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Do single-sex schools make girls more competitive?☆

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HIGHLIGHTS

- This study identifies the causal effect of single-sex schooling on competitiveness.
- There are no systematic differences in performance across gender or school type.
- Conditional on performance, girls are less competitive than boys.
- Single-sex schooling does not reduce the gender-gap in competitiveness.

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ABSTRACT

We examine the effect of single-sex schooling on students' competitiveness by studying middle school students in Seoul who were randomly assigned to either single-sex or coeducational schools within their school districts. Contrary to popular belief and existing studies, our results suggest that single-sex schooling does not reduce the gender gap in competitiveness conditional on student and parental characteristics.

1. Introduction

Researchers and policy makers have fiercely debated the merits of single-sex schooling relative to coeducational schooling. So far, many studies have focused on academic outcomes and found the effects equivocal (e.g., Halpern et al., 2011; Jackson, 2012; Behrman et al., 2013). However, relatively little attention has been devoted to non-academic outcomes, although those outcomes are heavily discussed. For example, some proponents of single-sex schooling raise a concern that, in coeducational settings, boys may dominate classroom interactions and draw more attention from teachers, which can promote gender stereotypes, and that single-sex schooling can mitigate this concern (e.g., Beaman et al., 2006). However, few empirical studies test that hypothesis with credible identification strategies.

This article examines the effect of single-sex schooling on a non-cognitive outcome, namely, willingness to compete (herein, *competitiveness*). We examine this outcome because competitiveness has been reported as an important factor in determining the choice of educational major, job promotion, and other economic

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outcomes and has thus been intensively studied in economics and related fields (e.g., Buser et al., in press; Niederle and Vesterlund, 2011). Furthermore, women are commonly found to prefer competition much less than men in various age groups and countries, although altering social norms arguably can reduce women's reluctance to compete (see Niederle and Vesterlund, 2011; Gneezy et al., 2009).

We think of single-sex schooling as a policy tool that may affect the gender gap in competitiveness, and we empirically examine this possibility. The key challenges to estimating the effect of single-sex schooling are two-fold: first, coeducational and single-sex schools often have different qualities, and second, students often select which type of school they attend. We address these challenges by examining middle school students (grades 7 to 9) in Seoul, South Korea. This experimental group is well-suited for the purpose of our study because a student is randomly assigned to a single-sex or coeducational school within a school district and all school districts have both single-sex and coeducational schools (see details in Section 2). Therefore, we identify the causal effect of single-sex schooling on competitiveness by estimating simple regression models controlling for school-district fixed effects and individual characteristics.

Our experimental design closely follows Niederle and Vesterlund (2007). Students are asked to solve addition problems consisting of 5 randomly drawn two-digit numbers. A student's performance is measured by the number of problems they solve correctly in a span of 3 min. We measure a person's competitiveness based on whether he/she chooses to compete against other participants for compensation. Since many factors other than competitiveness can affect a person's decision, we design the experiment to collect a participant's various characteristics in order to control for them in our analyses.

The hypothesis that single-sex schooling reduces the gender gap in competitiveness is not supported by our regression results. On the contrary, single-sex schooling may increase the gender gap. Our findings run contrary to a popular belief that single-sex schooling reduces gender stereotype, which could thus reduce the gender gap in competitiveness, and to the findings reported in Booth and Nolen (2012) for the UK where students choose either single-sex or coeducational schools. It is certainly possible that the effect of single-sex schooling on competitiveness is heterogeneous across ages and countries, and that this could account for our rather surprising findings. Alternatively, the difference in the estimated effect of single-sex schooling may crucially depend on whether students choose to attend a single-sex or coeducational school and, if so, the identification strategy used to address the resulting endogeneity (see Jackson, 2012).

2. Institutional background and experiment design

Our experimental group has multiple advantages for the purpose of our study. First, there is little room for endogenous school choice: within a school district, a student is randomly assigned to a single-sex or coeducational school[1]; the government's assignment rule does not take into account a student's preferences regarding middle schools in his/her district, and all school districts in Seoul have both single-sex and coeducational schools, implying that students cannot choose to go to a single-sex school by moving to a particular school district. Second, all middle schools are subject to the same educational policies, such as curriculum, number of school days, and teacher hiring. Therefore, we can identify the causal effect of single-sex schooling on competitiveness by estimating regression models controlling for school-district fixed effects and individual characteristics. We conduct our experiments in 2 rounds during the 2011/12 academic year and recruit 640 experiment participants from 21 middle schools located in 4 school districts. Note that those 4 school districts in our data are comparable to the rest of the school districts in Seoul in terms of household income and school-district level academic performance of middle school students. Furthermore, we find no statistical difference between the 21 middle schools in our sample and the rest of the middle schools within the 4 school districts in terms of academic performance according to the 2011 nation-wide test. See details in Online Appendixes A and B.

