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Seo-Young Cho

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Coordination: Bernd Hayo • Philipps-University Marburg
School of Business and Economics • Universitätsstraße 24, D-35032 Marburg
Tel: +49-6421-2823091, Fax: +49-6421-2823088, e-mail: hayo@wiwi.uni-marburg.de

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Cho, Seo-Young

MACIE, Philipps-Universität Marburg

Marburg Centre for Institutional Economics • Coordination: Prof. Dr. Elisabeth Schulte
c/o Research Group Institutional Economics • Barfuessertor 2 • D-35037 Marburg

Phone: +49 (0) 6421-28-23196 • Fax: +49 (0) 6421-28-24858 •
www.uni-marburg.de/fb02/MACIE • macie@wiwi.uni-marburg.de

Philipps Universität Marburg

The Role of Social Capital in Competition and Gender-Matching Environments ' Evidence from East Asian Countries

Seo-Young Cho*
(Philipps-University of Marburg)

Updated in March 2018

Abstract: This paper investigates the role of social trust in determining oneôs willingness to compete in math competitions in school, observing how competitive occupational choices often require higher quantitative skills. Using the data of the PISA test in math, the empirical results highlight that a higher level of trust in school environments promotes a studentôs willingness to participate in math competitions. However, this positive effect of trust maintains mainly in mixed-sex competition, but not in single-sex competition. Furthermore, the effect of trust on mixed-sex competition is greater for girls than boys, while the effect is equally insignificant for boys and girls in single-sex competition. These findings suggest the importance of trust in the rules of the game when girls are matched with boys. On the other hand, when they compete with other girls, concerns about fairness do not play a significant role in their consideration. This is possibly because single-sex matches reduce unfairness caused by gender discrimination.

Keywords: gender; competition; math studies; social trust; gender-matching school environments; institutions; survey; and East Asia
JEL-codes: I24; J16; O17; O53

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*Contact: Assistant Professor, Research Group of Empirical Institutional Economics, School of Business and Economics, Philipps-University Marburg. Barfuessertor 2, D-35037 Marburg, Germany. Tel. 49 (0)6421-28-23996. Email: seo.cho@wiwi.uni-marburg.de Web: www.uni-marburg.de/fb02/empinsti

1. Introduction

Being competitive is an important non-cognitive ability in labor markets, and thus, gender differences in competition can provide an explanation for gender gaps in earnings and professional successes. Literature discusses a glass-ceiling, in that women are disadvantaged in obtaining a promotion because of their low level of willingness to compete despite having equivalent professional qualifications to men (Niederle and Vesterlund 2010, 2011; de la Rica et al. 2008). Literature further attributes the gender-asymmetric level of competition to institutional conditions ï particularly male domination (female underrepresentation) in many parts of society that, in turn, discourages women and girls from participating in competition. Studies show that girls are more reluctant to enter a competition than boys when they have to compete in mixed-sex matches, but they become more competitive in single-sex settings (see Booth and Nolen 2012a, b; Booth 2009; Boschini and Sjögren 2007; Datta Gupta et al. 2013; Niederle and Vesterlund 2007).

The positive effect of single-sex environments on girlsô competition documented in these studies can be explained by several channels. They are namely: (i) the gender-matching of competitors increases girlsôconfidence in their own abilities, (ii) girls can trust the fairness of the rule more when competing with other girls than competing with boys, and/or (iii) single-sex environments reinforce a positive female gender role that can be shaped by active female peers and teachers who are more available in these environments. Among these channels, literature has so far addressed the effect of gender-matching environments on self-confidence (Niederle and Vesterlund 2007; Gneezy et al. 2003) and gender role models (Booth and Nolen 2012a, b; Booth 2009). However, literature has not yet detailed a linkage between trust (oneôs beliefs about fairness) and competition. To fill this gap in literature, this paper aims to identify the channel of gender-matching environments in which girls can more trust the fairness of competition. In doing so, one can establish the relationship between gender gaps in competition and social trust. In unraveling gender gaps in willingness to compete, this study focuses on competition in math because competitive occupational choices that offer high payment and promotion often require higher quantitative and mathematical skills (Friedman-Sokuler and Justman 2016). Thus, gender differences in competition in math in school can provide a lens to peer into future gender gaps in competitive labor markets that occur later in oneôs life.

The empirical analysis of this paper utilizes the data of the 2012 Programme for International Student Assessments (PISA, OECD 2012) that includes survey and test outcomes of students at age 15. So far, the majority of studies that investigate gender gaps in competition employed behavioral experiments, which revealed ñobservedò behavioral preferences towards competition (Booth and Nolen 2012a, b; Buser et al. 2014; Gneezy et al. 2003; Niederle and Vesterlund 2007). Application of survey data, on the other hand, examines another mode of preference towards competition ï ñstatedò behavioral choices. This implies that the findings of a survey can be used to identify whether stated preferences correspond to observed behaviors. While survey data runs the potential risk of over-/understatements in answers, stated preferences provide advantages in revealing preferences in non-experimental (not controlled) settings.

Furthermore, the PISA data incorporates a wide range of countries worldwide, so that the overrepresentation of North America and Europe that is present in experimental studies can be compensated for. In this study, East Asia is chosen as a regional focus to crosscheck whether the findings of the studies in the West can be supported by the findings of the study in the East. Accordingly, seven East Asian countries/economies whose data are available in the PISA 2012 were selected for the analysis ï i.e. Hong Kong, Japan, South Korea, Macao, Shanghai, Singapore, and Taiwan. These countries share several characteristics ï high-performing economies, high performance in studies present in the PISA tests, and cultural similarities of Buddhist and/or Confucianist heritages. More specifically, the seven countries form the best seven performers in the PISA math test in 2012.[1] These shared characteristics minimize the risks of biased results due to unobserved cultural differences between the countries.

