmates reduce overall mathematics achievement. Aizer (2009) finds that peers with undiagnosed attention deficit disorder generate negative externalities in the classroom, lowering test scores of other classmates. Carrell and Hoekstra (2010) suggest that peers who suffered from domestic violence reduces test scores of other students. Horoi and Ost (2015) find that students who were diagnosed as emotionally disabled have a negative impact on the academic performance of their peers. Carrell et al. (2018) show that children who were exposed to domestic violence negatively affect other students' wages in the long-run. Billings and Hoekstra (2019) find that exposure to peers linked to parental arrest decreases academic achievement and increases the likelihood of being arrested in adulthood. Zhao and Zhao (2021) show that peers with alcoholic fathers in the classroom reduce other students' test scores. I complement these findings by suggesting that misbehaving male peers play a crucial role in causing class misbehavior

of other students while addressing endogenous sorting by exploiting random student assignment and providing clear evidence of peer effects on students' actual misbehaviors in the class.

The reminder of the paper is structured as follows. Section 2 describes the institutional background and the data set. Section 3 discusses the empirical strategy. Section 4 reports the empirical results. Section 5 concludes.

2. BACKGROUND AND DATA

2.1. Institutional Setting

Since 1969, when the "leveling policy" was first introduced in South Korea, student allocation to middle schools has been fairly simple and straightforward (Kang, 2007). Elementary school graduates move to local middle schools within the residence-based school attendance zones assigned by a lottery system.[1] Then, they are assigned to a physical homeroom classroom at the beginning of each academic year (generally in the first week of March). The homeroom is the physical place where children mostly remain throughout a school day, and where subject teachers visit to teach them. Regardless of whether a school is public or private, almost all middle schools implement a random assignment of homerooms.

The most common method of assignment within the school is to order students by previous academic performance and assign them one by one across homerooms. For instance, the top-ranked student is assigned to Classroom 1, the second-ranked student to Classroom 2, the third-ranked student to Classroom 3, and so on.[2] Reporting the distribution of the previous academic performance to both students and their parents is strictly banned before classroom assignment is complete. This system prevents children from being compulsorily sorted into a homeroom peer group that is extremely skewed to high (or low) academic ability, naturally guaranteeing ability mixing within classrooms. This method yields as good as random classroom assignment of children to their own peer group with respect to at least students' non-academic characteristics. In addition to classmate assignment, homeroom teachers are also assigned, either by lottery or a committee, to specific homeroom classrooms (Lim and Meer, 2018). Homeroom teachers generally teach a specific subject themselves and are responsible for school discipline.

---

[1] The formulas used for school assignment are not known to the public; the assignment process involves random draws performed using software (Choi et al., 2015). Students are not permitted to change middle schools within the same zone, except in the case of residential relocations. Although students do transfer across different school attendance zones, they are randomly assigned to a new school in the new zone.

[2] Lim and Meer (2017) performed a survey to examine whether this rule is really applied in 197 South Korean middle schools by coordinating with local offices of education and found that almost all schools were applying this method of classroom assignment.

2.2. Sample Construction and Statistics

I use the 2012 Gyeonggi Education Panel Study (GEPS) data from the Gyeonggi Institute of Education, a research institute responsible for advising on educational policy in the Gyeonggi province (surrounding Seoul, South Korea).[3] In 2012, this province had a population of more than 12 million individuals and a per capita GDP of more than $28,000, compared with a national average of $31,000. GEPS surveys 7^{th} grade students in two classrooms randomly chosen within each school, and also collects information on these students' parents and homeroom teachers. This survey took place in April, one month after the beginning (March) of the new school year in the South Korean secondary schools. The initial dataset includes 4,051 7^{th} grade students. Dropping observations without information about parental marriage status (including legal divorce, separation, and bereavement) or classroom information leaves 4,009 observations.[4] Each student was asked to self-report their misbehavior related to classroom disruption or risky behavior.[5] As Angrist (2014) noted, there is a negative mechanical correlation between own and peer characteristics when adding peer averages to the right hand side peer variable in the specification. To address this problem, I follow their solution; thus, I exclude students with single parents from my dataset.[6] Table 1 provides summary statistics for the main sample of students used in the analysis. Male students constitute 51% of individuals in my sample. Table 1 also reports that 5% of individuals have male peers with a single-parent household in their classrooms. The proportion of female peers with a single-parent households in the classrooms is also 5%. Hence, boys and girls are equally likely to be linked to a household with a single parent in my sample dataset.

Table 1 Summary Statistics

	Mean	Std. Dev	Min	Max	N
A. Student Outcomes					
(Raw) Misbehavior Composite Index (MCI)	0.359	0.259	0.00	1.00	3,542
B. Student Characteristics					
Male	0.51	0.50	0.00	1.00	3,621

[3] This dataset is *only* representative of the Gyeunggi province. Sixty-three schools were randomly chosen from the population of 624 middle schools in the GEPS dataset using a two-stage cluster sampling design.

[4] There is no correlation between sample attrition and other student or classroom characteristics.

[5] I expect that there is significant underreporting of class misbehaviors to the Gyeonggi Institute of Education. If this underreporting is not correlated with the peer effects I consider, then estimated effects on class misbehaviors would be a conservative lower bound for the true effect on class misbehaviors in my empirical analysis.

[6] I consider a student to be a single-parent student if his or her parents indicated on the parental response survey that they are legally divorced, separated, or widowed. My dataset contains about 9.7% of students with single-parent households.

