Choosing To Compete: The Role Of Single-Sex Education*

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Recent economic experiments investigate if gender gaps in competitive behaviour can be explained by differences in feedback preferences, liking for competition, or risk aversion. These studies have been largely conducted with subjects attending co-educational universities. With the exception of Gneezy, Leonard and List (2008), economists have not yet tested if male inclination and female disinclination for competition could be due to nurturing. Yet the fact that girls' and boys' academic achievements differ across coeducational and single-sex environments suggests that nurture might matter. We therefore chose, for our laboratory experiment, year 10 and 11 students attending single-sex or coeducational schools. We find robust differences between the competitive choices of girls from single-sex and coed schools. Moreover, girls from single-sex schools behave more like coed boys even when randomly assigned to mixed-sex groups in the experiment. This suggests that observed gender differences might reflect social learning rather than inherent gender traits.

Keywords: tournament, piece-rate, gender, experiment, competitive behaviour

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I. Introduction

Women have been catching up to men in the workplace since the 1980s. The gender wage gap has not disappeared, though. Women still lag behind men in average pay and with regard to opportunities for advancement.[1] Commonly cited reasons for these differences are discrimination or claims that women, more than men, are sensitive to work-family conflicts and more inclined to make career sacrifices.[2] However, obtaining promotion and pay raises often involves competition, and it may be that women do not like to compete. If women do not like competition but men do, there will be two effects. First, fewer women will choose a competitive environment such as a tournament, and second there will be fewer women winning the tournament. Recent experimental evidence has found that, when given the choice of whether or not to enter tournaments, women 'shy away from competition' while men may choose to compete too much (e.g. Gupta, Poulsen, and Villeval (2005); Niederle and Vesterlund (2007)).[3] Understanding why women seem less inclined than men to compete may provide insight into why a gender gap still exists in the workplace and what type of policies might address this gap.

Innate differences are one obvious factor that might explain the gender competition-gap.[4] While nature might well be important in shaping competitive behaviour, the culture or environment in which an individual is raised might blunten or heighten gender disparities. For example, even if boys are more athletic than girls, hearing boys taunt one another with claims of 'throw-

1. A study by Bertrand and Hallock (2001) found that women in top corporate jobs earn about 5% less than their male counterparts and only represented 2.5% of high-level executives of large US firms from 1992-1997.

2. See for example Albrecht, Bjorklund and Vroman (2003), Blau and Kahn (2004), and Arulampalam, Booth and Bryan (2007).

3. Eckel and Grossman (2002) provide a summary of gender differences in much of the experimental literature and Eckel and Grossman (2008) focuses on the risk and gender.

4. Refer to Lawrence (2006) or Summers (2005) for discussions of the role innate differences may play. Barres (2006), on the other hand, aims to explain what is wrong with the nature hypothesis.

ing like a girl' may discourage athletically talented girls from participating in sports that involve throwing, increasing the differences that existed because of innate differences. Likewise, if girls are naturally more talented with the written word, requiring boys to read and prepare book reports may dampen any gap that existed. Psychologists have shown that framing of tasks and cultural stereotypes do affect the performance of individuals.[5] Therefore, even if innate differences do exist with regard to competition, the environment may still be a major factor contributing to observed differences. The role of nurture – environment, culture or upbringing – may therefore be central to explaining why men and women differ in their choices of whether or not to enter tournaments.[6]

In this paper we examine the role that nurture plays in explaining the stylized fact discussed above: that women shy away from competing. We do this by studying the choices made by girls from single-sex and coeducational schools when they are given the opportunity to enter a tournament in a controlled experiment. While we use a different subject pool to that utilised in the literature, we follow a similar methodology by observing subjects' behaviour in response to different compensation schemes. But we also augment that approach in several crucial respects, as will be described below.

It is often argued that girls benefit from single-sex education, in part by achieving higher scores on standardized exams.[7] Gneezy, Leonard and List (2008) look at a matrilineal and a patriarchal society and find that women from

5. See Steele, Spencer, and Aronson (2002) for a summary of the stereotype threat literature and the role of stereotype threat in performance.

6. Gneezy, Niederle and Rustichini (2003), using a subject pool of coed engineering students, find a significant gender gap in performance when compensation is tournament-based but not when it is piece-rate. This difference across groups might be due to stereotype threats (Steele, 1997), since being in a mixed group heightens subjects' awareness of gender and prompts them to behave in accordance with their gender stereotype. That subjects' behaviour alters in response to such prompts also suggests that environment matters - even an environment in which the subjects have been placed for such a short time. One goal of the present paper is to see if environments in which individuals have been placed for far longer - typically 4-5 years - counteracts this.

7. See Campbell and Sanders (2002) for an overview of the empirical studies on single-sex education and its effect on girls.

the matrilineal society choose to compete as much as men from the patriarchal society.[8] They interpret this as evidence that culture has an influence. We too use a controlled experiment to see if there are gender differences in the behaviour of subjects from two distinct environments or 'cultures'. But our environments - publicly-funded single-sex and coeducational schools - are closer to one another than those in Gneezy et al (2008) and it seems unlikely that there is much evolutionary distance between our subjects. Any observed gender differences in behaviour across these two distinct environments is more likely to be due to the nurturing received from parents, teachers or peers than to nature. Given this, we expect that girls from single-sex schools will chose to compete more than girls from coed schools.

The rest of this paper is divided into five parts. In section two we discuss possible conjectures for why women and men might differ with regard to competition. In section three we describe the pool from which our sample was drawn and the design of the experiment. The results are discussed in sections four and five, and at the end of section five we relate our findings to the existing literature. In section six we summarize the main results and conclude the paper.

II. Conjectures

In this section we outline five specific conjectures that may explain why women choose to compete less than men. In our experiment we use a tournament pay setting as our competitive environment.

8. Gneezy et al. investigated two distinct societies - the Maasai tribe of Tanzania and the Khasi tribe in India. The former are patriarchal while the latter are matrilineal. In the patriarchal society, women are less competitive than men, a result that is consistent with the findings of studies using data from Western cultures. But in the matrilineal society, women are more competitive. Indeed, the Khasi women were as competitive as Maasai men.

II.A. Choosing To Compete

Conjecture 1. Men choose to enter the tournament more than women.

If men, on average, prefer to compete more than women, this could explain why women appear to be shying away from competition. Men may choose the tournament because they receive utility from being able to compete against others. This difference in preferences for competition could come from innate differences in men and women or in how men and women are raised. If this conjecture is correct, and women do prefer not to compete as much as men, then women from single-sex and coeducational schools should not differ when it comes to choosing whether or not to compete. They should both choose to enter the tournament less than boys. Furthermore, we would also expect than men, independent of their school background, would choose to enter the tournament in roughly the same proportion.

Conjecture 2. Gender differences in tournament entry are sensitive to experimental peer-groups.

Women may like competing in general but they may not enjoy competing against men. If this is the case, they may choose not to enter a tournament involving competition against men. This preference may or may not be innate. For example, sports leagues are usually single-sex or made up of single-sex teams. Therefore, when women do compete, at least with regards to sports, it is generally against individuals of their own gender. If this conjecture is correct, women segregated into all-girl groups should choose to enter the tournament more than when they are competing against boys. With this in mind we will examine if a woman's decision to enter a tournament depends on the gender of those against whom she is competing.

We expect that girls in an all-girls group will choose to enter the tournament more than girls in a mixed gender group. Gneezy, Niederle, and Rustichini (2003) looked at group composition and performance and found that girls do not perform as well in tournaments when boys are present. We will investigate if having boys present affects the choices made by girls of whether or not to compete after controling for ability and background.

Conjecture 3. Gender differences in tournament entry are explained by differences in risk aversion.