The empirical results highlight the important role social trust plays in competition. A higher level of trust in school environments promotes oneôs willingness to compete and participate in math contests and clubs and motivation to pursue a competitive, quantitative career. However, this positive effect of trust holds true for mainly in mixed-sex schools, but not in single-sex ones, when competition takes place inside of school (i.e. in-school math competition). On the other hand, trust increases oneôs competitiveness in both single- and mixed-sex schools when competition involves outside of school surroundings (i.e. instrumental motivation in math-

[1] The ranking of countries in the PISA math test in 2012 (OECD 2012): 1. Shanghai-China (with a mean score of 613), 2. Singapore (573), 3. Hong Kong-China (561), 4. Taiwan (560), 5. South Korea (554), 6. Macao-China (538), and 7. Japan (536).

related careers after graduation). These results suggest that the trust effect is exhausted in gender-matching environments, probably because single-sex matches reduce unfairness caused by gender discrimination. The finding that the effect of trust is greater for girls than boys in mixed-sex competition (but no difference in single-sex competition) lends support for the argument of the gender-matching effect that reduces unfairness against girls.

2. Descriptive Findings: Gender Differences in Competitiveness, Social Trust, Confidence, and Performance in Math

This section illustrates with descriptive evidence how male and female students are different in the key dimensions of attitude and performance measurements investigated in this paper ï namely, oneôs competitiveness, trust, confidence, and math abilities. For the descriptive comparisons, the data of 6,215 male and 5,908 female high school students who took part in the PISA in 2012 in the seven East Asian countries/economies is used. Table 1.2 shows the mean values of male and female students, respectively, in the investigated dimensions.

First, competitiveness is measured by three indicators available in the PISA data that reflect different dimensions of competition: the frequency of competing in a math contest (*competition*); the frequency of participating in a school math club (*participation*); and the degree of instrumental motivation in pursuing math-related careers (*motivation*). Both *competition* and *participation* are measured on a scale of 1 (never) ï 4 (always). *Motivation* is a composite index that combines four questions on oneôs study and career plan related to math and is measured on a continuous scale from ï2.3 to +1.59. Appendix A provides detailed survey questions used to construct these three indicators.

In all of the three indicators, male students demonstrate a higher level of competitiveness. The mean value of male competition in a contest is 1.39 and that of femalesô is 1.21. Furthermore, male and female values are differently distributed, in that male values are placed significantly more on the right side (Mannï Whitney test of equal distributions z-statistics = 14.39, p-value = 0.00). The level of male participation in a math club is also significantly higher than the female level (mean values of 1.22 and 1.10, respectively, MW z-statistics = 13.75, p-value = 0.00). For instrumental motivation in math-related careers, male students have a score that is 0.20 points higher than female ones on average (mean values of ï0.16 and ï0.35,

respectively). This difference between the genders is maintained in all distribution tails of motivation scores (MW z-statistics = 11.11, p-value = 0.00).

Second, social trust is conceptualized in this paper as both trusting other people and the trustworthiness of others (social environments), following Fukuyama (1995) and Putnam (1993). To measure the level of ñtrusting other people,ò this paper employs the index of student-teacher relationship, which is comprised of five questions about teachersô fairness and interpersonal attitudes towards students that are evaluated by individual students. The student-teacher relationship measurement reveals how much a student trusts his or her teachers, who play an important role in evaluating a success in competition and advising for career choices. This relationship is measured on a scale from ï 3.11 to +2.16. As seen in Table 1.2, male students exhibit a higher level of trust with the mean value of 0.10 compared to that of females, 0.06. This gender difference is significant in all distribution tails of trust levels (MW z-statistics = 1.97, p-value = 0.049).

In addition, the trustworthiness of others is evaluated by the teachersô morale index, which utilizes school principalsô assessments of class teachers. With this index, one can evaluate the trustworthiness of school environments. While the index of student-teacher relationship relies on studentsô self-evaluation on how much they trust teachers, the teachersô morale index employs a third-personôs evaluation on the trustworthiness of the teachers. The teachersô morale index was constructed by using four questions on teachersô moral and professional attitudes that were asked to the head of each school (on a scale from ï 2.79 to +1.45). In contrast to the trust level, the trustworthiness level of environments is higher for girls (the mean value is ï 0.22 for girls and ï 0.26 for boys. MW z-statistics = ï 2.35, p-value = 0.019).

Third, oneôs confidence level in math is measured by using the index of self-concept in math that assembles five questions regarding how confident one is in studying math. This index is based on studentsô self-evaluation and is measured on a scale of ï 2.18 to +2.26. The mean confidence level of male students is ï 0.03, while that of female students is ï 0.40. This observation that boys are significantly more confident in math than girls is also supported by the gender difference in the distribution functions (MW z-statistics = 21.59, p-value = 0.00). On the other hand, female students are more anxious about math evaluation (evaluation aversion). Evaluation aversion is measured by the level of anxiety on receiving poor grades in math exams on a scale of 1 (not at all worried) to 4 (very worried). Female students

demonstrate a significantly higher level of evaluation aversion than male ones (mean values of 3.11 and 2.85, respectively, MW z-statistics = ï 14.90, p-value = 0.00).