Dad w BA or Higher Degree	0.60	0.49	0.00	1.00	3,603
Mom w BA or Higher Degree	0.49	0.50	0.00	1.00	3,604
Household Income (million KRW)	4.92	4.29	0.00	99.99	3,565
C. Peer Characteristics					
Male Peers w Single Parent	0.05	0.05	0.00	0.32	3,618
Female Peers w Single Parent	0.05	0.05	0.00	0.32	3,618
Male Peers w Single Parent (Net of School Fixed Effects)	0.00	0.03	-0.12	0.14	3,618
Female Peers w Single Parent (Net of School Fixed Effects)	0.00	0.03	-0.09	0.18	3,618
D. Teacher Characteristics					
Female Homeroom Teacher	0.81	0.39	0.00	1.00	3,482
Homeroom Teacher over 40	0.29	0.45	0.00	1.00	3,482
Homeroom Teacher Experience below 5 Years	0.21	0.40	0.00	1.00	3,482
Homeroom Teacher's College	0.71	0.45	0.00	1.00	3,445
Homeroom Teacher's Post Graduate	0.38	0.49	0.00	1.00	3,482

Notes: I restrict the sample to students who have not experienced parental divorce, separation or bereavement. One US Dollar (USD) is equal to around 1,070 in Korean Won (KRW, 2012).

2.3. Misbehaving Children and Composite Index

The GEPS data set includes questions that ask children how frequently they misbehave in the class. Students were asked to answer the following 4 questions:

How frequently did you engage in the following misbehaviors during this year?

Choose from "Never", "Once or Twice per year", "Once or Twice per semester", "Once or Twice per month", "Once or Twice per week", or "Nearly Every Day".

1. Chat with others in class 2, Defy teachers in class 3, Sleep in class 4, Goof off in class.

Each component of these misbehaviors is measured with scale scores ranging from one ("Never") to six ("Nearly Every Day"), revealing the intensity of children's misbehavior. The overall distribution of children's propensity to misbehave across each component is summarized in table 2. However, the distribution of the intensity of children's misbehavior is not balanced across each bad behavior. For example, the fraction of

students who never chat with others in class is 6.12%, while 62.52% of students report they never defy teachers in class. I simplify how intensity is measured, creating a binary variable by collapsing the six answers in table 2 into two categories: low and high tendency. Low tendency comprises "Never", "Once or Twice per year", and "Once or Twice per semester"; high tendency comprises "Once or Twice per month", "Once or Twice per week" and "Nearly Every Day". Note that this is not intended to proxy for a student's actual misbehaviors, but rather, as a (noisy) measure of how they perceive themselves to misbehave in the class. Appendix Table B1 provides the resulting narrower distribution of misbehavior tendency.

Appendix table B2 presents summary statistics on class misbehaviors and a correlation matrix of these misbehaviors. Panel A shows each misbehavior's mean and standard deviation. Panel B represents the correlation maxtrix of class misbehaviors. This shows positive correlations between four misbehaviors in class. To obtain a more straightforward table 2: Distribution Over Children's (Raw) Propensity to Misbehave in a Class misbehavior measure, I construct a single composite index of these misbehaviors by using the aggregation method of Anderson (2008).[7] I name this the Misbehavior Composite Index (MCI). This MCI is then normalized to z-scores with means of zero and standard deviations of one

Table 2: Distribution Over Children's (Raw) Propensity to Misbehave in a Class

	Never	Once or Twice per year	Once or Twice per semester	Once or Twice per month	Once or Twice per week	Nearly Every Day
Chat with others in class	6.12	7.29	6.96	14.47	36.59	28.58
Defy teachers in class	62.52	14.94	7.18	7.60	6.42	1.37
Sleep in class	32.87	13.77	9.45	15.08	21.27	7.56
Goof off in class	56.34	13.94	7.61	10.58	9.07	2.46

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. Each value represents a percentage (%) of self-reported misbehavior frequency. In each row, the tendency of misbehavior increases from left to right.

3. IDENTIFICATION STRATEGY

[7] In my empirical analysis, this method may improve statistical power to detect peer effects that go in the same direction within the class misbehavior.

3.1. Empirical Approach

The simple way to investigate misbehaving peer effects is to estimate the effects of peers' (average) MCI on a student's own MCI. However, this would be biased by the reflection problem (Manski, 1993). The student and his or her peers affect each other's misbehavior in the classroom. To overcome the reflection problem, I develop an instrument for measuring misbehaving peers. Although employing lagged characteristics of my sample students (7^{th} grade children) is a plausible way to avoid the reflection problem, the dataset does not allow me to do so because it does not contain information on these characteristics prior to the sample year.[8)]

Instead, I exploit a family attribute as the exogenous source of variation in peer quality in a manner similar to other papers (Kristoffersen et al., 2015; Carrell and Hoekstra, 2010; Carrell et al., 2018). In particular, the dataset contains information about whether children have experienced parental divorce, separation or bereavement. Some studies support that the effects of single parenting could lead children to suffer from behavioral, mental, or emotional problems. For instance, Singh and Kiran (2014) indicate that children from single-parent families are more likely to engage in delinquent behavior and juvenile crime, and to exhibit depression and other disorders. Alami et al. (2014) suggest that adolescents' self-esteem in single-parent families tends to be lower than that in the two-parent families. Panel C of table 1 shows that the residual variation is about 0.03 for both male and female peers with a single parent after removing school fixed effects, accounting for about three-fifths (0.03/0.05) of the overall variation (0.05). This demonstrates sufficient residual variation in these two peer measures. Appendix Figure A1 displays conditional means for students with single parents and both parents graphically. Specifically, the blue and red bars represent mean residuals for male and female students after regressing the MCI on school fixed effects. This figure shows that students with single parents have a higher MCI than those with both parents. In addition, male students with single parents have a much higher MCI than female students with single parents.[9)]

I consider single parenting as a relevant proxy for misbehavior. Importantly, I use two proxy variables, such as the proportion of male peers with a single parent and the proportion of female peers with a single parent to capture the effects on outcomes by peer gender. In doing so, I argue that these two variables are exogenous measures because there might be no feedback loop where a student's peer cause one's single parenting in the household. If this is so, a child's peer in the classroom should be able to induce

---

8) For example, Neidell and Waldfogel (2010), Carrell et al. (2011), Kristoffersen et al. (2015), and Horoi and Ost (2015) have used lagged outcomes or characteristics of peers as the variables of interest to resolve the reflection problem in the peer effects literature.