Each experiment session takes 45 min in total, starting with explaining the experiment to participants, conducting 4 Tasks, and then administering a brief survey of participants' demographic information. All participants complete each task but get paid (after the session) according to their performance on one randomly chosen Task. The Tasks are as follows. A student's performance is measured by the number of problems they solve correctly in a span of 3 min. Task 1 measures a person's performance under a piece-rate scheme that pays \$0.5 per correctly solved problem. In Task 2, participants perform under a tournament scheme. Participants are assigned to a randomly-chosen group of 2 girls and 2 boys, and they receive \$2 per correct answer if they are the top performer in their group, and 0 otherwise (in the case of ties, the winner is chosen randomly). In Task 3, participants first choose either the piece-rate or tournament scheme and then solve the addition problems. When a participant chooses the tournament, he/she receives \$2 per correct answer if his score in Task 3 exceeds that of the other members of his group from the just-completed Task 2; otherwise, he receives no payment. Importantly, a student's choice of compensation scheme in Task 3 does not influence the payment of any other participants. Therefore, we can rule out the possibility that participants do not enter the tournament because they do not want to impose a negative externality on others by winning the tournament. In Task 4, participants choose a compensation scheme (piece-rate or tournament) to apply to their performance in Task 2. The choice in Task 4 tells us whether a person avoided the tournament scheme in Task 3 because she dislikes performing a new task under competition (competitiveness) or because she intrinsically dislikes tournaments (risk aversion). We measure a person's competitiveness based on her choice of payment scheme in Task 3, controlling for her ability to perform as measured in Tasks 1 and 2 and risk aversion as measured in Task 4. For additional controls, we survey a person's belief about her performance in Task 2 as well as other individual characteristics.

3. Econometric framework

We design our regression model as follows:

$$Tournament_{isdr} = \alpha GirlinSingle_{isdr} + \beta GirlinCoed_{isdr} + \gamma Single_{isdr} + \theta X_{isdr} + \delta_d + \rho_r + u_{isdr}, \quad (1)$$

where $Tournament_{isdr}$ is 1 if student i, at school s, in school district d, in experiment round r, selects tournament in Task 3, and 0 if he/she opts for piece-rate, $GirlinSingle_{isdr}$ is 1 if the student is female and attends a girls-only school, $GirlinCoed_{isdr}$ is 1 if the school is female and attends a coeducational school, $Single_{isdr}$ if the student attends a single-sex school, X_{isdr} is a vector of the student's characteristics. Parameter α (β) measures the gender gap in competitiveness among students in single-sex schools (coeducational schools). That is, if $\alpha < 0$, then girls are less likely to select the tournament in Task 3 compared to boys who attend single-sex schools. If single-sex schooling reduces girls' reluctance to compete relative to coeducational schooling, $\alpha - \beta$ will be positive. Parameter δ_d captures school-district fixed effects, and ρ_r controls for

[1] The random assignment rule is in Seoul Metropolitan Office of Education Provision No. 1996-23. Using an additional dataset, we examine family characteristics of students in single-sex schools and those in coeducational schools and find no statistical differences between the two groups within a school district, consistent with the random assignment rule. See the Online Appendix for details.

Table 1
Competitiveness and sex composition at school. Dependent variable: 1 if selecting tournament scheme in Task 3.

Model	OLS (1)	OLS (2)	Probit (Marginal effects at mean) (3)
Gap in competitiveness: Boys–Girls			
- Students in single-sex schools (α)	−0.150**	−0.112*	−0.142**
	[0.061]	[0.058]	[0.055]
- Students in coeducational schools (β)	−0.084**	−0.076	−0.084*
	[0.038]	[0.053]	[0.041]
1 if attending a single-sex school	0.048	0.040	0.050
	[0.033]	[0.038]	[0.032]
Performance in Task 1	0.012***	0.000	0.012***
	[0.004]	[0.004]	[0.003]
Performance in Task 2 – Task 1	0.011*	0.001	0.011**
	[0.005]	[0.006]	[0.005]
Subjective rank in Task 2 (1:best, 4:worst)		−0.086**	
		[0.033]	
1 if selecting tournament in Task 4		0.241***	
		[0.048]	
R-sq	0.040	0.130	0.035
No. of observations	632	615	632
$\alpha - \beta$: gender gap reduction due to single-sex schooling			
Estimate	−0.066	−0.036	−0.058
Standard error	[0.063]	[0.065]	[0.062]
P-value: $\alpha - \beta = 0$	(0.308)	(0.588)	(0.349)

Standard errors are clustered at the school level and reported in brackets. Additional control variables: school-district and round fixed effects, and grade. Marginal effects are measured at mean for continuous variables and from 0 to 1 for dummy variables.
"$\alpha - \beta$" is positive (negative) if single-sex schooling narrows (widens) the gender gap in competitiveness.
* Significant at 10%.
** significant at 5%.
*** significant at 1%.

possible seasonal effects, as the first round of experiment took place in August 2011 and the second round in February 2012. Variable u_{isdr} is a random shock that can be correlated within a school.