Fourth, the gender difference in math abilities is assessed by the math score each student receives in the PISA test (the performance-based measurement of abilities). Male students received about 11 points higher than female students on average, and the gender gap in math scores is significant at a 1-percent level (MW z-statistics = 6.46, p-value = 0.00).

The descriptive findings presented in this section show that boys are more competitive, participatory, and instrumentally motivated than girls in terms of math-related activities. Also, they are more trusting and confident and perform better in math. On the other hand, girls have more trustworthy school environments, and they are more evaluation averse. Detailed descriptive statistics and survey questions used for these variables can be found in Table 1 and Appendix A.

3. **Research Design**

3.1. Articulation of Testable Hypotheses

This paper focuses on the role of social capital in explaining why women are less competitive than men. Literature widely attributes gender gaps in competition to gender differences in confidence and gender-specific role models (Booth and Nolen 2012a, b; Booth 2009; Datta Gupta et al. 2013; Gneezy et al. 2003, 2009; Niederle and Vesterlund 2007, 2011). However, little has been discussed regarding the influence of social trust on oneôs level of competitiveness despite the fact that whether one trusts the fairness of the rules of the game is crucial in making a decision to enter a competition. Without trusting the rules of competition, individuals would be reluctant to participate in competition because their performance may not be fairly evaluated.

In literature, it is shown that women trust less than men (Buchan et al. 2008; Dohmen and Falk 2011; Glaeser et al. 2000). This is because social minorities, having experienced various forms of discrimination throughout their lifetime(s), are less likely to believe that ñmost people can be trustedò (Buchan et al. 2008). With a lower level of trust, women tend to perceive the rules of a competition as unfair to them when they compete especially against

men ï the socially dominant group. In this respect, Niederle and Vesterlundôs study (2007) hints that women shy away from competition presumably because they trust the fairness of the game less. However, the authors do not further substantiate empirical evidence on the relationship between trust and competitiveness, and instead emphasize the role of confidence in explaining gender gaps in competition.

Instead of directly connecting gender gaps in trust and competitiveness, literature insinuates the importance of trust by identifying effects of gender-matching environments. For instance, Gneezy et al. (2003) and Niederle and Vesterlund (2007) show that single-sex tournaments increase female participation in competition. Also, Booth and Nolen (2012a, b) find that girls in all-girls schools are more competitive and more often take risks than other girls in co-educational schools.[2] In fact, there are several possible channels that can explain the positive gender-matching effects on female competitiveness. First, one must consider the nexus between trust and competition, as discussed above. In single-sex environments, women would trust the fairness of the game more because women are not social minorities under such conditions. Second, same-sex competition could boost womenôs confidence because women may more positively evaluate their abilities when competing with female counterparts. Third, the gender-matching environments may provide positive role models for women through interacting with other women ï e.g. female teachers, mentors, and peers. Thus, the assumed positive effect of single-sex environments for women and girls is presumably an outcome of the combination of increasing trust, confidence, and positive gender roles.

Considering all possible channels of gender-matching environments, this paper aims to single-out the net effect of social trust on female competitiveness. To do so, the effect of trust is estimated in gender-matching and mixed-gender environments, respectively, and then, the difference is gauged instead of estimating the aggregate gender-matching effect that may reflect a combined effect of the three channels. This approach is articulated based on the argument that trust can be more important for women when they have to compete with men than competing with other women because women are likely more concerned about the fairness of the competition in cross-gender matches. Thus, the role of trust is expected to be larger for girls in mixed-sex settings than others in all-girls environments.

[2] On the other hand, Lee et al. (2014) provide counter-evidence through a country-case study of South Korea in that girls in single-sex schools are less competitive than girls in coeducational schools, possibly because single-sex schools reinforce gender-stereotypes.

With this in mind, the following hypotheses are proposed and empirically tested.

H1. A higher level of trust increases the probability of one entering competition.
H2. The positive effect of social trust on competition is greater for girls in mixed-sex schools than others in all-girls schools.

3.2.Empirical Model

To test for the hypotheses discussed above, the following econometric model is formulated.

$$\begin{aligned}\text{Competition}_{isc} = {} & \alpha_s + d_c + \beta_1\text{Female}_{isc} + \beta_2\text{Trust}_{isc} + \beta_3\text{Trustworthiness}_{isc} + \beta_4\text{Math Score}_{isc} \\ & + \beta_5\text{Confidence}_{isc} + \beta_6\text{Evaluation Aversion}_{isc} + \beta_7\text{Single-sex School}_{isc} \\ & + \beta_8\,\text{Female}_{isc}*\text{Single-sex School}_{isc} + C_{isc}'\theta + W_{isc}'\gamma + u_{isc} \qquad (1)\end{aligned}$$

The data used for the analysis is the PISA survey and test scores of 12,123 individual students (i = 1,,,,, 12,123) in 1,029 schools (s = 1,,,,, 1,029) in the seven East Asian countries/economies (c = 1,,,, 7) in 2012.[3] With this sample, the analysis exploits variations across individual students at the micro-level.

In the model (Equation 1), the dependent variable (*competition*) is the level of a studentôs competitiveness in math. As explained in section 2, it is measured by the following three indicators, and each variable enters the model separately: DV = {the frequency of competition in math contests, a scale of 1 to 4; the frequency of participation in math clubs, a scale of 1 to 4; and the level of instrumental motivation in math-related careers, a scale of ï 2.3 to +1.59}.