Entering a tournament involves payoff uncertainty. Gender differences in risk aversion may explain why women choose to enter tournaments less than men. For example, if women are more risk-averse than men, they may choose not to compete because they prefer a payment with certainty to the uncertain payoff from a tournament. To look at this conjecture, we had participants complete an exit survey that asked questions about risk-attitudes. We will examine if boys and girls differ in their responses and if those differences explain any gender gaps in competitive behaviour.

Conjecture 4. Gender differences in overconfidence are sensitive to school-level nurturing.

When looking at the volume of trades made by men and women, Barber and Odean (2001) found that men traded more than women. This is consistent with men being more confident with their predictions of stock movements than women. If men are overconfident, they will choose to enter the tournament more than they should suggesting that women are not shying away from competition but that men are choosing to compete too much. Niederle and Vesterlund (2007) found that college aged men were more over-confident in their choice to enter the tournament. Using our environmental controls - single-sex education and being in an all-girls group - we will examine if our sample of teenagers show signs of overconfidence and look at how men and women change their performance on the margin. This will allow us to see if 'overconfidence' is being driven by environmental fators or is indeed innate to men.

Conjecture 5. Gender differences in tournament entry may be because they are discouraged from competing.

Women may be discouraged from competing in everyday situations. For example, a woman may be told that she is behaving in an 'unladylike' way when she shows any sign of competition; she may even be expected to be a coalition builder instead, as discussed in Babcock and Laschever (2003). If this is the case, a woman who is given the opportunity to enter a tournament may choose not to, because she is discouraged from competing every day. This conjecture relies heavily on a nurturing story – it is the environment in which a woman is raised that causes her not to choose the tournament. *Ceteris paribus*, given the different educational cultures of single-sex and coeducational schools, we would therefore expect girls educated in single-sex schools to enter the tournament more than their coeducational counterparts.

III. Experimental Design

Our experiment is designed to test between the five conjectures listed above. We are particularly interested in looking at conjecture five and in examining the extent to which nurture might explain observed gender gaps in competitive choices. To examine the role of nurturing, we recruited as subjects students from coeducational and single-sex schools.[9] We also designed an 'exit' survey to elicit information about family background characteristics. At no stage were the

9. In the terminology of Harrison and List (2004) our experiment would be called an artefactual field experiment.

schools we selected, or the subjects who volunteered, told why they were chosen. Our subject pool is unusually large for a controlled, laboratory-type experiment. We wished to have a large number of subjects from a variety of educational backgrounds in order to be able to investigate the conjectures outlined above.

Below we first discuss the educational environment from which our subjects were drawn, and then the experiment itself.

III.A. Subjects and Educational Environment

In September 2007, 328 students from eight publicly-funded schools in the counties of Essex and Suffolk in the UK were bused to the Colchester campus of the University of Essex to participate in the experiment. Four of the schools were single-sex.[10] The students were from year 10 or 11. On arrival, students from each school were randomly assigned into groups of four. Groups were of three types: all-girls; all-boys; or mixed. Mixed groups had at least one student of each gender and the modal group comprised two boys and two girls. The composition of each group - the appropriate mix of single-sex schools, coeducational schools and gender - was determined beforehand. Thus only the assignment of girls or boys from a particular school to a group was random. Due to absences, 14 of the 87 groups were of size three and 2 were of size two.[11] The school mix was two coeducational schools from Suffolk (115 students), two coeducational schools from Essex (77 students), two all-girl schools from Essex (81 students), and two all-boy schools from Essex (54 students).

10. A pilot was conducted several months earlier, in June at the end of the previous school year. The point of the pilot was to determine the appropriate level of difficulty and duration of the actual experiment. The pilot used a different subject pool to that used in the real experiment. It comprised students from two schools (one single-sex in Essex and one coeducational in Suffolk) who had recently completed year 11. The actual experiment conducted some months later, at the start of the new school year, used, as subjects, students who had just started years 10 or 11.

11. See Tables 1 and 2 for average group size. There were 32 all-girl groups (comprising 121 girls), 15 all-boy groups (comprising 54 boys) and 40 mixed groups. Two of the 32 all-girl groups had only two girls in them, three had three girls, and the remainder four girls.

[Insert Table 1 – Summary statistics overall and by gender]

In Suffolk county there are no single-sex publicly-funded schools. In Essex county the old "grammar" schools remain, owing to a quirk of political history.[12] These grammar schools are single-sex and, like the coeducational schools, are publicly funded. It is highly unlikely that students themselves actively choose to go to the single-sex schools. Instead Essex primary-school teachers, with parental consent, choose the more able children to sit for the Essex-wide exam for entry into grammar schools.[13] Parents must be resident in Essex for their children to be eligible to sit the entrance exam (the 11+ exam). It is possible that more informed or more competitive Essex parents may persuade their children to sit for the 11+ and indeed may coach their children for the 11+. Sitting for the 11+ is more likely to reflect the ambition or pushiness of the parents and teachers rather than that of the children. Therefore students at the single-sex schools are not a random subset of the students in Essex, since they are selected based on measurable ability at age 11 as well as "parental pushiness".[14] Our controls for parental education - obtained from the exit questionnaire -may pick up unobservable "parental pushiness", which is part of the nurturing environment. We also control for ability in our analysis, as will be described below. Moreover, we asked our participating coeducational schools from both Essex and

12. In the UK, schools are controlled by local area authorities but frequently "directed" by central government. Following the 1944 Education Act, grammar schools became part of the central government's tripatrtite system of grammar, secondary modern and technical schools (the latter never got off the ground). By the mid-1960s, the central Labour government put pressure on local authorities to establish "comprehensive" schools in their place. Across England and Wales, grammar schools survived in some areas (typically those with long-standing Conservative boroughs) but were abolished in most others. In some counties the grammar schools left the state system altogether and became independent schools; these are not part of our study. However, in parts of Essex, single-sex grammar schools survive as publicly-funded entities, while in Suffolk they no longer exist.

13. If a student achieves a high enough score on the exam, s/he can attend one of the 12 schools in the Consortium of Selective Schools in Essex (CSSE). The vast majority of these are single-sex. The four single-sex schools in our experiment are part of the CSSE.

14. Examples of parental unobservables likely to determine whether or not children are encouraged to sit for the 11+ include parental ambition, parental heterogeneity in discount rates, social custom factors, or lack of information about potential benefits of education.

Suffolk to provide students only from the higher-ability academic stream so that they would be more comparable to the grammar school students.[15] There are no grammar schools in Suffolk. We will perform a series of robustness checks to control for possible differences between students from co-ed and single-sex schools after we examine different choices made by students.

The experiment took place in a large auditorium with 1,000 seats. Students in the same group were seated in a row with an empty seat between each person. It was easy for subjects to see which other students were in the same group. If two students from the same school were assigned to a group, they were forced to sit as far apart as possible; for example, in a group of four, two other students would sit between the students from the same school. There was one supervisor, a graduate student, assigned to supervise every five groups. Once the experiment began, students were told not to talk. Each supervisor enforced this rule and also answered individual questions. Consequently, during the experiment there was very little talking within or between groups.

III.B. Experiment

At the start of the experiment, students were told that they would be performing a number of tasks, and that one of these would be randomly chosen for payment at the end of the experiment.[16] Each task involved students solving as many of 15 mazes as possible in five minutes.[17] Before the first

15. To compare students of roughly the same ability we recruited students from the top part of the distribution in the two coeducational schools in Essex: only students in the academic streams were asked to participate. Students from Suffolk do not have the option to take the 11+ exam and therefore higher ability students are unlikely to be selected out of Suffolk schools in the same way as in Essex. Nonetheless we only recruited students from the academic streams in the Suffolk as well.

16. Payment was randomized in the same manner as in Gupta, Poulsen, and Villeval (2005) and Niederle and Vesterlund (2007). Since the round students are paid for is randomly selected at the end of the experiment, they should maximize their payoff in each round in order to maximize their payment overall. Moreover, as only one round was selected for payment, students did not have the opportunity to hedge across tasks.

