Supplementary Information for "Does School Environment Shape Gender Differences in Leadership and Participation? Evidence from a Natural Experiment in South Korea"

Contents

1 Background on the Natural Experiment

1.1 High School Equalization Policy

Before 1974, there was fierce competition for admission to a handful of selective, prestigious high schools, which typically served as feeder schools to top universities and, by extension, high-paying jobs. Parents spent aggressively on private tutoring for their children, and such a competitive climate placed an excessive burden of studying on young pupils. To alleviate competition and reduce the gap between schools, the South Korean government enacted an educational reform in 1974, called the *High School Equalization Policy*, which involved eliminating admission tests for high schools and randomly assigning students to high schools within their residential areas through a lottery process. The Equalization Policy was first implemented in Seoul (the capital) and Busan (the second largest city) in 1974 and was then gradually adopted throughout the country.

Under this policy, incoming freshmen were randomly placed in high schools in their school districts. Within the principle of random school assignment, each of the Metropolitan and Provincial Offices of Education in South Korea had the authority to set specific guidelines on school placement to be followed in its territory. In Seoul, a couple of procedural considerations were taken into account in placement decisions, such as schools' enrollment capacity[9] and students' travel distance to school,[10] but the Office of Education prioritized keeping the schools as equal as possible in terms of student characteristics.[11]

This policy was applied to all regular academic high schools, to which most middle school students transition (see Supplementary Table S1), and excluded special-purpose high schools (specialized in teaching science, foreign languages, arts, or sports) and vocational high schools. Randomization occurred at the individual student level, and noncompliance was rare. A few exceptions were made, but they had to be officially approved by the Education Office before the assignment began. For example, students with disabilities could request to be assigned to a school closest to their home; student athletes were excluded from the random assignment process as they were assigned to schools equipped to provide their sport-specific training programs. According to reports released by the Seoul Metropolitan Office of Education, the students who were granted exceptions made up only about 1-2%. For the rest 98% of the students, their high school was randomly assigned, and once assigned, they had to enroll at that school, and changing schools was allowed only when the student moved to another school district. Those unhappy with their school assignment *could* move to a different school district; however, they would then be entered again into a lottery and randomly assigned to one of the schools in their new district.

Over time, more and more regions in the country adopted adjustments to the policy to

[9] In 2008, about 1% of students students were assigned to a school in a neighboring district because schools could not accommodate all of the students in their own districts.

[10] Students were assigned to schools located within 30 minutes of travel time from their homes. Most schools within a school district are accessible within that time frame by foot or public transport.

[11] Documents detailing student placement procedures—before the 2010 adoption of school choice expansion for regular high schools—are available at the Seoul Metropolitan Office of Education website, www.sen.go.kr/web/services/bbs/bbsView.action?bbsBean.bbsCd=26bbsBean.bbsSeq=140

incorporate students' school preferences into placement decisions, a change in response to the growing demand for school choice. Seoul is one of the last regions to adopt the school choice model. Beginning in 2010, students can submit a rank-order list of the schools they prefer and are "randomly" assigned to one of these schools. Most students are placed in their first- or second-choices schools.

Table S1: Seoul High Schools as of 2009

School Category	No. of Schools (%)	No. of Students (%)
Regular Academic High School	214 (69.0%)	293027 (79.6%)
Special-Purpose High School	18 (5.8%)	13576 (3.7%)
Vocational High School	78 (25.2%)	61472 (16.7%)
Total	310	368075

Source: Korean Education Statistics Service

Table S2: Number of Single-Sex and Coeducational High Schools in Seoul and Students Enrolled in 2009

School Type	No. of Schools (%)	No. of Students (%)	
		Boys	Girls
All-Boys High School	67 (31.3%)	99165 (62.9%)	-
All-Girls High School	61 (28.5%)	-	85374 (63.1%)
Coeducational High School	86 (40.2%)	58497 (37.1%)	49991 (36.9%)
Total	214	157662	135365

Note: The proportions of students assigned to single-sex or coeducational schools correspond to the number of schools in each category. For example, for boys, schools are 60.9% all-boys (67 schools) and 39.1% coeducational (43; half of enrollment in 86 coeducational schools reserved for boys). Some schools vary in enrollment capacity, so the proportion of students does not perfectly match the ratio of school type. However, the Seoul Metropolitan Office of Education made efforts to keep class size identical across schools, at around 37 students per class, so class size effects are constant.
Source: Korean Education Statistics Service

1.2 Private vs Public Schools

Table S3: Number of Respondents from Single-Sex, Coed, Public, and Private High Schools

	Public	Private	Total
Single-Sex High School	322	1237	1559
Coeducational High School	1338	544	1882
Total	1660	1781	3441

2 Information on Sample and Study Design

This study on leadership and participation was pre-registered (https://osf.io/k8e5c) and approved by the IRB of the University of Pennsylvania (protocol #850433).