The independent variables of main interest are *female*, *trust*, and *trustworthiness*. The *female* dummy variable accounts for the gender effect of being a girl on competition. *Trust* measures a studentôs self-assessed level of trusting teachersô fairness by using the PISA Index of Teacher-Student Relations (a scale of ï 3.11 to +2.16), as described in section 2. *Trustworthiness* is the level of class teachersô morale and teaching attitudes as assessed by school administration. The PISA Index of Teachersô Morale that is evaluated on a scale of ï 2.79 to +1.45 is used to proxy the trustworthiness of school environments.

[3] The PISA administration explains that the double stratification of the sampling was used to ensure the random selection of schools and students (OECD 2014).

The other explanatory variables are *confidence*, *evaluation aversion*, *math score*, *single-sex school*, and the vectors of cultural and resource-based capital variables (C and W, respectively). *Confidence* measures a studentôs confidence level in math studies on a scale from ï 2.18 to +2.26 by aggregating the answers of five questions that composes the Index of Self-Concept in Math (see Appendix A for each question). This variable is included because gender gaps in competition can be largely attributed to gender differences in confidence (Gneezy et al. 2003; Niederle and Vesterlund 2007). Controlling for confidence level can separate a potentially compounding effect between confidence and trust that gender-matching environments may create simultaneously, as discussed in section 3.1. In addition, evaluation aversion is also included in this model to further control for the effect of the lack of confidence caused by anxiety. This variable is constructed by using a question in the PISA survey, ñ*How much do you agree that you worry about getting poor grades in math*?ò Evaluation aversion reflects possibilities that students may not participate in competition or pursue competitive career paths because of anxiety against negative feedback (Niederle and Yestrumskas 2008).

As a studentôs abilities are also likely a determinant of oneôs decision to enter competition, individual study records are taken into account in this model by employing the PISA math score as a measurement of performance-based cognitive abilities. The PISA score ranges from 0 to 1,000 and scores are adjusted to have a mean of 500 test-score points and a standard deviation of 100 across the OECD countries (OECD 2014). In this paper, the sample-mean score of the seven East Asian countries/economies is 564. That is 64 points higher than the OECD-average, while the standard deviation (101) remains almost unchanged. This higher mean score indicates a relatively high level of math abilities of East Asian students.

The *single-sex school* and *female*single-sex school* variables represent gender-matching environments in that girls are expected to participate in competition more often because they are matched with other girls to compete. In this model, the interaction term between *female* and *single-sex school* accounts for any augmented effect of single-sex schooling specifically beneficial for girls. In addition to their inclusion as control variables, the categorization of single- and mixed-sex schools is further used to sub-sample students by school type in order to find a link between gender-matching and trust effects, as formulated in Hypothesis 2.

Literature also underscores cultural influences on oneôs choice of competitive studies and careers (Guiso et al. 2008; González de San Román and de la Rica Goiricelaya 2012). In this respect, oneôs country of origin is an important factor in oneôs cultural background at the macro-level. At the micro-level, family situation influences an individual significantly from their childhood onward. Especially, a motherôs employment status can be a crucial determinant of childrenôs attitudes ï in particular, girlsô career ambitions ï because working mothers can serve as a professional woman role model for their daughters (Farre and Vella 2013; Gneezy et al. 2009; Nollenberger et al. 2016). With this in mind, two variables are considered as key cultural capital in this paper and are included in vector C = {motherôs job, a scale of 1 to 4; and ethnic background, dummy}. The motherôs job variable measures the employment status of a mother on a four-point scale (out of labor force, in job markets, part-time, and full-time, respectively). A migrant status (*ethnic background*) refers to the effect of being an ethnic majority/minority in the country of residence. Additionally, the model incorporates country-specific characteristics ï country dummies denoted as d_c in Equation 1 in order to account for the effect of national cultural heritage on individual competitiveness.

In addition to cultural capital, resource-based capital that reflects a studentôs socio-economic conditions can be a decisive factor of oneôs competitiveness. Vector W comprises three variables in this respect: a family wealth level and the availability of cultural and educational resources at home. Accordingly, the PISA Indices of Wealth, Cultural Possessions, and Home-based Educational Resources are used as the respective measurements: W = {wealth, a scale of ï 5.08 to +3.13; cultural possessions, a scale of ï 1.51 to +1.27; and educational resources, a scale of ï 3.93 to +1.12}.

Moreover, the model controls for school-specific effects because teacher quality, curriculum, school structures, and peer compositions that differ across schools can influence a studentôs choice of competition and career ambitions. The school effect is denoted as $\breve{U}_s$ in Equation 1 in that each schoolôs characteristics are accounted for by including school dummies. In addition, country dummies, d_c, reflect the country-specific heterogeneity of each of the seven countries/economies in question, as mentioned above. Furthermore, this paper addresses heterogeneous patterns of studentsô behaviors and performance across schools and countries by constructing a multilevel model, in which observations of individual students are nested within schools which are further nested within countries (three-level nested model). In

addition, robust standard errors are applied to correct for heteroscedasticity and correlations within the lowest-level group.

The model is first estimated with the full sample of all students in the seven countries/economies. Then, the sample is sub-grouped by school type and the gender of students. Accordingly, the sub-samples consist of four groups: girls in all-girls schools, boys in all-boys schools, girls in mixed-sex schools, and boys in mixed-sex schools. The sub-group estimations are conducted to test for Hypothesis 2, which assumes that single-sex schools provide fairer environments for girls.