17. Mazes were of the type that can be found at http://games.yahoo.com/games/maze.html. The difficulty was the easiest of the "Easy to Hard" scale found at the bottom right hand side

task was explained, students were shown a practice maze, given instructions on how to solve it, and allowed to ask any questions. Immediately before each round, students were told the nature of the task to be carried out and the payment for that round. At this stage, students were permitted to ask questions of clarification about that round. At no stage were students told how they performed relative to others in their group. The specific payment mechanisms are explained below, in the order in which the rounds occurred. No student was able to solve all 15 mazes in the time allotted.

The first three rounds of the experiment follow closely those of Niederle and Vesterland (2007). We wished to use a well-tested experimental strategy to investigate a new conjecture - that nurturing, in either single-sex or coeducational environments, may affect women's propensity to compete. In contrast, Niederle and Vesterland (2007) used the coeducational subject pool of the Pittsburgh Experimental Economics Laboratory at the University of Pittsburgh. Their tasks involved the addition of numbers whereas ours involve completing paper mazes.

Round 1: Piece Rate. Students were told they would each receive £0.50 for each maze solved correctly if this round was randomly selected for payment.

The results will be used to chart are any gender gaps in maze-solving and to provide controls for ability in later rounds.

Round 2: Tournament. Students were told to solve as many mazes as possible and that, if this round was randomly selected for payment, the group-winner would receive £2 for each maze solved correctly and the other members zero. (If there were only three people in the group she would get £1.50 - and if only two people in the group £1 - per correct maze.)

on the webpage.

This round will show how women and men perform in a competitive environment when they are *required* to participate. It provides a measure of performance in a tournament-setting that is free from selection effects.

Round 3: Choice of Tournament or Piece Rate. Students were told to choose either Option One or Option Two, and that payment would depend on which option they chose if this round was randomly selected for payment. If a student were to choose Option One, she would get £0.50 per maze solved correctly. If she chose Option Two, she would get £2 per maze solved correctly *IF* she solved more mazes correctly than anyone else in her group did the *previous* round and zero otherwise.[18]

This round will indicate if men and women have different preferences for competing. Competing against other group-members' *previous* round tournament scores removes the strategic element of trying to figure out choices other group-members might be making in this round. It also ensures that students do not have to consider any externalities their current decisions might impose on other group-members.

Round 4: Lowest Performer. Each student was told to solve as many mazes as possible. If this round was randomly selected for payment, they would each be paid the same: £0.50 per maze correctly solved by the *lowest-performing* person.[19]

This round is designed to reveal how, on the margin, students view themselves in the distribution. A student who is confident that she is a high performer will have a lower incentive to solve as many mazes as before,

18. Again, if there were only three people in the group she would get £1.50 and if there were only two people in the group she would get £1 per maze solved correctly.

19. In a subsequent round we also asked students to choose a lottery and we analyse the results from this in a working paper at http://privatewww.essex.ac.uk/~pjnolen/risk.pdf. Copies are also available from the authors upon request.

because she will not be paid for any mazes she solves over and above the number solved by the worst performer.

Exit Questionnaire. At the end, students completed an exit questionnaire before being paid (both the show-up fee of £5 plus any payment from performance in the randomly selected round). This questionnaire asked about family background, parents, any siblings, residential postcode and risk-attitudes.

[Table 2 – Summary Statistics by Group and School Type]

Table two contains summary statistics by both group and school type for girls. There are some significant differences between girls from coeducational and single-sex schools. The parents of girls at single-sex schools are more likely to have gone to university, suggesting "parental pushiness" may be at play, to the extent that educated parents may be more likely to push their daughters into grammar schools. (Alternatively, better educated parents might give their children a head-start in skills acquisition, facilitating better performance in the 11+.) Moreover, an educated parent could affect a daughter's propensity to compete. For example, educated parents might be more competitive, or enjoy competition more, and encourage their children to compete in more events or tasks than would parents without a university degree. The gender make-up of siblings may also affect an individual's competitiveness. If males are more competitive than females, having more brothers may cause a girl to feel more at home in a competitive environment. It is interesting that girls at single-sex schools have fewer sisters than girls at coeducational schools, and fewer siblings in general. Since we are aiming to compare girls from single-sex and coeducational schools who are roughly the same, we will control for these factors in the empirical analysis below. Finally, a comparison of mixed gender and all-girl groups reveals that girls in all-girls groups are older than girls in the mixed gender groups. Because of this, we also control for the age of students when we run the regressions below.

IV. Piece-Rate and Tournament

In the first round of the experiment, students were told that they would be paid a piece-rate of 50 pence per correct maze solved.[20] The first three columns in table three show the OLS regressions for the piece-rate round. On average, students solved 2.87 mazes correctly. Column [1] shows that women solve roughly half a maze less than boys. The coefficient on female does not change significantly when we add in controls for parental background, the age of the student and siblings, and allow those effects to vary by gender, as shown in column [2] – girls still solve fewer mazes than boys. Column [3] allows comparisons of students from single-sex and coed schools and students in all-girl, all-boy and mixed gender groups. When controlling for educational background and group composition, there is no longer a gender gap in performance; the coefficient on female is insignificant. However, students from single-sex schools solve 0.49 mazes more than students from coed schools.

[Table 3 – Basic Regressions]

The next round of the experiment was the mandatory tournament. The information from this round will be used in our subsequent analysis. Each student was again given 5 minutes to solve up to 15 mazes but now compensation was tournament-based: the student in the group who solved the most mazes correctly would receive £2 while other group members would receive nothing. The change in performance following a shift from piece-rate to tournament might be affected by a number of factors, including ability, learning, and competition.

20. Mazes that the students completed were double-blind marked as is standard in UK universities.

The larger payment given to the winner gives students an incentive to work harder; they get four times as much for each maze they solve correctly if they win. The last three columns of table three show how a student changed behavior in the tournament compared with the piece-rate setting. Columns [4]-[6] present the regression results for a student's tournament score (the number of mazes solved in the second round) minus her/his piece-rate score (the number of mazes solved in the first round).

In all cases, girls from either type of school did not increase their performance as much as boys. There were no environmental gaps for girls in performance improvement. Single-sex or coed distinctions (school-background or experiment group) did not matter. Girls increased their performance in the tournament setting by 0.65 mazes less than boys.[21] Interestingly, having fewer sisters is correlated with an improvement in performance for boys. Also, students solving a large number of mazes in the first round were not able to increase their performance as much as students solving fewer mazes during the first round.

The results of these first two rounds – the tournament score and the increase in performance from the piece-rate to tournament setting – will be used to control for ability and learning when examining a student's choice about whether or not to enter a tournament in round three. However round two is important for another reason: it provides students with information about how they perform in a tournament setting. Therefore, when *choosing* to compete in round three, the student knows her ability, how she performs under pressure, and has had experience in the competitive environment. Hence she should be able to make an informed decision on whether or not to enter the tournament.

21. This contrasts with Gneezy et al. (2003), who found a significant gender gap in performance when compensation is tournament-based but not when it is piece-rate. (Their subject pool was coed students enrolled for an engineering degree in Israel.) They also found that the gender-gap was stronger when looking within mixed groups than when comparing scores between single-sex groups. This is not the case for our experiment.

IV...1 The Probability of Winning Round Two

Table two showed that the average number of mazes solved by single-sex schoolgirls in the piece-rate round was 2.58 while for coed schoolgirls it was 2.16, and the difference was statistically significant. The scores for the mandatory tournament, round two, were 4.2 and 3.93 for single-sex and coed schoolgirls respectively and the difference was not statistically significant. Table one shows that these scores are lower for girls than boys. Because of these gender differences in the probability of winning, we might expect girls and boys to make different competitive choices. Moreover, the probability of winning will differ depending on the group to which they were assigned. Of course subjects do not know how they compare with others in their group because they are never told this. But they will have beliefs about this, beliefs that are likely to be shaped by their performance in the piece-rate and mandatory tournament as well as by their backgrounds. Hence it is important to control for background factors and for previous performance when estimating the tournament choice in round three.