2.1 Sample Characteristics

We recruited a sample of 4,000 Korean adults who graduated from Seoul high schools between 1990 and 2010, balancing the sample with respect to gender and type of school.

Table S4: Demographic Profile of Respondents

	n	(%)
Gender		
Male	1709	49.7
Female	1732	50.3
Age		
30-40	2005	58.3
41-50	1436	41.7
High school type		
Co-educational school	1882	54.7
Single-sex school	1559	45.3
Public school	1660	48.2
Private school	1781	51.8
Educational Attainment		
High school diploma	226	6.6
Some college	530	15.4
BA or higher	2685	78.0

Note. Sample Size=3441

2.2 Survey Instrument

Participation.
We are going to list some types of actions people take to express their views about politics and society. Please indicate if you have taken any of these actions in the past few years: (Mark yes or no for each activity)

1. Signed a petition about a political or social issue
2. Boycotted or deliberately purchased certain products for political, ethical, or environmental reasons
3. Attended a political meeting, rally, or demonstration
4. Contacted a politician or a civil servant to express your views
5. Donated money to a candidate or political party
6. Donated money or raised funds for charitable causes

7. Posted or shared political content on the internet, social media, or KakaoTalk
8. Visited online community boards, portal sites, or online news sites and posted or replied to political content
9. Voted in an election

- Yes
- No

Attitudes toward Leadership.
How much do you agree or disagree with each of the following statements:

1. Most of the time, I prefer being a leader rather than a follower.
2. I am the type of person who likes to be in charge of others.
3. I feel confident that I can be an effective leader in the groups that I work with.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Experience in Leadership Roles. Respondents were first asked about membership in voluntary associations and then asked whether they had held a leadership position in their associations.

Are you part of any groups, clubs, or societies that meet regularly? They may be a community group, NGOs, professional organization, a men or women's groups, a sports group, a church group, a school group, an art group, a group with similar hobbies, and so on. Are you a member of any of the clubs and organizations listed below? Please select all that apply.

1. Resident or neighborhood associations
2. Community groups or volunteer organizations
3. Non-profit advocacy groups
4. Church groups or other religious organizations
5. Professional or trade associations
6. Arts and culture organizations
7. Sports or hobby clubs
8. Charitable and social welfare organizations
9. Alumni or hometown associations
10. Other (Specify:)
11. Not a member of any club or organization

[SHOW ALL SELECTED] Have you ever been in a position of leadership in this group or association?

- Yes
- No

Hostile Sexism.
Below is a series of statements concerning men and women and their relationships in contemporary society. Please indicate the degree to which you agree or disagree with each statement using the scale below:

1. Women are too easily offended.
2. Most women fail to appreciate fully all that men do for them.
3. Women seek to gain power by getting control over men.
4. Women exaggerate problems they have at work.
5. Once a woman gets a man to commit, she usually tries to put him on a tight leash.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Traditional Gender Role Beliefs.
Now, we would like to ask you a few additional questions about family life and your views on society more generally. Please indicate how much you agree or disagree with each of the following statements:

1. It is more important for a wife to help her husband's career than to pursue her own career.
2. A husband's job is to earn money; a wife's job is to look after the home and family.
3. You need to marry no matter what.
4. A working mother can establish just as warm and secure a relationship with her children as a mother who does not work. (reverse-coded)
5. All in all, family life suffers when the woman has a full-time job.
6. Being a housewife is just as fulfilling as working for pay.

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Parental Education.
Please tell us about your parents' education. What is the highest level of education achieved by your parents?

1. Father
2. Mother

- No formal schooling
- Elementary school
- Middle school
- High school
- 2-year (vocational) college
- 4-year university
- Master's degree
- Doctoral degree
- Not applicable/Don't know

Parental Employment in Childhood.
Think back to when you were 14 or 15 years old. Did your parents work?