4. Results

4.1. What Determines Competitiveness? ï Gender and Social Trust

Table 2 presents the baseline results of the nested model analysis with the full sample, in that marginal effects are estimated by a linear estimation technic. First, Columns 1ï 2 show the determinants of the frequency of competing in math contests (*competition*). Column 1 estimates the gross gender effect without taking into account other covariates. In this case, being a girl reduces oneôs competitiveness level by 0.162 points on a four-point scale (4.1 percentage-points). Conditional on the other covariates (Column 2), the negative gender effect remains substantial but its magnitude decreases by 40 percent: from 4.1 to 2.5p.p. In other words, nearly 40 percent of the gender gap in competitiveness can be attributed to gender differences in trust, performance, confidence, evaluation aversion, single-sex schooling, and cultural and resource-based capital.

Among them, both trust and trustworthiness have significant, positive effects on competitiveness. A one-standard deviation increase in trust level increases competition in math by 0.45p.p. The same increase in trustworthiness boosts oneôs competitiveness by 0.24p.p. In addition, confidence is an important determinant of oneôs competitiveness. Increasing oneôs confidence level by one-standard deviation increases oneôs competitiveness level by 5.6p.p. This finding corroborates the literature that explains gender gaps in confidence as a main cause of gender gaps in competition as discussed in section 3.1. However, cognitive abilities (math score), single-sex schooling, and cultural capital do not have a significant effect on the frequency of one competing in a math contest. In contrast,

resource-based capital strengthens competition. Increasing cultural possessions of a student by one-standard deviation increases oneôs competitiveness level by almost one percentage-point. Increasing educational resources at home by the same margin adds 0.55p.p. to a studentôs competition level.

Columns 3ï4 provide the results of the frequency of participating in a math club (*participation*). The gross gender effect (see Column 3) is ï0.114 points, in that being a girl reduces oneôs participation level by 2.85p.p. After accounting for the other effects, the net gender effect is mitigated by 30 percent: from 2.85 to 2p.p. (Column 4). This shows that the observed characteristics of a student explain about 30 percent of the gender gap in participation in a math club, but 70 percent of the gap is unexplained. Alike the results of competition presented above, the effect of trust on participation is positive. Increasing oneôs trust level by one-standard deviation results in 0.53p.p. more frequently participating in a math club. However, contrary to its positive effect on competition in a math contest, trustworthiness does not influence oneôs participation in a math club.

Oneôs performance in math is a significant determinant of participation in a math club. However, it has an opposite direction of the effect to the expectation. Having a lower math score encourages (rather than discourages) oneôs participation. Reducing oneôs math score by one-standard deviation increases oneôs participation level by 5.63p.p. This is possibly because underperforming students participate in a math club in order to improve their math scores. On the other hand, the effect of confidence remains consistently positive for participation ï with a smaller margin than the one in the competition model in Column 2. With an increase in confidence level by one-standard deviation, one participates in a math club 2.83p.p. more often. Resource-based capital also positively affects the frequency of one participating in a math club. The size of the effects of cultural possessions and educational resources together is 0.04 points, in that, with a one-standard deviation increase in resource-based capital, one increases oneôs participation level by about 1p.p.

When oneôs competiveness level is measured by oneôs instrumental motivation towards pursuing math-related careers (Columns 5ï6), the findings further verify the positive role of social trust. Both trust and trustworthiness reinforce oneôs motivation level, and the effect of trust is substantially large. Increasing trust level by one-standard deviation increments oneôs motivation level by 5.54p.p. An increase in trustworthiness by the same extent increases oneôs

motivation by 0.62p.p. Also, the effect of confidence is large. Increasing one-standard deviation in confidence level boosts oneôs motivation level by 11.7p.p. Interestingly, a higher level of evaluation aversion strengthens oneôs motivation (a one standard deviation increase in evaluation aversion is associated with an increase in motivation by 2.78p.p). It seems that anxiety about grades reflects oneôs concerns on studies that may be positively related to oneôs instrumental motivation towards careers. Additionally, cultural capital turns to influence oneôs motivation, different from competition and participation. Being part of the ethnic majority of a respective country increases an individual motivation level by almost 1 p.p. On the other hand, two factors of resource-based capital cancel out the effect of one another. The effect of a studentôs family wealth is negative with a magnitude of ï0.068, while that of educational resources is positive with +0.066.

In this model of motivation, the gender effect significantly decreases after accounting for the other observable factors. The gross gender effect on instrumental motivation is ï0.187 points (a gender gap of 4.79 p.p. against girls, see Column 5), but after controlling for the other covariates, a three-quarter of the negative gender effect disappears, and the gender gap in motivation reduces to 1.18p.p (Column 6).

Evidence in Table 2 substantiates the positive effect social trust has on competiveness. In particular, trust enhances oneôs level of competitiveness in all three dimensions, whereas trustworthiness affects competition and motivation but not participation. Variations in oneôs confidence level can also explain individual variations in competitiveness to a great extent. Furthermore, gender remains to have a significant net effect of decreasing female competitiveness with a margin of 1ï2.5p.p. This negative gender effect supports the findings in the literature. However, the magnitude of the net gender effect estimated in this paper by using a survey tends to be smaller than the sizes gauged through behavioral experiments ï for instance, a net effect of 16p.p. suggested in Niederle and Vesterlund (2007) and 12p.p. in Buser et al. (2014). This difference implies that girls tend to state their preferences towards competition more positively compared to their revealed preferences through action.