To assess the probability of winning round two, we randomly created four-person groups from the observed performance distribution for round two. Conditioning on gender and group (single-sex or mixed), the win probability is 25% for girls and boys assigned to same-gender groups but in mixed groups it is 35% for boys and 15% for girls.[22] Therefore, if girls and boys know the performance distribution of the mandatory tournament (and they do not), they should choose to enter the tournament in round three at the same rate if they are in same-gender groups. However in mixed groups boys should choose the

22. For each group type (all girls, all boys, or half each) we randomly drew 10,000 groups comprising that mix, where we sampled with replacement. The frequency of winning is computed from this. The whole procedure was repeated 100 times. The average of these win frequencies is reported for each group in the text. For the win probabilities conditional on number of mazes solved correctly, to be discussed below, the same procedure was followed.

tournament more than girls.

Now consider the win probability conditional on performance in the mandatory tournament. For boys solving 5 mazes in same-gender groups, the probability of winning is 12% while for girls it is 39%. For those who solved 6 mazes, it increases to 45% for boys and 76% for girls. Next we calculated the probability of winning conditional on performance for the mixed groups. For boys solving 5 mazes in round 2 it is 26% while it is 19% for girls. But for people solving 6 mazes the probability of winning jumps to 63% for boys and 54% for girls.

When looking at the decision to enter the tournament or not in round three a risk neutral student should choose to enter the tournament if her probability of winning, $p(win)$, is greater than 25%. That is $0.5*x < 2*x*p(win) \Longrightarrow 0.25 < p(win)$ where x is the number of mazes solved correctly. Given the probabilities of winning in a mixed gender group, both girls and boys who solved 5 mazes or less correctly should take the piece-rate option (assuming that there is some risk aversion for boys) and both boys and girls should chose to enter the tournament if they solved six or more mazes correctly. However 23% of girls and 51% of boys who solved 5 or less mazes correctly chose to enter the tournament. Therefore a large percent of students are either risk loving or other factors are affecting a student's choice to enter the tournament.

V. Choosing To Compete

Next we examine a student's choice of whether or not to enter a tournament. First we will see if girls from coed and single-sex schools differ in their propensity to chose competition. Then we will compare girls to boys from coed and single-sex schools: our goal here is to see if a single-sex girl makes different choices to those made by boys of the same ability. Finally, we will relate our findings to the five conjectures discussed earlier.

V.A. Differences Between Girls

At the beginning of the third round, students were given a choice between two options, a piece-rate or a tournament. Option one, the piece-rate, involved receiving £0.50 per maze solved correctly in the third round. The second option was to enter a tournament and receive £2 per correct maze if she scored higher than everyone else in the group in round two and zero otherwise.[23] As noted above, having the subjects compete against predetermined scores, as in Niederle and Vesterlund (2007), helps to isolate their choice and minimize the chance that strategic games are being played. A student should choose option two if she thinks she can do better than everyone else in her group did last time. Her choice should therefore be unaffected by concerns about other students' choices in the current round. Moreover, because her performance this round will not affect anyone else's payoff, she will not worry about externalities, for instance causing someone else to lose if she chooses the tournament. We say that a student chooses to compete if she chooses option two.

We initially examine females alone, in order to focus more clearly on differences in behaviour across girls from different educational backgrounds. We estimated probit models on the subsample of females, where the dependent variable takes the value one if the student choose option two and zero otherwise. Columns [1] - [6] of table four present the marginal effects calculated at the variable average. Column [1] shows how much of the decision can be explained by a girl's performance in the round two tournament and the increase in her performance from the piece-rate to the tournament setting. A girl who solved more mazes correctly in the round two tournament is 11 percent more likely

23. If there was a tie then the winner was chosen at random. Payments were adjusted acording to the size of the group: if there were only 3 students in the group the winner would receive £1.50 per correct maze; if there were only 2 students in the group the winner would only recieve £1 per correct maze.

to enter the tournament in round three.[24] How one functioned in a tournament relative to a piece-rate setting, as represented by the tournament score minus the piece rate score, is insignificant. Column [2] adds controls for family background and age. None of these is statistically significant.

Column [3] includes our main variables of interest: attendance at a single-sex school and whether or not the girl was randomly assigned to an all-girl group. *Ceteris paribus,* a girl who attends a single-sex school is 30 percent more likely to choose to enter the tournament than a girl from a coed school. This is after controlling for ability, learning, family-background, and age. Given that the gender gap in choosing whether or not to compete was roughly of that magintude in Niederle and Vesterlund (2007) and Gneezy, Leonard and List (2008), it would seem that a single-sex educational background has the potential to change the way women view tournaments.

To look further at the role of nurture, we now consider the all-girl group coefficient. Since girls were randomly assigned to groups, this 'environment' variable was controlled by us and allows us to see if the environment a girl has been in for less than 20 minutes affects her decision. As the coefficient shows, a girl in an all-girls group is 15 percent more likely to choose to enter the tournament, roughly half the difference that exists between single-sex and coed girls.

These two factors suggest that the environment in which a girl is placed affects whether or not she chooses to compete. However, before pushing this interpretation too far, we first need to examine the robustness of the results and to explore other possible explanations.

We begin by dividing the sample into different subgroups. The regression results in columns [4] and [5] compare single-sex girls to various subsets of our

24. The marginal effect was calculated for a girl who had solved 4 mazes correctly in round two – the average number of mazes solved correctly by girls in that round.

sample. In column [4], we report marginal effects from a specification estimated on a subsample comprising female students from single-sex schools in Essex and from coed schools in Suffolk. Since Suffolk does not have selective grammar schools, students in that county attend the school in whose catchment area they live. In this regression, the single-sex and all-girls coefficients are again significant and the coefficient to single-sex schooling increases by five percentage points to 34%. Column [5] estimates are from a slightly larger subsample, comprising girls from single-sex schools in Essex, girls from Suffolk, and girls who took the 11+ exam and live in Essex. If we assume that pushy parents encourage their child to take the exam and raise her to be more competitive, then those Essex girls who sat the exam should be more ex ante similar to those Essex girls attending the single-sex schools than the Essex girls who did not sit the exam. The results reported in column [5] show that the coefficients are significant and of similar magnitude to those in column [1]. Therefore selection issues do not appear to be affecting our results.

Next we check the robustness of the all-girls coefficient. When choosing whether or not to compete, a girl's decision could be influenced by the composition of her group, as found in Gneezy et al. (2003). For example, if a female chooses to compete more in an all-girls group, perhaps it is because she believes she has a better chance of beating a girl's score rather than a boy's score.[25] If that is the case, the all-girls group dummy may be picking up this effect. To examine this, we add an extra control to the column [3] specification. This is a dummy variable that equals one if a mixed-gender group has 50% or more boys in it; the base group is therefore groups with fewer than 50% boys

25. It could also be that girls are genetically or culturally programmed to defer to men in order to get a mate. For the same reason, they might compete more with women. That such deference has altered dramatically in the course of the 20th century suggests conditioning rather than genetics. Moreover, individuals' competitive behaviour is not observed here - none of the other group members knows what choices are being made although they will have beliefs about their behaviour as noted in the text.

(and which therefore comprises only one male in the typical four-student group). The results are reported in column [6]. If girls are choosing to compete more in the all-girls group because there are no boys present, we would expect the new coefficient to be negative and the significance of the coefficient on the all-girl dummy variable to decrease. That neither of these effects is found suggests that the estimated coefficient to all-girls group is unlikely to be due simply to group composition.