9) The p-value (0.02) of the t-test for the difference is less than 0.05, suggesting that MCI of male students with single parents is statistically distinguishable from MCI of female ones with single parents.

single parenting within the child's own household. I test directly for this in Subsection 3.2 and find no evidence that a child's single parenting is affected by peers' single parenting. I thus estimate a reduced-form (RF) specification in which peer quality is directly substituted for such proxy variables:

$$MCI_{ICS} = \alpha + \frac{1}{n_c - 1}\sum_{i \neq j}\left(\beta_0 MaleSingleParent_{jcs} + \beta_1 FemaleSingleParent_{jcs}\right) + \gamma X_{ICS} + \delta T_{CS} + S_S + \varepsilon_{ics}) \quad (1)$$

where MCI_{ics} is the MCI for 7^{th} grade student *i*, randomly assigned to classroom c in school s. $MaleSingleParent_{jcs}$ is the indicator for 7^{th} grade male student *j* with a single parent, randomly assigned to classroom c in school s. $FemaleSingleParent_{jcs}$ is the indicator for 7^{th} grade female student *j* with a single parent, randomly assigned to classroom c in school s. X_{ics} is a vector of student observed characteristics. Student characteristics include student gender, parents' education, and household income. T_{cs} is a vector of homeroom teacher observed characteristics.[10] These teacher characteristics include homeroom teacher gender, whether the homeroom teacher is older than 40 years, whether the homeroom teacher has less than 5 years of teaching experience, whether the homeroom teacher graduated from a teachers college, and whether the homeroom teacher has a postgraduate degree. I also control for other peer composition variables and class size to avoid confounders, including leave-out means of indicators for a male students, for a dad having a BA degree or higher, for a mom having a BA degree or higher, and the amount of household income. I cluster standard errors at the classroom level to account for any arbitrary correlations across students within the same classroom. S_s is a set of school fixed effects.[11] ε_{ics} is the idiosyncratic error term. In equation (1), β_0 and β_1 represent misbehaving peer effects of interest.

3.2. Tests for Randomization

Both institutional setting and evidence in the literature (Kang; 2007, Lim and Meer, 2018) support that the random assignment of peers takes place in South Korea middle schools. Regarding this setting, I provide additional evidence by testing whether the average characteristics of classroom peers are associated with the student's own characteristics. Following Guryan et al. (2009), I also address the potential for a negative bias problem when regressing an individual's own characteristics on peers'

[10] As Kang (2007) noted, omitting homeroom teacher characteristics in the specification for estimating the effects of classroom peers does not provide robust estimates. However, my data contains information about homeroom teachers; therefore, I am able to overcome this limitation by controlling for homeroom teacher' background.

[11] Controlling for school fixed effects accounts for the random assignment of students and other resources to classrooms within schools, as well as any broader unobserved school factors.

characteristics. As Guryan et al. (2009) refer to Sacerdote (2001)'s critique of typical randomization tests, sampling without replacement causes each individual to be removed from the "urn" from which the peer group is chosen. Peers for high-ability individuals are therefore chosen from a group with a slightly lower mean ability than the peers for low-ability individuals. This creates a mechanical negative correlation between one's own and one's peers' characteristics, and controlling for the leave-out mean for the population from which peers are drawn is a good way to rule out this problem. Hence, I examine the independence of characteristics:

$$x_{ics} = \alpha + \beta \frac{1}{n_c - 1} \sum_{i \neq j} (x_{ics}) + \gamma \frac{1}{n_s - 1} \sum_{i \neq j} (x_{js}) + \rho_s + \varepsilon_{ics,} \quad (2)$$

where x_{ics} is student i's characteristic in randomly assigned classroom c within school s, and n_c and n_s are the number of students in classroom c and school s, respectively. The term on the right-hand-side that includes x_{js} represents the mean of the characteristic within the school, which is necessary to alleviate a negative mechanical bias. School fixed effects (ρ_s) account for random assignment within a school, and ε_{ics} is the idiosyncratic error term.

Table 3 indicates that only one of five student characteristics is statistically significantly correlated with the corresponding peer's characteristic, yielding evidence of as good as random assignment to the peer group. In particular, column (1) shows that there is no systematic correlation between peers' having single-parent households and a student's own having a single-parent household. This evidence supports my assumption that a child's peer do not cause child's single parenting.

Table 3: Regression of Own Characteristics on Peer Characteristics

	(1) Single Parent	(2) Male Student	(3) Dad BA+	(4) Mom BA+	(5) Household Income
Avg. Classroom Peers Characteristics	-0.048	-0.184	0.059*	0.026	-0.022
	(0.061)	(0.121)	(0.030)	(0.032)	(0.017)
Observations	4,006	4,006	3,897	3,875	3,937
*R*2	0.937	0.950	0.958	0.958	0.945

Notes: Each column represents results from a separate regression, including school fixed effects and the leave-out mean of school peers' characteristic. I also control for the school peers' leave-out mean (school-level mean for the relevant characteristics excluding the individual's own values) to overcome the negative mechanical bias of the randomization tests. In each column, dependent variables are indicators for a single-parent household, for male students, for having a dad with a BA degree or higher, for having a mom with a BA or higher degree, and household income (in millions of KRW). Standard errors, shown in parentheses, are clustered at the school level.

*p<0.10, ** p<0.05, *** p<0.01.