4.2. Are the Effects of Social Trust Greater for Girls in Mixed-sex Schools than Girls in Single-sex Schools?

As proposed in Hypothesis 2, the effect of trust on competition can be different between single- and mixed-sex schools. This is because of the gender-matching effect single-sex schooling is expected to create. In single-sex schools, girls are only competing with other girls and do not compete with boys. Under these circumstances, female students can be less concerned about unfair treatment caused by gender discrimination. Hence, the importance of social trust should be smaller for girls in all-girls schools than others in mixed-sex schools.

To test for this hypothesis, the sample is broken down into school type and studentsô gender, and the effect of social trust is compared across the sub-samples. Table 3 presents the results, in that the effect of social trust is heterogeneous to the gender composition of competition. When competition takes place inside a school ï i.e. competition in a math contest and participation in a math club ï the effect of trust is insignificant in single-sex schools but remains positive in mixed-sex schools. This means that in same-sex competition trust does not play an important role, whereas it maintains its positive influence on mixed-sex matches as hypothesized. This result applies to both girls and boys. However, in mixed-sex competition, trust plays a more important role for girls than boys. The effect is twice as large for girls as boys regarding competition, and about 40 percent larger for girlsô participation than boysô. It seems that girls are more concerned about fairness when they have to compete with boys, compared to boys competing with girls.

Conversely, when competition refers to instrumental motivation towards competitive career choices, the effect of trust is consistently positive regardless of school type and a studentôs gender. Instrumental motivation in careers involves competition that takes place outside of school because in pursuing careers, one competes with others across schools. Thus, students in both single- and mixed-sex schools face mixed-sex competition in this regard. Accordingly, a positive effect of trust is predicted and the result supports the prediction. However, the effect is larger for students in mixed-sex schools than others in single-sex schools and moreover, the effect is largest for girls in mixed-sex schools. Specifically, a one-standard deviation increase in trust level increases girlsô motivation by 5.8p.p. in mixed-sex schools while it is 5.4p.p. in all-girls schools,. For boys, the effect is 5.3p.p. in mixed-sex schools and 5p.p. in all-boys schools. This larger effect of trust on girls in mixed-sex schools even when the gender composition of competition is already mixed regardless of school type adds further evidence that mixed-sex environments necessitate a greater role of trust ï particularly for girls.

Different from trust, trustworthiness does not play an important role. There is limited evidence of a positive effect of trustworthy environments in single-sex schools only: increasing girlsô competition in a math contest and boysô instrumental motivation. However, no further effect is found in other types of competition in single-sex schools, and the effect is minimal in all types of competition in mixed-sex environments. Performance (math scores) is generally irrelevant to explaining oneôs competitiveness level ï similar to the results of the full-sample in Table 2. However, in certain occasions, math abilities have a significant effect but interestingly, with the opposite direction of the effect between girls and boys. Namely, math abilities enhance girlsô competition in all-girls schools ($coeff._{competition}$ = +0.328, or 8.2p.p.), but constrain boysô competition and participation in mixed-sex schools ($coeff._{competition}$= ï0.159, or 4p.p. and $coeff._{participation}$= ï0.397, or 9.3p.p.). This shows that underperforming boys demonstrate a higher level of competitiveness in mixed-sex environments. This could be because boys try to compensate for a low level of performance with a high level of competitive attitudes when girls are present. By contrast, gender-matching school environments facilitate girlsô abilities to boost their competitiveness. In addition to these findings, oneôs confidence level maintains high explanatory power over oneôs competitiveness as it was in the full-sample estimations presented in Table 2.

These results empirically support the hypothesis that trust plays a more important role for girls in mixed-sex environments than in single-sex ones. However, in identifying the effect of trust in single- and mixed-sex competition, one remaining issue needs to be further discussed. There is a possibility that the effect of trust disappears in single-sex schools for reasons besides the gender composition of schools. Single-sex schools may provide fairer environments due to better quality of instruction or school administration, as they tend to be more selective and resourceful than mixed-sex schools in many countries. In this case, the role of trust may be minimized in single-sex schools not because of gender-matching effects, but because of better school quality that provides fairer rules in competition. However, this concern can be reduced as the model explicitly controls for heterogeneous school quality by including school fixed-effects. Moreover, the finding of the greater role of trust on girlsô competition in mixed-sex schools remains consistent when competition takes place outside of school. Therefore, competition is less influenced by the quality of each respective school. This result restates that the gender composition of environments is, indeed, a crucial determinant of girlsô competitiveness.

5. Conclusion

This paper addresses the importance of social trust in determining oneôs competitiveness in that gender gaps in social trust are proposed a cause of gender gaps in competition. Furthermore, the findings of this study highlight the channel of gender-matching environments that mediates the effect of social trust as same-sex competition arguably provides fairer environments for girls. With this evidence, this study suggests trust-ensuring institutions as a stimulator of female competition, as proposed by Apicella et al. (2017) and Niederle and Yestrumskas (2008).

In the future, it is certainly warranted to further investigate the relationship between gender gaps in competition and trust. In doing so, one may examine whether the effect of social trust can still be mediated through gender-matching environments when it concerns competition among adults whose perception about fairness is more established than teenage students.