We report estimates of the LPM in column [7]. The LPM coefficients on single-sex education and being in an all-girls group are roughly the same as the marginal effects in the probit regressions.[26] Finally, column [8] in table four reports the results from an additional test of the robustness of the single-sex finding: the use of an instrument for single-sex school attendance. This is potentially endogenous: parental pushiness and single-sex school attendance might be positively correlated. We therefore want an instrument that is correlated with single-sex schooling but uncorrelated with the probability that a student will choose a tournament. We utilize instruments based on the student's residential postcode. Travel-to-school time is a good measure of the cost to a family of attending a particular school. The further away a student lives, the earlier she has to get up in the morning and the more parental traveling is involved in ferrying children to extra-curricular activities. There are far fewer single-sex schools in Essex than there are coed schools, and hence on average children attending Essex single-sex schools live further away. (Suffolk-based children cannot attend state-funded single-sex schools at all.) Living further away from a school is likely to be associated with a greater cost of attendance.

With this in mind, we used the six-digit residential postcode for each student

26. To examine further the role of group composition, we estimated a LPM specification with a fixed-effect for each group. It is interesting that the single-sex coefficient stayed roughly the same, suggesting that group compositional effects are not affecting the single-sex coefficient much. Moreover the fixed-effects are not statistically significant, either individually or jointly, suggesting that the experiment was appropriately controlled.

to calculate the distances to the nearest single-sex school and to the nearest coed school. (Our sample size shrinks slightly, as some postcode responses were unreadable.) From this, we imputed the minimum traveling time to the closest coeducational school and to the closest single-sex school.[27] We next calculated a variable equal to the minimum time needed to travel to the closest single-sex school minus the minimum time to travel to the closest coeducational school. The means of these variables are reported in tables one and two for various groups. We then break this variable into deciles creating 10 dummy variables. For example, if the difference in travelling time for a student fell in the first decile, that student would be assigned a one for the first dummy variable and a zero for all others. Using these 10 variables, we instrumented for attendance at a single-sex school using a two-step process. First, we estimated the probability of a student attending a single-sex school, where the explanatory variables were an Essex dummy (taking the value one if the student resides in Essex and zero otherwise) and an interaction of Essex-resident with the 10 travelling-time variables. We then estimated the regression reported in column [9], where we use predicted single-sex school attendance in place of the original single-sex school dummy. Since the equation uses predicted values, we bootstrapped the standard errors for attending a single-sex school.[28] Again, the coefficient to single-sex schooling is statistically significant although now slightly smaller in magnitude.[29]

27. To calculate this, we used the postcode of each school and the postcode in which a student resides. We then entered the student's postcode in the "start" category in MapQuest.co.uk (http://www.mapquest.co.uk/mq/directions/mapbydirection.do) and the school's postcode in the "ending address." Mapquest then gave us a "total estimated. time" for driving from one location to the other. It is this value that we used. Thus the "average time" is based on the speed limit of roads and the road's classification (i.e. as a motorway or route).

28. We randomly drew 1,000 different samples from our experimental data to calculate the bootstrap results.

29. We also experimented with using a different instrument - a set of dummy variables for students' residential postcode. The results were no different to those reported above, so in the interests of brevity we do not report this in the table. The estimates are available from the authors on request.

V.B. Differences between Girls and Boys

Our results from subsection V.A suggest that, *ceteris paribus*, girls from single-sex schools are much more likely to choose the tournament than their coed counterparts. This result is robust to a number of different estimation methods and lends support to the view that school-level nurturing significantly affects girls' choices. We next investigate how these girls compare to boys. In subsection V.C we shall relate our overall findings to the conjectures raised in Section 2.

The regression results reported in table five are obtained from the sample of boys and girls, and from different subsets of the full sample, as described in the note under the table.

[Table 5 - Whole Sample]

Column [1] of table five reports a specification including only the gender dummy. It shows that girls choose to enter the tournament less than boys. This result is similar in size and significance to the results obtained by Niederle and Vesterlund (2007) and Gneezy, Leonard and List (2008). Column [2] reports estimates from a specification in which we also control for previous-round performance, family background, age, and interactions with gender. The inclusion of these variables does not diminish the size or significance of the marginal gender effect. The size of the marginal gender effect increases considerably: a coed girl who solved 4 mazes correctly in the round two tournament is roughly 50 percent less likely to choose to enter the round three tournament than a boy who solved 4 mazes correctly. This is a much larger effect than that found in other work, perhaps because we are not using adults or college-aged students. These remarkable differences suggest that, even after controlling for ability as measured by previous round performance, there is a large gender gap in choosing to enter the tournament. However, observe from column [3] that girls from single-sex schools are just as likely to enter the tournament as boys from coed schools (the base): when summing the female and single-sex coefficients together, we find that girls from single-sex schools enter the tournament just as much as coed boys. Therefore the educational background is having some effect on a girl's decision to compete. A boy at a single-sex school is 37 percent more likely to enter the tournament than his coed counterparts.

We shall discuss also discuss some of the specifications reported in table five in the next subsection, which relates our findings to the conjectures. Before turning to these, we report in columns [7]-[8] the coefficients from a linear probability model estimated on the full sample of girls and boys. Our goal is to examine further the effect of single-sex education following the same approach used in the previous subsection. Column [7] presents the baseline LPM estimates with no fixed effects. The estimates are not that different to those from the probit estimation.[30]

Column [8] reports the results from an additional test of the robustness of the single-sex finding: the use of an instrument for attendance at a single-sex school. Again we used relative travel-to-school time and followed the two-step approach described in detail in the previous subsection. We use predicted single-sex school attendance and the interaction of female with predicted single-sex school attendance in place of the original single-sex school dummy and its interaction with female. The standard errors for going to a single-sex school and the interaction between female and going to a single-sex school are bootstrapped. Again, the single-sex coefficient is statistically significant and of similar magnitude to the other specifications.[31]

30. When we added group fixed-effects - not reported - we again found that single-sex education is associated with a significantly higher probability of entering the tournament. However the fixed-effects are not statistically significant, either individually or jointly.

31. We also experimented with using a set of dummy variables for students' residential postcodes. Since the results were no different to those reported above, we do not report this in the table but the estimates are available on request.

V.C. Teasing Apart Explanations

We next relate our findings to the conjectures raised in Section 2.

First Conjecture

Conjecture one, that men choose to enter the tournament more than women, is less of a nurture story than the fourth conjecture. If men choose to compete only because of the enjoyment they get from competition, then environmental factors – such as single-sex schooling or the all-boys group set-up – should should not be significant in the regressions presented in table five. If environmental factors do affect a male's choice of whether or not to compete, he must be taking something other then 'enjoyment from competition' into account. For example, if he chooses to compete less when in an all-boys group, this could imply he is thinking strategically and believes he has less of a chance of winning than when competing against girls. Therefore it is not a drive to 'compete' *per se* that is causing him to choose to enter the tournament but a strategic choice based on his probability of winning as well.