In addition, my identification strategy is motivated by an assumption: variation in the share of students with single-parent households across classrooms in a given school is as good as random. As the balancing test to support the validity of across-classroom identification, I examine whether peer measures of interest in equation (1) are correlated with some of the observed covariates, conditional on school fixed effects. The estimation results are listed in table 4. This table shows that two of the sixteen estimates are statistically significant at the 5% level, and only one is statistically significant at the 10% level. Although the effects on two variables are statistically significant at the 5% level, the corresponding estimates are not sizable in magnitude. In column (2), adding one male student with a single parent to a classroom of 30 increases the probability of having a mom with a BA or higher degree by 1.0%p. In addition, the estimated coefficients in column (8) indicate that adding one female student with a single parent to a classroom of 30 increases the probability of having a homeroom teacher with a Master degree or higher by 6.3%p. These results provide little evidence that two different shares of students with single-parent families systematically correlate with the observed covariates.

Table 4 Balancing Test for Student and Teacher Characteristics

	(1) Dad BA+	(2) Mom BA+	(3) Household Income	(4) Female Teacher	(5) Teacher over 40	(6) Low Experience	(7) Teacher's College	(8) Postgraduate
Male Peers w Single Parent	0.239	0.308**	-0.494	1.696*	0.830	-0.854	0.825	0.662
	(0.153)	(0.141)	(1.509)	(0.960)	(0.801)	(1.046)	(0.959)	(0.984)
Female Peers w Single Parent	-0.124	-0.117	-0.454	0.160	0.809	-0.899	-0.264	1.894**
	(0.143)	(0.132)	(1.170)	(0.867)	(0.850)	(0.850)	(1.000)	(0.940)
Observations	3,600	3,601	3,562	3,482	3,482	3,482	3,445	3,482
*R*2	0.163	0.150	0.061	0.530	0.709	0.606	0.483	0.560

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. Each column represents results from a separate regression, including indicators for a male student with a single parent and for a male student, and school fixed effects. The independent variables are the proportion of classroom peers with a single parent. In each column, dependent variables are indicators for having a dad with a BA or higher degree, for having a mom with a BA or higher degree, and household income (in millions of KRW), and indicators for homeroom teacher gender, whether the homeroom teacher is older than 40 years, whether the homeroom teacher has less than 5 years of teaching experience, whether the homeroom teacher graduated from a teachers college, and whether the homeroom teacher has a postgraduate degree. Standard

errors, shown in parentheses, are clustered at the classroom level. *p<0.10, ** p<0.05, *** p<0.01.

4. EMPIRICAL RESULTS

4.1. Main Effects

I present the results of misbehaving peers on students' MCIs in table 5. Each column includes school fixed effects along with student- and classroom-level observed characteristics. Robust standard errors are clustered at the classroom level, which allows any arbitrary correlations across students within their classroom. The outcome variable for each column is the MCI.

Columns (1)-(4) present the reduced-form estimates by replacing classroom peers' MCI with both a fraction of male peers with a single parent and a fraction of female peers with a single parent. Column (1) shows that the coefficient on male peers with a single parent (the variable of interest) is 0.983.[12] This estimate is statistically significant at the 5% level. It suggests that adding one misbehaving male peer, proxied by male peer with a single parent, to a classroom of 30 increases a student's MCI by 3.3% (0.983/30) of a standard deviation. In contrast, female peers with a single parent negatively impact a student's MCI, but this impact is not statistically significant. In columns (2)-(4), including student-, teacher-, peer-level controls and class size does not change these estimates substantially, providing further evidence of as good as random assignment holds in my data.

My estimated effects of misbehaving male peers on other students' misbehaviors are qualitatively similar to the findings in previous studies that estimate the effects of misbehaving peers. Figlio (2007) shows that adding one additional disruptive boy to the classroom increases peers' likelihood of being suspended from school. Billings and Hoekstra (2019) show that exposure to male peers linked to parental arrest is associated with increases in antisocial behavior, though this effect is not statistically significant

Table 5 Peer Effects on a Student's Own Misbehavior Composite Index

	(1)	(2)	(3)	(4)
Male Peers w Single Parent	0.983**	1.096**	1.070**	1.152**

[12] To investigate whether the proportion of male peers with single parents increases peers' average MCI, I perform the regression of peers' MCI on male peers with single parents, female peers with single parents, and school fixed effects. In column (1) of Appendix table B3, I find that the estimated coefficient on male peers with single parents is 0.612 and statistically significant at the 5% level. In Columns (2)-(4) of Appendix table B4, including student-, teacher, peer-level controls and class size does not substantially change this coefficient. Hence, these results suggest that the effects of male peers with a single parent on a student's class misbehavior might be driven by the increased class misbehavior of peers.

	(0.480)	(0.473)	(0.446)	(0.455)
Female Peers w Single Parent	-0.659	-0.702	-0.463	-0.399
	(0.429)	(0.441)	(0.434)	(0.442)
Observations	3,539	3,465	3,298	3,298
*R*2	0.056	0.059	0.061	0.062
School fixed effects	Y	Y	Y	Y
Student-level controls	N	Y	Y	Y
Teacher-level controls	N	N	Y	Y
Peer-level controls and class size	N	N	N	Y

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. Each column represents results from a separate regression, including an indicator for a male student. In each column, the dependent variables are the composite index of a students' own misbehavior. Student level controls include indicators for a dad having a BA degree or higher, for a mom having a BA degree or higher, and household income (in millions of KRW). Teacher-level controls include indicators for homeroom teacher gender, whether the homeroom teacher is older than 40 years, whether the homeroom teacher has less than 5 years of teaching experience, whether the homeroom teacher graduated from a teachers college, and whether the homeroom teacher has a Master degree or higher. Peer-level controls include peer characteristics that are leave-out means of an indicator for a male student and student-level controls. Standard errors, shown in parentheses, are clustered at the classroom level. *p<0.10, ** p<0.05, *** p<0.01.