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Table 1. Descriptive Statistics

1.1. Full sample (both male and female students)

Variable	Observation	Mean	Std.Dev.	Min.	Max.
Competition in Math Contest	12,123	1.31	0.64	1	4
Participation in Math Club	12,121	1.16	0.50	1	4
Instrumental Motivation	12,107	ï 0.26	0.98	ï 2.3	1.59
Female	12,123	0.48	0.5	0	1
Trust	12,123	0.08	1.01	ï 3.11	2.16
Trustworthiness	12,123	ï 0.24	0.97	ï 2.79	1.45
Math Score	12,123	564	101	184	925
Confidence	12,123	ï 0.21	0.95	ï 2.18	2.26
Evaluation Aversion	12,123	2.98	0.91	1	4
Single-sex School	12,123	0.14	0.35	0	1
Motherôs Job	12,123	2.95	1.31	1	4
Ethnic Background	12,123	0.77	0.42	0	1
Wealth	12,123	ï 0.57	0.78	ï 5.08	3.13
Cultural Possessions	12,123	ï 0.13	1.04	ï 1.51	1.27
Educational Resources	12,123	ï 0.20	0.99	ï 3.93	1.12

1.2. Comparison between male and female students

	Male Students (n = 6,215)				Female Students (n = 5,908)			
Variable	Mean	Std.Dev.	Min.	Max.	Mean	Std.Dev.	Min.	Max.
Competition in Math Contest	1.39	0.72	1	4	1.21	0.51	1	4
Participation in Math Club	1.22	0.58	1	4	1.10	0.39	1	4
Instrumental Motivation	ï 0.16	1.00	ï 2.30	1.59	ï 0.35	0.96	ï 2.30	1.59
Trust	0.10	1.04	ï 3.11	2.16	0.06	0.97	ï 3.11	2.16
Trustworthiness	ï 0.26	0.96	ï 2.79	1.45	ï 0.22	0.98	ï 2.79	1.45
Math Score	569.46	104.05	207.83	924.84	558.41	97.24	183.99	912.30
Confidence	ï 0.03	0.94	ï 2.18	2.26	ï 0.40	0.92	ï 2.18	2.26
Evaluation Aversion	2.85	0.96	1	4	3.11	0.84	1	4
Single-sex School	0.12	0.32	0	1	0.16	0.37	0	1
Motherôs Job	2.95	1.31	1	4	2.95	1.31	1	4
Ethnic Background	0.77	0.42	0	1	0.76	0.43	0	1
Wealth	ï 0.56	0.80	ï 5.08	3.13	ï 0.59	0.77	ï 5.04	3.11
Cultural Possessions	ï 0.23	1.04	ï 1.51	1.27	ï 0.03	1.03	ï 1.51	1.27
Educational Resources	ï 0.24	1.02	ï 3.93	1.12	ï 0.17	0.96	ï 3.93	1.12

Table 2. Competitiveness, Gender, and Trust, full sample, nested model

DV	Competition		Participation		Motivation	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	ï 0.162	ï 0.098	ï 0.114	ï 0.082	ï 0.187	ï 0.046
	(0.028)***	(0.013)***	(0.018)***	(0.012)***	(0.029)***	(0.025)***
Trust		0.018		0.021		0.214
		(0.007)***		(0.008)***		(0.007)***
Trustworthiness		0.01		0.003		0.025
		(0.006)*		(0.004)		(0.009)***
Math Score		ï 0.03		ï 0.225		0.017
(log)		(0.082)		(0.041)***		(0.204)
Confidence		0.236		0.119		0.481
		(0.035)***		(0.023)***		(0.019)***
Evaluation		ï 0.005		ï 0.001		0.119
Aversion		(0.019)		(0.011)		(0.027)***
Single-sex School		0.027		0.008		0.055
		(0.034)		(0.019)		(0.086)
Female*Single		ï 0.016		ï 0.015		ï 0.037
-sex School		(0.034)		(0.026)		(0.066)
Motherôs Job		0.002		0.001		ï 0.010
		(0.005)		(0.005)		(0.005)*
Ethnic		ï 0.033		ï 0.027		0.036
Background		(0.043)		(0.022)		(0.015)**
Wealth		0.005		0.008		ï 0.068
		(0.005)		(0.009)		(0.008)***
Cultural		0.033		0.019		ï 0.005
Possessions		(0.013)**		(0.005)***		(0.016)
Educational		0.022		0.021		0.066
Resources		(0.006)***		(0.009)**		(0.008)***
School Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7
Schools	1,020	1,020	1,020	1,020	1,020	1,020
Observations	12,123	12,123	12,133	12,133	12,139	12,139
Log Likelihood	ï 23,254	ï 10,456	ï 17,414	ï 8,249	ï 33,926	ï 14,455

Note: Random intercepts are applied. Parentheses are robust standard errors. * $p < .10$, ** $p < .05$, *** $p < .001$.

Table 3. Competitiveness, Gender, Trust, and Gender-matching Environments, nested model