Inspection of column [3] in table five reveals that the positive single-sex school coefficient and the negative all-boys group coefficient are statistically significant. This suggests that boys are varying their choices based on some environmental factors. The specifications reported in columns [4]-[6] of table 5 provide robustness checks for the single-sex and all-boys coefficients. Column [4] compares boys from single-sex schools in Essex to their counterparts in Suffolk where there are no selective grammar schools. Column [5] compares boys from single-sex schools in Essex to their counterparts in Suffolk and to boys in Essex who took the 11+ exam. In both columns, the single-sex and all-boys coefficients are statistically significant. Interestingly, the coefficient to the all-boys group is negative in both cases – contrasting sharply with the all-girls coefficient. The negative aspect of this coefficient could suggest that boys are choosing to compete less because they feel that it will be harder to win against boys than girls - a strategic choice rather than one based on preferences for competition *per se.*

In the specification in column [6], we control for the effect of having other males in the group. We add a dummy variable equal to one if 50% or less of the other members of one's group are male. The base group is then mixed-gender groups with more than 50% boys (for our typical group of 4 students there are at least two other boys present). Thus the base group is more like the all-boy groups. If the all-boys coefficient is picking up the effect of group composition, we would expect the coefficient's signficiance would decrease. Furthermore we would expect a positive coefficient to the dummy variable with 50% or less boys. The new variable is positive but insignificant and the coefficient on all-boys is now insignificant. These results may suggest that boys are making strategic choices and are not making a decision based solely on their preference to compete. Given these results are consistent with boys making choices based on who their competitors are, there seems to be no evidence to support the first conjecture.

Second Conjecture

The second conjecture - that gender differences in tournament entry are sensitive to experimental peer-groups - can be either a nature or nurture story. Table six summarizes the information from column [7] of table five.

[Table 6 – Girls and Coed Boys Matrix]

Table six compares girls from single-sex schools when in mixed or all-girl groups to boys from co-ed schools in mixed groups. Girls from single-sex schools are not significantly different to boys from coed schools in either case. Girls from coed schools are also compared to their male counterparts and they always choose to enter the tournament less than the boys. This at least suggests that the any ‘dislike’ of competing against boys in not fundamental since, controlling for ability and family background, girls from single-sex schools and boys from coed schools are statistically indistinguishable.

Third Conjecture

The third conjecture is that gender differences in tournament entry can be explained by differences in risk attitudes. Entry into a tournament means that a subject will face an added risk over her payoff as compared to the piece-rate option. If risk attitudes differ between males and females, or between females from single-sex and coed schools, this could explain the observed differences in the choices made. To investigate this conjecture, we use information from the exit survey. There we asked students “are you fully prepare to take risks?” and requested that they pick a number on a scale from 1-10, with 10 being ‘fully prepared to take risks’ and 1 being ‘not at all prepared to take risks’. Males and females in our sample are, on average, just as prepared to take risks. Furthermore girls from single-sex and coed schools are, on average, also just as prepared to take risks.[32] To investigate if risk preferences might explain the results from single-sex education or group-type, we control for risk using the value 1-10 choice by the student. The regression results are shown in table seven.

[Table 7 – Risk3 with Risk Aversion]

Risk preferences are statistically significant; the more likely a student is to take risks, the more likely she is to enter the tournament. However, even with this new control, the coefficients to single-sex schooling and the all-girls group remain significant and their magnitude barely alters. Moreover, the interaction between risk and gender is insignificant.[33] In summary, the third conjecture is

32. Refer to the last row of tables 1 and 2 for the averages of the risk question by group.
33. The results do not change if dummies are used for each possible choices of risk (i.e. risk=1 or risk=2... etc.).

not supported by our data. There is no evidence of gender differences in risk attitudes and there are no gender differences in the impact of risk-aversion on the probability of entering a tournament. Furthermore, the inclusion of risk attitudes does not change the single-sex school coefficient.

Fourth Conjecture

The fourth conjecture is that men are more likely than women to choose a tournament because they are more overconfident. Round four of our experiment was designed to examine how confident a student is in her ability to solve mazes. To our knowledge this round has not been conducted in any other economics experiments. Students were told they would all be paid the same and that they would receive £0.50 per maze solved correctly by the student in the group who solved the *least* number of mazes in that round. Therefore a student will have an incentive to solve mazes up to the number she believes will be solved by the lowest performer in her group. Above that value, she will receive no monetary reward for additional mazes solved. If a student believes that she is more likely to be in the top part of the distribution, on the margin she should put in less effort than when the highest performer was being rewarded in the tournament. This means that, if we examine how a student reacts on the margin in the lowest performer round, compared to her performance in the tournament, we will have an idea of how likely she thinks she is to be placed in the top part of the distribution.

[Table 8 – R2 SQ]

Table 8 shows the OLS regressions for performance in the fourth round. The first column includes the number of mazes solved by a student in the round two tournament ($R2$), controls for age, family background, group type, and schooling. Boys from single-sex schools do better than all other groups of students. In fact, ceteris paribus there is no gender gap in performance: boys from coed schools, girls from coed schools, and girls from single-sex schools all perform at the same level. Column [2] allows us to look at how students changed their performance on the margin. To see this, we calculate $dR4/dR2$. This is given by 0.36+2(0.04)(4.38)-0.21 = 0.5 mazes, where the value of 4.38 is the average number of mazes correctly solved in the round two tournament. From this, it can be seen that a one-maze increase in the $R2$ score is associated with only a half maze increase in the $R4$ score, which might be interpreted as showing that the lowest performer round decreases the incentive of the average student to perform better.

As a comparison, column [3] presents the same specification as column [2] but now the dependent variable is the number of mazes solved correctly in the third round by individuals who chose the tournament in that round. The sample size is therefore only 122 girls and boys. The average number of mazes solved correctly by these people was 6.42, for whom $dR3/dR2$ is given by -2.02+2(0.29)(6.42)-0.45= 1.3 mazes. This compares with the marginal effect of just 0.5 mazes for the worst performer round. Compared to the round 3 tournament, students in round four (worst performer) had the incentive to solve fewer mazes.

We now ask which students, in the lowest performer round, decreased their marginal performance most. The specification in column [4] of table eight examines the difference between performance on the margin for coed boys, single-sex boys, single-sex girls, and coed girls. Coed boys are the base group. Not surprisingly, the coefficient to the interaction of $R2$ tournament performance-squared with single-sex school attendance is negative. This suggests that, on the margin, boys from single-sex schools decrease their performance more in the lowest performer round than do boys from coed schools. Boys from single-sex schools therefore seem to be more confident that they are not in the lower part of the distribution than are boys from coed schools. In fact they are correct.

In the round two tournament, boys from single-sex schools solved around 0.65 mazes more than boys from coed schools. Likewise it can be seen that, on the margin, girls from single-sex schools are indistinguishable from boys from coed schools. When the coefficient of the tournament squared interacted with being from a single-sex school, and the coefficient of tournament squared interacted with female being from a single-sex school, are combined, the combination is insignificant. However, what is surprising is that, on the margin, girls from coed schools *decreased* their performance on the margin in the fourth round compared to the round 2 tournament as much as boys from single-sex schools. Girls from coed schools were the worst performing group in round two and were the least likely to enter a tournament in round three.

One possible explanation for the lower performance in the fourth round by coed girls is that they knew they would perform better after three rounds of mazes. Then their marginal decrease in performance would be justified. Table nine presents the percentage of members of each group who were actually the lowest performers in the fourth round. It shows that 40% of girls from coed schools were the lowest performer in their groups whereas only 20% of boys from single-sex schools were the lowest performers. This difference is significant at the 1% confidence level. However, the percentage of girls from single-sex schools and boys from coed schools who lost in the fourth round were statistically indistinguishable, and were statistically significantly greater than the percentage of single-sex schoolboys who lost.

This examination of round four shows that, while single-sex boys, single-sex girls, and coed boys seem to respond as expected given where they are located in the distribution, girls from coed schools do not. Girls from coed schools decrease their performance - even though it means they will be financially worse off. Another possible explanation is that girls from coed schools are vindictive towards other members of their group; by lowering their performance, they can inflict a financial loss on other group members. However, any member of their group could be equally vindictive – they could simply not solve any mazes in the fourth round. For vindictiveness to explain the results, one would have to believe that girls from coed schools are more vindictive than students from single-sex schools or boys from coed schools. This seems implausible.