4. Data and results

We have 124 boys and 238 girls from 6 single-sex middle schools and 130 boys and 148 girls from 15 coeducational middle schools. On average, students correctly answer 11 questions in Task 1 and 12 questions in Task 2. We find no statistical differences in performance or in family background between the four subgroups based on gender (boys and girls) and school type (single-sex schools and coeducational schools). However, girls are less likely than boys to choose tournament: 29.9% of boys select tournament in Task 3, while 22.3 girls do (p-value of testing no gender gap: 0.032). This difference remains even after we control for students' characteristics. See details in Online Appendix C.

The hypothesis that single-sex schooling reduces the gender gap in competitiveness is not supported by our regression results. In column 1 of Table 1, the estimates "−0.150" and "−0.084" under "Gap in competitiveness: Boys–Girls" in column 1 imply that, all else being equal, girls in single-sex schools are 15.0 pct. pts. less likely to select tournament than their male counterparts, while the gender gap in competitiveness among students in coeducational schools is only 8.4 pct. pts. Contrary to the popular hypothesis, single-sex schooling worsens the gender gap in competitiveness by 6.6 pct. pts. compared to coeducational schooling, although the impact is not significant at a conventional level. Note that "1 if attending a single-sex school" measures the effect of single-sex schooling on overall competitiveness, not the gender gap. The effect of single-sex schooling on the gender gap in competitiveness remains stable if we additionally control for subjective rank and risk aversion (column 2), use alternative models such as probit (column 3), and conduct subgroup analyses (see Online Appendix D). Note that the subjective rank in Task 2 ranges from 1 (best) to 4 (worst) and its negative coefficient implies that a student who thinks he/she performed better in Task 2 than his/her peers is more likely to select tournament in Task 3.

Our findings are contrary to the findings in UK reported in Booth and Nolen (2012). They examine 260 UK students with ages similar to those in our sample and find that single-sex schooling reduces the gender gap by over 60%. However, this large reported impact may be due to selection bias because in the UK setting, students can choose either coeducational or single-sex schools, and students in single-sex schools tend to have parents with higher socioeconomic status.[2]

5. Conclusion

This paper finds that girls are less competitive than boys, conditional on performance and characteristics, and that this gender gap can be reduced not by expanding single-sex schooling, but possibly by altering parental inputs. This paper suggests that the effect of single-sex schooling on non-academic outcomes may not be as strong as is often argued, and therefore, whether policies expanding single-sex schools will promote gender equality is a question that requires more thorough empirical investigation.

Appendix A. Supplementary data

Supplementary material related to this article (Online Appendix) can be found online at http://dx.doi.org/10.1016/j.econlet.2014.07.001 or www.soohyunglee.com/research.

References

Beaman, Robyn, Wheldall, Kevin, Kemp, Coral, 2006. Differential teacher attention to boys and girls in the classroom. Educational Rev. 58 (3), 339–366.

[2] In our sample, the gender gap in competitiveness is smaller among students whose parents have good socioeconomic status. See Online Appendix E for the relationship between parental background and competitiveness.

Behrman, Jere, Choi, Jaesung, Park, Hyungjoon, 2013. Causal effects of single-sex schools on college attendance: random assignment in Korean high schools. Demography 50 (2), 447–469.
Booth, Alison, Nolen, Patrick, 2012. Choosing to compete: How different are girls and boys? J. Econ. Behav. Organ. 81, 542–555.
Buser, Thomas, Niederle, Muriel, Oosterbeek, Hessel, 2013. Gender, competitiveness and career choices. Q. J. Econom. (in press).
Gneezy, Uri, Leonard, Kenneth L., List, John A., 2009. Gender differences in competition: evidence from a matrilineal and a patriarchal society. Econometrica 77 (5), 1637–1664.
Halpern, Diane, Eliot, Lise, Bigler, Rebecca, Fabes, Richard, Hanish, Laura, Hyde, Janet, Liben, Lynn, Martin, Carol, 2011. The pseudoscience of single-sex schooling. Science 333, 1706–1707.
Jackson, C.Kirabo., 2012. Single-sex schools, student achievement, and course selection: evidence from rule-based student assignments in Trinidad and Tobago. J. Public Econom. 96 (1–2), 173–187.
Niederle, Muriel, Vesterlund, Lise, 2011. Gender and competition. Ann. Rev. Econom. 3, 601–630.
Niederle, Muriel, Vesterlund, Lise, 2007. Do women shy away from competition? Do men compete too much? Q. J. Econom. 122 (3), 1067–1101.