DV	Competition				Participation				Motivation			
School Type	Single-sex Schools		Mixed-sex Schools		Single-sex Schools		Mixed-sex Schools		Single-sex Schools		Mixed-sex Schools	
Gender (Student)	F	M	F	M	F	M	F	M	F	M	F	M
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Trust	0.010	0.007	0.023	0.012	ï 0.010	0.005	0.027	0.019	0.209	0.192	0.224	0.205
	(0.013)	(0.023)	(0.011)**	(0.005)**	(0.022)	(0.016)	(0.010)***	(0.010)*	(0.050)***	(0.042)***	(0.02)***	(0.014)***
Trust-Worthiness	0.023	ï 0.010	0.005	0.016	ï 0.007	ï 0.018	ï 0.002	0.011	0.008	0.058	0.020	0.026
	(0.004)***	(0.033)	(0.006)	(0.010)	(0.013)	(0.018)	(0.007)	(0.007)	(0.032)	(0.011)***	(0.013)	(0.020)
Math Score (log)	0.328	0.108	0.083	ï 0.159	ï 0.032	0.089	ï 0.058	ï 0.397	0.020	0.203	0.021	0.014
	(0.146)**	(0.267)	(0.093)	(0.072)**	(0.107)	(0.255)	(0.046)	(0.045)***	(0.330)	(0.338)	(0.238)	(0.195)
Confidence	0.152	0.322	0.174	0.287	0.065	0.124	0.083	0.154	0.550	0.554	0.450	0.485
	(0.018)***	(0.068)***	(0.029)***	(0.043)***	(0.008)***	(0.022)***	(0.025)***	(0.027)***	(0.044)***	(0.030)***	(0.017)***	(0.02)***
Evaluation Aversion	ï 0.040	0.028	ï 0.025	0.005	ï 0.029	ï 0.068	ï 0.008	0.012	0.187	0.097	0.106	0.120
	(0.023)*	(0.035)	(0.023)	(0.024)	(0.021)	(0.020)***	(0.008)	(0.018)	(0.044)***	(0.068)	(0.030)***	(0.03)***
Motherôs Job	ï 0.002	ï 0.012	0.003	0.004	ï 0.006	ï 0.027	0.005	0.003	ï 0.038	ï 0.025	ï 0.007	ï 0.005
	(0.013)	(0.010)	(0.004)	(0.006)	(0.008)	(0.017)	(0.004)	(0.007)	(0.016)**	(0.010)**	(0.008)	(0.005)
Ethnic Background	ï 0.005	ï 0.340	ï 0.056	0.028	ï 0.024	ï 0.161	ï 0.017	ï 0.023	0.077	0.086	0.009	0.047
	(0.042)	(0.10)***	(0.021)***	(0.061)	(0.010)**	(0.057)***	(0.012)	(0.034)	(0.054)	(0.058)	(0.044)	(0.023)**
Wealth	ï 0.019	0.005	0.006	0.005	0.006	ï 0.023	0.015	0.002	0.029	ï 0.014	ï 0.092	ï 0.059
	(0.034)	(0.039)	(0.005)	(0.010)	(0.018)	(0.032)	(0.012)	(0.014)	(0.035)	(0.050)	(0.012)***	(0.02)***
Cultural Possessions	0.048	0.029	0.021	0.046	0.021	ï 0.010	0.013	0.031	ï 0.045	ï 0.038	0.006	ï 0.005
	(0.020)**	(0.035)	(0.015)	(0.011)***	(0.009)**	(0.016)	(0.007)*	(0.007)***	(0.042)	(0.036)	(0.023)	(0.014)
Educational Resources	0.020	0.039	0.017	0.025	0.012	0.071	0.014	0.023	0.101	0.033	0.080	0.055
	(0.010)**	(0.022)*	(0.011)	(0.006)***	(0.019)	(0.022)***	(0.011)	(0.011)**	(0.045)**	(0.051)	(0.013)***	(0.01)***
School Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	7	7	7	7	7	7	7	7	7	7	7	7
Schools	83	67	843	854	83	67	843	854	83	67	844	855
Observations	968	743	4,940	5,472	968	743	4,946	5,476	968	744	4,947	5,480
Log Likelihood	ï 666.02	ï 754.98	ï 3,281.6	ï 5,381.7	ï 358.58	ï 662.31	ï 2,222.3	ï 4,496.3	ï 1,1895	ï 935.31	ï 5,743.7	ï 6,564.8

Note: Random intercepts are applied. Parentheses are robust standard errors. * $p < .10$, ** $p < .05$, *** $p < .00$

Appendix A. Survey Questions

A.1. Dependent Variables

- Competition in a math contest

  How often do you participate in math competition? (always, often, sometimes, or never/rarely)

- Participation in a math club

  How often do you participate in a math club? (always, often, sometimes, or never/rarely)

- The index of instrumental motivation in math-related career

  How much do you agree that math (is):

  (i) Worthwhile for work

  (ii) Worthwhile for career chances

  (iii) Important for future study

  (iv) Helps to get a job

  (strongly agree, agree, disagree, or strongly disagree)

A.2. Explanatory Variables

- The index of student-teacher relationship (evaluated by students)

  How much do you agree that:

  (i) You get along with teachers

  (ii) Teachers are interested

  (iii) Teachers listen to students

  (iv) Teachers help students

  (v) Teachers treat students fairly

  (strongly agree, agree, disagree, or strongly disagree)

- The index of teachersô morale (evaluated by school heads)

  Think about the teachers in your school. How much do you agree with the following statements?

(i) The morale of teachers in this school is high.

(ii) Teachers work with enthusiasm.

(iii) Teachers take pride in this school.

(iv) Teachers value academic achievement.

(strongly agree, agree, disagree, or strongly disagree)

- The index of self-concept in math (confidence)

  How much do you agree that you (are):

  (i) Not good at math

  (ii) Get a good grade in math

  (iii) Learn math quickly

  (iv) Find math to be one of the best subjects

  (v) Understand difficult mathematics

  (strongly agree, agree, disagree, or strongly disagree)

- Math anxiety (evaluation aversion)

  How much do you agree that you worry about getting poor grades in math?

  (strongly agree, agree, disagree, or strongly disagree)