Fifth Conjecture

The fifth conjecture is that gender differences in tournament entry may be because they are discouraged from competing - the environment in which they are raised conditions their attitudes to competition. While our first four conjectures have evidence stacking up against them, the data from the experiment do not contradict the fifth explanation; that girls may avoid the tournament because they are conditioned not to compete. We argue that this explanation has the least counter-evidence because the environmental factors affecting girls are significant in all regressions. Being in an all-girls group seems to have a different effect than just competing against fewer boys.

The single-sex school coefficient is statistically significant in explaining tournament choice even when we control for family background, age, and ability; when instrumenting for attendance at a single-sex school or comparing single-sex school students to students from Suffolk where selection is not an issue; and even when controlling for risk preferences.

VI. Conclusions

Our controlled experiment was designed to investigate if there are gender differences in competitive behaviour across subjects from two distinct environments - publicly-funded single-sex and coeducational schools. While the relevant experimental economics literature has been conducted with college-age men and women attending co-educational universities, it is well-known that the academic achievement of girls and boys responds differentially to co-educational environments, suggesting that nurture might play a role. We therefore sampled a different subject pool - students from years 10 and 11 who are attending either single-sex or coeducational schools - to examine the possible effect of school-level nurturing on competitive choices in an experimental environment. Controlling for family background, we find that girls from coeducational schools are significantly less likely to choose the tournament than are boys in either single-sex or coeducational schools. But girls from single-sex schools are significantly more likely to choose the tournament than are coeducational girls.

Our experimental evidence suggests that women seem to be shying away from competition, as also shown by other studies. There are many potential reasons that might explain this and a number of conjectures have been examined in the paper. The bulk of our evidence seems to suggest that a girl's environment plays an important role in explaining why she chooses not to compete. We have looked at the choices made by girls from single-sex and co-ed schools and found that there are robust differences in their behaviour. Furthermore being assigned to an all-girls group seems also to affect the decision a girl makes, even when controlling for composition of the group to which she is randomly assigned for the experiment.

In summary, we have discovered at least one setting - in addition to the Kasai tribe of India studied by Gneezy, Leonard and List (2008) - in which it is untrue that the average female avoids competitive behaviour more than the average male. On average girls from single-sex schools are found in our experiment to be as likely as coed boys to choose competitive behaviour. This suggests that the observed gender differences in competitive choices found in previous studies might reflect social learning rather than inherent gender traits.

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Table 1: Sample Average and Proportions

VARIABLES	ENTIRE SAMPLE	GIRLS	BOYS	DIFFERENCE
Percent Female	0.62			
	[0.03]			
Number of Mazes Solved in Piece-Rate Round (R1)	2.53	2.33	2.87	-0.54***
	[0.06]	[0.08]	[0.11]	[0.13]
Number of Mazes Solved in Tournament Round (R2)	4.39	4.04	4.97	-0.93***
	[0.09]	[0.10]	[0.13]	[0.17]
Mean Difference between R1 and R2	1.85	1.71	2.1	-0.39**
	[0.08]	[0.10]	[0.12]	[0.16]
Number of Siblings	1.6	1.64	1.55	0.09
	[0.06]	[0.08]	[0.10]	[0.13]
Number of Female Siblings	0.71	0.66	0.77	-0.11
	[0.05]	[0.05]	[0.08]	[0.09]
Average Birth Order	1.74	1.75	1.74	0.01
	[0.05]	[0.07]	[0.09]	[0.11]
Average Age of Student	14.79	14.86	14.69	0.17**
	[0.03]	[0.04]	[0.05]	[0.07]
Percent who have transferred to current school	0.19	0.18	0.2	-0.02
	[0.02]	[0.03]	[0.04]	[0.04]
Percent at a Single-Sex School	0.41	0.39	0.44	-0.05
	[0.03]	[0.03]	[0.04]	[0.06]
Percent with Mother who has a University Degree	0.25	0.23	0.28	-0.05
	[0.02]	[0.03]	[0.04]	[0.05]
Percent with Father who has a University Degree	0.32	0.28	0.37	-0.09
	[0.03]	[0.03]	[0.04]	[0.05]
Minimum travel time to the nearest Coed School	17.84	16.77	19.6	-2.83**
(Mintrv Coed)	[0.64]	[0.81]	[1.02]	[1.31]
Minimum travel time to the nearest Single-Sex School	20.26	20.7	19.55	1.15
(Mintrv SS)	[0.49]	[0.63]	[0.78]	[1.01]
Mean Difference between Mintrv Coed and Mintrv SS	2.36	3.87	-0.05	3.92**
	[0.93]	[1.19]	[1.48]	[1.90]
Average Risk Score	6.64	6.64	6.65	-0.01
(Scale 1- 10: 10 being fully prepared to take risks)	[0.10]	[0.13]	[0.18]	[0.22]
Observations	328	204	124	

Standard Deviations in brackets
**** Significant at the 1% level, ** Significant at the 5% level*

Table 2: Sample Proportions and Averages by School and Group type for Girls.

VARIABLES	SINGLE-SEX	COED	DIFFERENCE	ALL-GIRL	MIXED	DIFFERENCE
Number of Mazes Solved in Piece-Rate Round (R1)	2.58	2.16	0.42***	2.32	2.34	-0.02
	[0.12]	[0.09]	[0.15]	[0.10]	[0.12]	[0.15]
Number of Mazes Solved in Tournament Round (R2)	4.2	3.93	0.27	4.08	3.98	0.1
	[0.15]	[0.14]	[0.21]	[0.14]	[0.15]	[0.21]
Mean Difference between R1 and R2	1.61	1.76	-0.15	1.75	1.64	0.11
	[0.16]	[0.13]	[0.21]	[0.13]	[0.16]	[0.21]
Number of Siblings	1.49	1.73	-0.24	1.73	1.51	0.22
	[0.11]	[0.11]	[0.16]	[0.12]	[0.10]	[0.16]
Number of Female Siblings	0.55	0.74	-0.19*	0.65	0.67	-0.02
	[0.08]	[0.07]	[0.11]	[0.07]	[0.08]	[0.11]
Average Birth Order	1.7	1.78	-0.08	1.82	1.64	0.18
	[0.10]	[0.09]	[0.13]	[0.09]	[0.08]	[0.13]
Average Age of Student	14.88	14.84	0.04	14.96	14.7	0.26***
	[0.06]	[0.05]	[0.08]	[0.05]	[0.07]	[0.08]
Percent who have transferred to current school	0.15	0.21	-0.06	0.19	0.18	0.01
	[0.04]	[0.04]	[0.06]	[0.04]	[0.04]	[0.06]
Percent at a Single-Sex School				0.35	0.47	-0.12*
				[0.04]	[0.06]	[0.07]
Percent with Mother who has a University Degree	0.43	0.1	0.33***	0.21	0.25	-0.04
	[0.06]	[0.03]	[0.06]	[0.04]	[0.05]	[0.06]
Percent with Father who has a University Degree	0.5	0.15	0.35***	0.28	0.29	-0.01
	[0.06]	[0.03]	[0.06]	[0.04]	[0.05]	[0.06]
Minimum travel time to the nearest Coed School	24.39	11.88	12.51***	15.32	18.94	-3.62**
(Mintrv Coed)	[1.69]	[1.07]	[1.40]	[1.42]	[2.04]	[1.64]
Minimum travel time to the nearest Single-Sex School	15.91	23.94	-8.03***	21	20.24	0.76
(Mintrv SS)	[1.21]	[0.82]	[1.16]	[1.02]	[1.29]	[1.30]
Mean Difference between Mintrv Coed and Mintrv SS	-8.48	12.21	-20.69***	5.69	1.05	4.64*
	[1.16]	[0.54]	[1.90]	[0.74]	[1.14]	[2.41]
Average Risk Score	6.9	6.47	0.43	6.57	6.73	-0.16
(Scale 1- 10: 10 being fully prepared to take risks)	[0.21]	[0.16]	[0.26]	[0.17]	[0.20]	[0.26]
Observations	81	123		121	83	

Standard Deviations in brackets

**** Significant at the 1% level, ** Significant at the 5% level*

Table 3: Regression Results for Piece-Rate and Tournament - Piece Rate.