4.1.1. Effects on individual misbehaviors

In my main analysis, my estimation results using MCI reflect the overall pattern of spillover effects of peers with single parents on other students' class misbehavior. Rather than using the composite index of class misbehaviors, I further investigate the peer effects using four individual misbehaviors as outcomes. These outcome measures have a value of zero (Low Tendency) or one (High Tendency). Results are shown in Appendix table B5.

In column (1), I find no evidence that both male and female peers with single parents affect three misbehaviors, including chatting with others in class, sleeping in class, and goofing off in class. However, male peers with single parents increase other students' intensity of defying teachers in class, and the point estimate for this effect is statistically significant at the 5% level. Specifically, adding one male peer with single parents in a class of 30 increases other students' likelihood of moving from low tendency (0) to high tendency (1) by 1.8pp. This effect size is equivalent to about 11.69% (0.018/0.154) of the mean (0.154). Surprisingly, female peers with single parents decrease class defiance of others, and the corresponding estimate is also statistically significant at the 5% level. I am still agnostic on why this result occurs. However, given the negative relationship between female peers with single parents and peers' tendency to class misbehavior in the first stage (Appendix Table B4), it is likely that an increase in female peers who do not cause class defiance could contribute to a decrease in class defiance of other peers. These results seem to be robust with the inclusion of student-, teacher-, peer-level controls and class size (column (2)). These findings provide additional information on a

student's misbehaviors affected by her peers, though I still prefer my main estimates in table 5 using the aggregate measure of class misbehaviors.

4.2. Heterogeneous Effects

In this section, I investigate heterogeneous effects with respect to student gender, household income, and class size. I also study the differential effects of misbehaving peers based on which parent lives with them. I then explore non-linearities in the impact of misbehaving peers.

I first examine the heterogeneous effects across student gender. In panel A of table 6, I present the results by allowing the interaction of the main parameters, as shown in table 5, with student gender. The results show that the impacts of male peers with a single parent are noticeably revealed for a male student: adding one male peer with a single parent to a classroom of 30 increases a male student's MCI by 6.1% (1.819/30) of a standard deviation. These peers also have a positive effect on female students, but the estimate is not precisely estimated. Female peers with a single parent negatively affect class misbehaviors of both boys and girls, but these effects are statistically insignificant. Hence, these findings suggest that the effect of misbehaving peers on class misbehavior is mainly driven by the spread on a male-to-male basis. These findings also corroborates the similar findings from Carrell and Hoekstra (2010) who show that adding one additional troubled boy peer to a classroom of 20 students increases the number of infractions of other male students by 0.33. This estimate is qualitatively consistent with my finding, though it is difficult to compare directly. More broadly, this evidence connects to the existing studies documenting that peer effects operate through matches along certain attributes, such as gender and race. For instance, Billings et al. (2019) show that neighborhood peers are more likely to increase the probability of crime partnership of students with the same gender and race. Mouganie and Wang (2020) find that increased exposure to high-ability female peers in school college outcomes for female students. Briole (2021) provides evidence that a larger share of female peers in school increases female students' test scores and probability of graduating from high school and reduces their dropout rates. Borbely et al. (2023) also show that a higher proportion of female peers in the classroom improve test scores of female students and reduces their absenteeism, though male students are unaffected. These findings may support that a direct social interaction is one of the important mechanisms behind peer effects (Fletcher et al., 2020).

Next, I explore the heterogeneity of misbehaving peer effects across the household income. Panel B of table 6 shows the coefficients estimated from the subgroup analysis by interacting peer measures with indicators for the household income level. To do so, I divide students into two groups – low-income and high-income groups – according to whether their household is below the poverty line. Results show that male peers with single parents are more likely to positively affect MCI for students in high-income

households than in low-income households. I implement the t-test to examine whether two coefficients for male peers with single parents interacted with the male dummy and male peers with single parents interacted with the female dummy are significantly different in the same regression. I find the p-value (0.00) of this test to be smaller than 0.01, showing that the difference between those effects is statistically significant. The estimated effect for those peers on students in high-income families implies that adding one male peer with a single parent to a classroom of 30 increases MCI for students in high-income families by 6.0% (1.798/30) of a standard deviation. However, this effect is just statistically significant at the 10% level. Conversely, female peers with single parents negatively affect MCI for students in both high- and low-income households. The corresponding estimates for these effects are not statistically significant.

I further investigate the heterogeneous effects across the class size. The results of the subgroup analysis by interacting peer measures with indicators for the class size are shown in Panel C of Table 6. I categorize student groups as either having an above- or a below-median class size (33). Moreover, I include class size variable in the specification. I find that male peers with single parents primarily cause the positive effects on the MCI of others in smaller classes. The estimate effect is statistically significant at the 1% level and implies that adding one male peer with a single parent to a classroom of 30 increases MCI for students in smaller classes by 4.7% (1.422/30) of a standard deviation. I also find that female peers with single parents negatively affect others' MCI in both smaller and larger classes. However, these effects are not statistically significant.

In summary, results from tables 6 indicate that male peers with single parents primarily impact class misbehaviors of boys and students in smaller classes. This evidence of heterogeneity suggests that student gender and class sizes are likely to be potential factors to intensify the effects of misbehaving male peers.