1. Father
2. Mother

- Worked full-time
- Worked part-time
- Unemployed or did not work outside the home
- Not applicable

Siblings.
Do you have siblings? How many brothers and sisters? If none, put 0.

1. Brother
2. Sister

3 Tables

Table S5: Effects of Single-Sex Schools on Civic and Political Participation

		Women			Men	
Political Participation Index	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.033**	0.034**	0.041**	0.021+	0.020+	0.019
	(0.012)	(0.012)	(0.015)	(0.012)	(0.012)	(0.014)
Private high school (vs. public)			-0.014			0.003
			(0.015)			(0.014)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Voting	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.030*	0.031*	0.029+	0.020	0.016	0.014
	(0.013)	(0.013)	(0.015)	(0.013)	(0.013)	(0.016)
Private high school (vs. public)			0.003			0.005
			(0.016)			(0.016)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Private Activism	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.030+	0.031+	0.039*	0.029+	0.030+	0.031+
	(0.016)	(0.016)	(0.019)	(0.016)	(0.016)	(0.019)
Private high school (vs. public)			-0.014			-0.003
			(0.019)			(0.019)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Collective Activism	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.024	0.024	0.039	0.028	0.027	0.018
	(0.021)	(0.021)	(0.025)	(0.021)	(0.021)	(0.023)
Private high school (vs. public)			-0.027			0.018
			(0.025)			(0.023)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Political Contact	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.041*	0.041*	0.049*	0.008	0.007	0.005
	(0.017)	(0.017)	(0.020)	(0.017)	(0.017)	(0.020)
Private high school (vs. public)			-0.015			0.004
			(0.020)			(0.020)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1732	1732	1732	1709	1709	1709

Note: Standard errors in parentheses. All dependent variables range from 0 to 1. $+p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$

Table S6: Effects of Single-Sex Schools on Attitudes toward and Experience in Leadership Roles

		Women			Men	
Attitudes Toward Leadership	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.015	0.014	0.023+	-0.007	-0.009	-0.012
	(0.011)	(0.011)	(0.014)	(0.011)	(0.011)	(0.012)
Private high school (vs. public)			-0.017			0.005
			(0.014)			(0.011)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Experience in Leadership Roles	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.081***	0.079***	0.073**	0.015	0.015	-0.016
	(0.024)	(0.024)	(0.028)	(0.026)	(0.026)	(0.029)
Private high school (vs. public)			0.012			0.066*
			(0.028)			(0.029)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1732	1732	1732	1709	1709	1709

Note: Standard errors in parentheses. All dependent variables range from 0 to 1. For attitudes toward leadership, higher values indicate more positive attitudes toward leadership roles. For participation in leadership, '1' indicates the respondent has held a position of leadership in any group or voluntary organization they are part of, and '0' otherwise. $+p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$

Table S7: Effects of Single-Sex Schools on Hostile Sexism and Traditional Gender Role Beliefs

		Women			Men	
Hostile Sexism Scale	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	0.005	0.005	0.002	0.004	0.003	0.001
	(0.011)	(0.011)	(0.014)	(0.011)	(0.011)	(0.012)
Private high school (vs. public)			0.006			0.004
			(0.014)			(0.012)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
Traditional Gender Role Beliefs	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Single-sex high school (vs. coed)	-0.007	-0.007	-0.012	0.000	-0.001	-0.000
	(0.007)	(0.007)	(0.009)	(0.007)	(0.007)	(0.008)
Private high school (vs. public)			0.008			-0.001
			(0.009)			(0.008)
Pretreatment covariates	No	Yes	Yes	No	Yes	Yes
Class Year x School District FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1732	1732	1732	1709	1709	1709

Note: Standard errors in parentheses. All dependent variables range from 0 to 1, with higher values reflecting stronger sexist attitudes and more traditional gender role attitudes. $+p<0.10$, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

4 Balance Check

We studied a sample of 3,441 people who graduated from regular academic high schools in Seoul between 1990 and 2010, a period in which incoming high school freshmen were randomly assigned to schools in their districts. Using screening questions, we obtained a sample balanced by gender and type of school (single-sex or coeducational). Since the random assignment of students to schools took place prior to this survey, we checked the balance of pretreatment covariates between the single-sex and coeducational school graduates to ensure that our results are not affected by imbalances in covariates in our sample.