Table 6 Heterogeneous Effects

Outcome Variable	Misbehavior Composite Index
A. Student Gender	1.819***
Proportion of Male Peers w Single Parent × Own Male	(0.640)
Proportion of Male Peers w Single Parent × Own Female	0.574
	(0.526)
Proportion of Female Peers w Single Parent × Own Male	-0.010
	(0.801)
Proportion of Female Peers w Single Parent × Own Female	-0.674
	(0.584)
Observations	3,298

*R*2	0.063
B. Household Income	1.798*
Proportion of Male Peers w Single Parent × High-Income	(1.023)
Proportion of Male Peers w Single Parent × Low-Income	1.127**
	(0.453)
Proportion of Female Peers w Single Parent × High-Income	-0.540
	(1.121)
Proportion of Female Peers w Single Parent × Low-Income	-0.408
	(0.463)
Observations	3,293
*R*2	0.063
C. Class Size	1.422***
Proportion of Male Peers w Single Parent × Below Median	(0.514)
Proportion of Male Peers w Single Parent × Above Median	0.417
	(0.826)
Proportion of Female Peers w Single Parent × Below Median	-0.632
	(0.553)
Proportion of Female Peers w Single Parent × Above	-0.051
Median	(0.581)
Observations	3,298
*R*2	0.062

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. Each estimate is obtained from a regression, including an indicator for a male student. The dependent variable is the composite index of a students' own misbehavior. The specification controls for student-, teacher- and peer-level controls, and class size. Student-level controls include indicators for a dad having a BA degree or higher, for a mom having a BA degree or higher, and household income (in millions of KRW). Teacher-level controls include indicators for homeroom teacher gender, whether the homeroom teacher is older than 40 years, whether the homeroom teacher has less than 5 years of teaching experience, whether the homeroom teacher graduated from a teachers college, and whether the homeroom teacher has a Master degree or higher. Peer-level controls include peer characteristics that are leave-out means of an indicator for a male student and student-level controls. Standard errors, shown in parentheses, are clustered at the classroom level. *p<0.10, ** p<0.05, *** p<0.01.

5. CONCLUSION

This paper estimates the impact of misbehaving peers on the intensity of a student's own misbehavior during secondary school in South Korea. To avoid the self-selection problem, I focus on randomly assigned classrooms within schools. I also exploit as good as random variation in the proportion of children with single-parent households to distinguish peer effects from confounding factors.

Results indicate that male peers with single parents statistically significantly increase

the intensity of others' misbehaviors in the classroom, while female peers with single parents do not. The estimated effect indicates that the increase of one single male peer with a single parent household among 30 students in the classroom leads to the increase of other students' MCI by around 0.03 standard deviations. My heterogeneity analysis suggests that male peers with single parents appear to primarily impact class misbehaviors of male students. It also shows that the spillover effect of male peers with single parents on class misbehaviors of other students are particularly revealed in smaller classes.

Overall, I interpret my findings as providing robust evidence that misbehaving boys play a significant role in driving behavioral problems for other pupils in the class. Although more work needs to be implemented in other contexts and with other data sets, my results may have policy implications for addressing student misbehavior in the class; at least in this context, doing so might be effective if it mainly targets misbehaving boys. In addition, I leave the investigation of potential channels underlying the main result as future research.

REFERENCES

Aizer, A., "Peer effects, institutions and human capital accumulation: the externalities of add," NBER Working Paper, 14354, 2009.

Alami, A., S. Khosravan, L. S. Moghadam, F. Pakravan, and F. Hosseni, "Adolescents' self-esteem in single and two-parent families," *International journal of community based nursing and midwifery*, 2(2):69, 2014.

Anderson, M. L., "Multiple inference and gender differences in the effects of early intervention: A reevaluation of the abecedarian, perry preschool, and early training projects," *Journal of the American Statistical Association*, 103(484), 2008, pp. 1481-1495.

Anelli, M. and G. Peri, "The effects of high school peersâ gender on college major, college performance and income," *The Economic Journal*, 129(618), 2019, pp. 553-602.

Angrist, J. D., "The perils of peer effects," *Labour Economics*, 30, 2014, pp. 98-108.

Beaman, R., K. Wheldall, and C. Kemp, "Differential teacher attention to boys and girls in the classroom," *Educational review*, 58(3), 2006, pp. 339-366.

Billings, S. B. and M. Hoekstra, "Schools, neighborhoods, and the long-run effect of crime-prone peers," Technical report, National Bureau of Economic Research, 2019.

Billings, S. B., D. J. Deming, and S. L. Ross, "Partners in crime," *American Economic Journal: Applied Economics*, 11(1), 2019, pp. 126-150.

Borbely, D., J. Norris, and A. Romiti, "Peer gender and schooling: Evidence from ethiopia," *Journal of Human Capital*, 17(2), 2023, pp. 207-249.

Briole, S., "Are girls always good for boys? short and long term effects of school peers' gender," *Economics of Education Review*, 84, 2021, pp. 102-150.

Carrell, S. E. and M. L. Hoekstra, "Externalities in the classroom: How children exposed to domestic violence affect everyone's kids," *American Economic Journal: Applied Economics*, 2(1):211–28, 2010.

Carrell, S. E., M. Hoekstra, and J. E. West, "Is poor fitness contagious?: Evidence from randomly assigned friends," *Journal of Public Economics*, 95(7-8), 2011, pp. 657-663.

Carrell, S. E., M. Hoekstra, and E. Kuka, "The long-run effects of disruptive peers," *American Economic Review*, 108(11), 2018, pp. 3377-3415.

Chambers, C. P., T. Cuhadaroglu, and Y. Masatlioglu, "Behavioral influence," *Journal of the European Economic Association*, 21(1), 2023, pp. 135-166.

Chetty, R., J. N. Friedman, N. Hilger, E. Saez, D. W. Schanzenbach, and D. Yagan, "How does your kindergarten classroom affect your earnings? evidence from project star," *The Quarterly Journal of Economics*, 126(4), 2011, pp. 1593-1660.

Choi, J., H. Park, and J. R. Behrman, "Separating boys and girls and increasing weight? assessing the impacts of single-sex schools through random assignment in seoul," *Social Science &*

Medicine, 134, 2015, pp. 1-11.

Chung, J., M. Sun, and S. Jang, "An analysis of factors affecting delinquency in middle school students," *Studies on Korean Youth*, 27(2), 2016, pp. 325-352.

Comeau, J. and M. H. Boyle, "Patterns of poverty exposure and children's trajectories of externalizing and internalizing behaviors," *SSM-Population Health*, 4, 2018, pp. 86-94.

Daryanani, I., J. L. Hamilton, L. Y. Abramson, and L. B. Alloy, "Single mother parenting and adolescent psychopathology," *Journal of Abnormal Child Psychology*, 44(7), 2016, pp. 1411-1423.

Figlio, D. N., "Boys named sue: Disruptive children and their peers," *Education Fnance and Policy*, 2(4), 2007, pp. 376-394.

Fletcher, J. M., S. L. Ross, and Y. Zhang, "The consequences of friendships: Evidence on the effect of social relationships in school on academic achievement," *Journal of Urban Economics*, 116, 2020, pp. 103-241.

Gong, J., Y. Lu, and H. Song, "Gender peer effects on students' academic and noncognitive outcomes evidence and mechanisms," *Journal of Human Resources*, 56(3), 2021, pp. 686-710.

Gould, E. D., V. Lavy, and M. Daniele Paserman, "Does immigration affect the long-term educational outcomes of natives? quasi-experimental evidence," *The Economic Journal*, 119(540), 2009, pp. 1243-1269.

Guryan, J., K. Kroft, and M. J. Notowidigdo, "Peer effects in the workplace: Evidence from random groupings in professional golf tournaments," *American Economic Journal: Applied Economics*, 1(4), 2009, pp. 34-68.

Horoi, I. and B. Ost, "Disruptive peers and the estimation of teacher value added," *Economics of Education Review*, 49, 2015, pp. 180-192.

Hoxby, C., "Peer effects in the classroom: Learning from gender and race variation," NBER Working Paper, 2000.

Huang, B. and R. Zhu, "Peer effects of low-ability students in the classroom: evidence from china's middle schools," *Journal of Population Economics*, 33(4), 2020, pp. 1343-1380.

Kang, C., "Classroom peer effects and academic achievement: Quasi-randomization evidence from south korea," *Journal of Urban Economics*, 61(3), 2007, pp. 458-495.

Kristoffersen, J. H. G., M. V. Krægpøth, H. S. Nielsen, and M. Simonsen, "Disruptive school peers and student outcomes," *Economics of Education Review*, 45, 2015, pp. 1-13.

Lavy, V. and A. Schlosser, "Mechanisms and impacts of gender peer effects at school," *American Economic Journal: Applied Economics*, 3(2), 2011, pp. 1-33.

Lim, J. and J. Meer, "The impact of teacher–student gender matches random assignment evidence from south korea," *Journal of Human Resources*, 52(4), 2017, pp. 979-997.

Lim, J. and J. Meer, "How do peers influence bmi? evidence from randomly assigned classrooms in south korea," *Social Science & Medicine*, 197, 2018, pp. 17-23.

Lyle, D. S., "Estimating and interpreting peer and role model effects from randomly assigned social groups at west point," *The Review of Economics and Statistics*, 89(2), 2007, pp. 289-299.

Manski, C. F., "Identification of endogenous social effects: The reflection problem," *The Review of Economic Studies*, 60(3), 1993, pp. 531-542.

Mouganie, P. and Y. Wang, "High-performing peers and female stem choices in school," *Journal of Labor Economics*, 38(3), 2020, pp. 805-841.

Neidell, M. and J. Waldfogel, "Cognitive and noncognitive peer effects in early education," *The Review of Economics and Statistics*, 92(3), 2010, pp. 562-576.

OECD, "What makes schools succesful?," resources, policies and practices vo. IV, 174, 2012.

Orpinas, P., C. McNicholas, and L. Nahapetyan, "Gender differences in trajectories of relational aggression perpetration and victimization from middle to high school," *Aggressive Behavior*, 41(5), 2015, pp. 401-412.