As shown in Supplementary Table S8, we observe imbalances on age, maternal employment, and attendance in public or private schools. These imbalances could be due to chance, but they may have to do with the fact that there were fewer coeducational schools in earlier years before 2000 than there were single-sex schools. Over time, as schooling in Korea and other countries moved away from single-sex education model, new public schools built to accommodate a growing population were mostly coeducational, hence we observe an imbalance with respect the share of private vs public schools that are single sex vs coeducational, as shown earlier in Table S3. To ensure that these imbalances do not affect our substantive results, we used entropy balancing (Hainmueller 2012) for the female and male sample separately (see Table S9) and re-estimate our models using the sample adjusted for these imbalances. As shown in Table S10, matching estimates are not substantively different from the ones presented in the main text.

Table S8: Balance Check

	Women			Men		
	$M_{SingleSex}$	M_{Coed}	t	$M_{SingleSex}$	M_{Coed}	t
Respondent age (in years)	39.1	37.6	5.47***	41.6	39.3	8.31***
Father college graduate (yes)	0.36	0.37	-0.15	0.41	0.39	1.01
Mother college graduate (yes)	0.22	0.21	0.24	0.25	0.23	0.79
Father worked full time (yes)	0.94	0.94	0.25	0.93	0.92	0.81
Mother worked full time (yes)	0.41	0.45	-1.87+	0.35	0.42	-2.81*
Respondent has sister(s) (yes)	0.53	0.52	0.41	0.50	0.51	-0.34
Respondent has brother(s) (yes)	0.62	0.62	0.09	0.50	0.44	2.40*
Attended private high school (vs. public)	0.82	0.26	27.75***	0.77	0.32	20.78***

Women N=1732; Men N=1709. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; +$p < 0.10$;

Table S9: Sample Adjusted by Entropy Balancing

	Women		Men	
	$M_{SingleSex}$	$M_{CoedSchool}$	$M_{SingleSex}$	$M_{CoedSchool}$
Respondent age (in years)	39.1	39.1	41.6	41.6
Father college graduate (yes)	0.36	0.36	0.41	0.41
Mother college graduate (yes)	0.22	0.22	0.25	0.25
Father worked full time (yes)	0.94	0.94	0.93	0.93
Mother worked full time (yes)	0.41	0.41	0.35	0.35
Respondent has sister(s) (yes)	0.53	0.53	0.50	0.50
Respondent has brother(s) (yes)	0.62	0.62	0.50	0.50
Attended private high school (vs. public)	0.81	0.81	0.77	0.77

Table S10: Analysis Using Balanced Sample

Women

	Participation	Like to Lead	Been Leader	Sexism	Gender Role Belief
Single-sex high school (vs. coed)	0.039*	0.030*	0.096***	0.005	-0.013
	(0.016)	(0.014)	(0.029)	(0.015)	(0.010)
N	1732	1732	1732	1732	1732

Men

	Participation	Like to Lead	Been Leader	Sexism	Gender Role Belief
Single-sex high school (vs. coed)	0.007	-0.014	-0.037	0.007	-0.004
	(0.014)	(0.011)	(0.031)	(0.012)	(0.008)
N	1709	1709	1709	1709	1709

Note. Standard errors in parentheses. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

5 Research Ethics

There were no ethical challenges or perceived ethical issues related to this research. The topics addressed in our survey are routinely and openly discussed in Korean society and have been the subject of previous public opinion polls by other researchers/organizations.

Survey participants voluntarily consented to participate in the survey and were not directly paid by us. We drew our sample from an online research panel maintained by a leading Korean survey company named Embrain. Panelists have agreed to respond to requests to participate in survey research and receive "points" as an incentive for completing each survey, which can be later redeemed for cash, gift cards, or other rewards. Embrain is responsible for determining how many points a panelist earns for each completed survey.

Embrain has a large, demographically diverse pool of people in their research panel. For our study, we recruited only those who fit our target population: adult Korean nationals who graduated from regular high schools in Seoul between 1990 and 2010.

Our participant pool did not include vulnerable or marginalized populations. Our research was not designed with the goal of differentially benefiting (or harming) any particular groups and we do not believe it had any inadvertent effects in that regard.