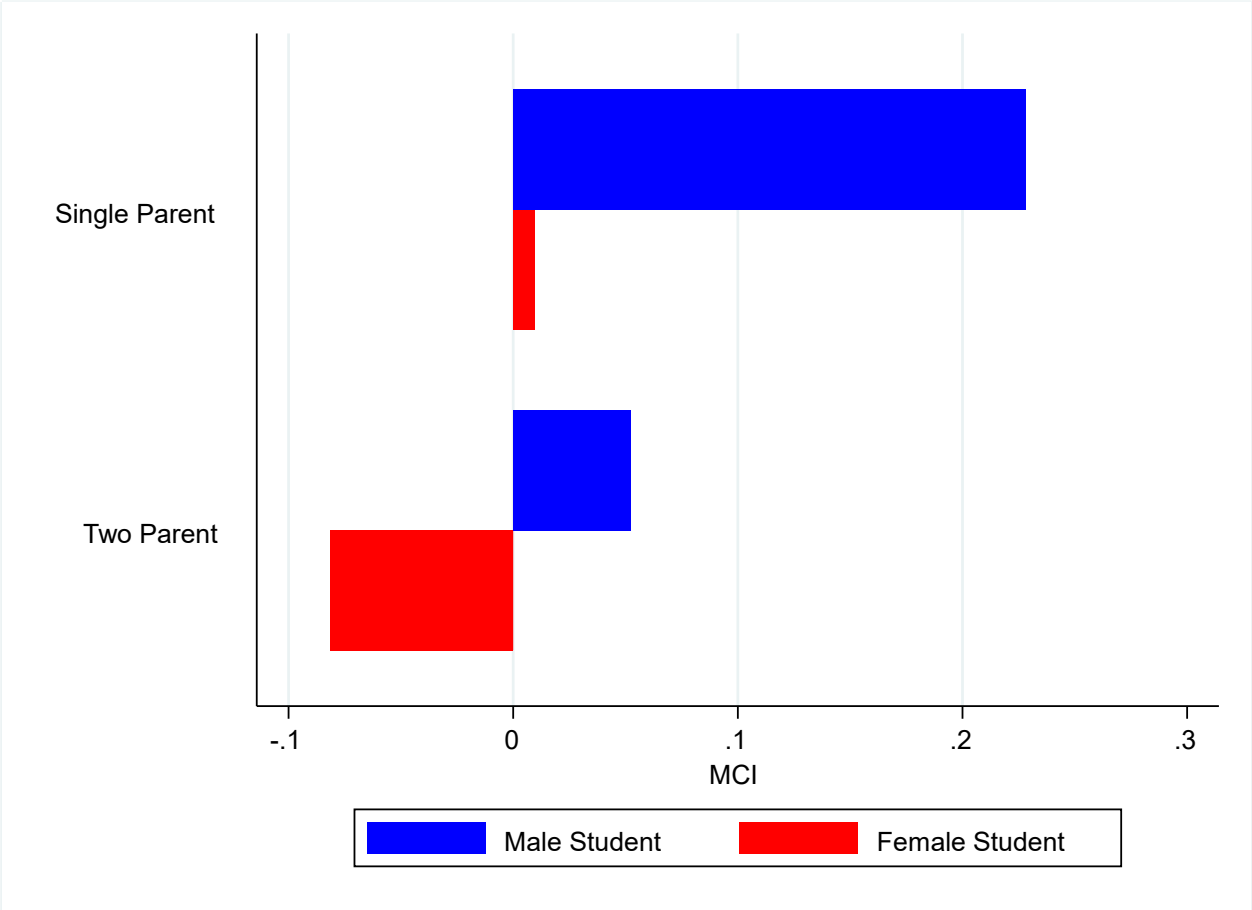
Pearl, M., B. F. French, J. E. Dumas, A. D. Moreland, and R. Prinz, "Bidirectional effects ofparenting quality and child externalizing behavior in predominantly single parent, underresourced african american families," *Journal of Child and Family Studies*, 23(2), 2014, pp. 177-188.

Sacerdote, "Peer effects with random assignment: Results for dartmouth roommates," *The Quarterly Journal of Economics*, 116(2), 2001, pp. 681-704.

Singh and U. Kiran, "Effect of single parent family on child delinquency," *Int J Sci Re*, 3.

A.1 Appendix Figure

Figure A1 Single Parenting and MCI



Notes: This figure depicts the relationship between single parenting in the household and a student's misbehaving composite index (MCI). The values of MCI on x-axis are the conditional means of residuals from a regression that includes school-fixed effects.

B.1 Appendix Table

Table B1 Distribution Over Children's (Transformed) Propensity to Misbehave in a Class

	Low Tendency	High Tendency
A. All Students		
Chat with others in class	20.36	79.64
Defy teachers in class	84.61	15.39
Sleep in class	56.09	43.91
Goof off in class	77.89	22.11
B. Male Students		
Chat with others in class	19.06	80.94
Defy teachers in class	79.34	20.66
Sleep in class	57.47	42.53
Goof off in class	79.29	20.71
C. Female Students		
Chat with others in class	21.73	78.27
Defy teachers in class	90.12	9.88
Sleep in class	54.65	45.35
Goof off in class	76.43	23.57

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. This table is created by collapsing six answers of Table 2 into two categories: low tendency includes "Never", "Once or Twice per year" and "Once or Twice per semester"; high tendency contains "Once or Twice per month", "Once or Twice per week" and "Nearly Every Day". Each value represents a percentage (%) of self-reported misbehaving frequency in terms of those two categories. In each row, the tendency of misbehavior increases from left to right.

Table B2: Summary Statistics and Correlations: Class Misbehaviors

	Chat with others in class	Defy teachers in class	Sleep in class	Goof off in class
A. Summary Statistics				
Mean	0.80	0.15	0.44	0.22
Standard Deviation	0.40	0.36	0.50	0.42
B. Correlation Matrix				
Chat with others in class	1.00	-	-	-
Defy teachers in class	0.21	1.00	-	-
Sleep in class	0.30	0.26	1.00	-
Goof off in class	0.19	0.13	0.23	1.00

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. The values of each misbehavior are either one (high tendency) or zero (low tendency).

Table B3: Peer Effects on Peers' Misbehavior Composite Index

	(1)	(2)	(3)	(4)
Male Peers w Single Parent	0.612**	0.601**	0.622**	0.736***
	(0.261)	(0.261)	(0.240)	(0.231)
Female Peers w Single Parent	-0.637**	-0.649**	-0.482*	-0.415
	(0.268)	(0.269)	(0.245)	(0.264)
Observations	3539	3465	3298	3298
$R2$	0.056	0.059	0.061	0.062
School fixed effects	Y	Y	Y	Y
Student-level controls	N	Y	Y	Y
Teacher-level controls	N	N	Y	Y
Peer-level controls and class size	N	N	N	Y

Notes: I restrict the sample to students who do not have experienced parental divorce, separation or bereavement. Each column represents results from a separate regression, including an indicator for a male student. In each column, the dependent variables are the composite index of peers' misbehavior. Student-level controls include indicators for a dad having a BA degree or higher, for a mom having a BA degree or higher, and household income (in millions of KRW). Teacher-level controls include indicators for homeroom teacher gender, whether the homeroom teacher is older than 40 years, whether the homeroom teacher has less than 5 years of teaching experience, whether the homeroom teacher graduated from a teachers college, and whether the homeroom teacher has a Master degree or higher. Peer-level controls include peer characteristics that are leave-out means of an indicator for a male student and student-level controls. Standard errors, shown in parentheses, are clustered at the classroom level.
*p<0.10, ** p<0.05, *** p<0.01.