VARIABLES	DEPENDENT VARIABLE: No. mazes solved in Piece-Rate			DEPENDENT VARIABLE: Tournament Score - Piece-Rate Score		
	[1]	[2]	[3]	[4]	[5]	[6]
Female (=1)	-0.54***	-0.56**	-0.48	-0.62***	-0.68**	-0.65*
	[0.13]	[0.28]	[0.31]	[0.16]	[0.32]	[0.38]
Number of mazes solved in Piece-Rate				-0.42***	-0.45***	-0.46***
				[0.07]	[0.07]	[0.08]
Mother went to University (=1)		0.01	-0.03		0.07	0.05
		[0.30]	[0.30]		[0.35]	[0.36]
Father went to University (=1)		0.16	0.05		0.03	-0.03
		[0.29]	[0.30]		[0.32]	[0.33]
Number of Siblings		0.04	0.08		0.13	0.15
		[0.12]	[0.12]		[0.15]	[0.16]
Number of Female Siblings		-0.31**	-0.32**		-0.38**	-0.38**
		[0.14]	[0.14]		[0.15]	[0.16]
Student is 14 years-old (=1)		0.31	0.11		0.24	0.12
		[0.23]	[0.27]		[0.24]	[0.24]
Female * Mother went to University		-0.01	-0.11		-0.56	-0.58
		[0.37]	[0.37]		[0.44]	[0.45]
Female * Father went to University		0.01	0.01		0.39	0.42
		[0.35]	[0.36]		[0.42]	[0.43]
Female * Number of Siblings		0.01	-0.02		-0.08	-0.11
		[0.14]	[0.14]		[0.18]	[0.19]
Female * Number of female siblings		0.26	0.29		0.43*	0.45**
		[0.18]	[0.18]		[0.22]	[0.23]
Female * 14 years-old		-0.64**	-0.44		-0.38	-0.24
		[0.29]	[0.32]		[0.34]	[0.35]
Student goes to single-sex school (=1)			0.49*			0.3
			[0.27]			[0.26]
Female * Student goes to single-sex school			-0.08			-0.18
			[0.33]			[0.35]
Student in an all-girls group (=1)			-0.07			0.07
			[0.15]			[0.20]
Student in an all-boys group (=1)			0.06			0.08
			[0.22]			[0.21]
Constant	2.87***	2.88***	2.71***	3.30***	3.36***	3.27***
	[0.11]	[0.23]	[0.24]	[0.25]	[0.37]	[0.37]
Observations	328	327	327	328	327	327
R-squared	0.051	0.093	0.121	0.13	0.162	0.166

Robust standard errors in brackets

**** p<0.01, ** p<0.05, * p<0.1*

Table 4: Dependent Variable = 1 if student chose to enter the tournament, zero otherwise.

VARIABLES	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Number of mazes solved in Tournament	0.11***	0.13***	0.11***	0.12***	0.12***	0.12***	0.10***	0.12***
Round (R2)	[0.03]	[0.03]	[0.03]	[0.04]	[0.04]	[0.03]	[0.03]	[0.03]
Number of mazes solved in Tournament	-0.03	-0.04	-0.03	-0.03	-0.02	-0.03	-0.02	-0.03
(R2) - number solved in Piece-Rate (R1)	[0.03]	[0.03]	[0.03]	[0.04]	[0.04]	[0.03]	[0.03]	[0.03]
Mother went to University (=1)		0.15	0.06	0.08	0.1	0.06	0.06	0.11
		[0.09]	[0.09]	[0.11]	[0.10]	[0.09]	[0.09]	[0.09]
Father went to University (=1)		-0.04	-0.12*	-0.14	-0.16**	-0.12*	-0.11	-0.09
		[0.08]	[0.07]	[0.09]	[0.08]	[0.07]	[0.08]	[0.08]
Number of Siblings		-0.05	-0.04	-0.05	-0.06	-0.04	-0.05*	-0.07**
		[0.03]	[0.04]	[0.05]	[0.04]	[0.04]	[0.03]	[0.03]
Number of Female Siblings		0.08	0.10*	0.13*	0.14**	0.10*	0.10*	0.11**
		[0.05]	[0.06]	[0.07]	[0.06]	[0.06]	[0.05]	[0.05]
Student is 14 years-old (=1)		0.09	0.15*	0.15	0.12	0.14*	0.13*	0.12*
		[0.08]	[0.09]	[0.10]	[0.09]	[0.08]	[0.07]	[0.07]
Student goes to single-sex school (=1)			0.30***	0.34***	0.33***	0.30***	0.28***	0.22**
			[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.10]
Student in an all-girls group (=1)			0.15**	0.16*	0.15**	0.18**	0.16**	0.15**
			[0.07]	[0.08]	[0.07]	[0.09]	[0.06]	[0.06]
More than half of the group is male (=1)						0.06		
						[0.12]		
Constant							-0.28***	-0.30***
							[0.09]	[0.09]
Observations	204	203	203	141	159	203	203	190
Model Type	Probit	Probit	Probit	Probit	Probit	Probit	OLS	IV
R-Squared							0.203	0.232
F-Stat for Distance*Essex and Essex Dummy Variables								68.34

Robust standard errors in brackets

**** p<0.01, ** p<0.05, * p<0.1*

Columns [1], [2], [3], [6], [7], and [8] involve the entire sample of girls. Column [4] uses only girls from Suffolk and from single-sex schools. Column [5] uses only girls from Suffolk, girls from Essex who took the 11+ exam, and girls from single-sex schools. Marginal Effects are reported when the model type is Probit. Single-sex in instrumented for using travelling time and dummy variables in column [8].

Table 5: Dependent Variable = 1 if student chose to enter the tournament, zero otherwise.

VARIABLE	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Female (=1)	-0.24***	-0.27**	-0.49***	-0.54***	-0.47***	-0.48***	-0.42***	-0.37***
	[0.05]	[0.11]	[0.12]	[0.16]	[0.15]	[0.13]	[0.12]	[0.13]
Number of mazes solved in Tournament Round (R2)		0.12***	0.10***	0.10***	0.11***	0.10***	0.08***	0.09***
		[0.03]	[0.03]	[0.04]	[0.03]	[0.03]	[0.02]	[0.02]
Number of mazes solved in Tournament (R2) - number solved in Piece-Rate (R1)		-0.04	-0.03	-0.05	-0.05	-0.03	-0.02	-0.03
		[0.03]	[0.03]	[0.04]	[0.04]	[0.03]	[0.03]	[0.03]
Mother went to University (=1)		-0.02	-0.08	-0.09	-0.09	-0.08	-0.08	-0.08
		[0.12]	[0.11]	[0.12]	[0.12]	[0.11]	[0.11]	[0.11]
Father went to University (=1)		0.13	0.04	0.03	0.06	0.04	0.04	0.03
		[0.11]	[0.12]	[0.13]	[0.12]	[0.12]	[0.11]	[0.11]
Number of Siblings		-0.05	0.01	-0.02	-0.03	0.01	0.01	0.02
		[0.05]	[0.05]	[0.06]	[0.06]	[0.05]	[0.05]	[0.05]
Number of Female Siblings		0.02	-0.02	0.03	0.02	-0.02	-0.02	-0.04
		[0.06]	[0.07]	[0.08]	[0.08]	[0.07]	[0.06]	[0.06]
Student is 14 years-old (=1)		-0.15*	-0.29***	-0.29***	-0.26**	-0.29***	-0.27***	-0.29***
		[0.08]	[0.09]	[0.11]	[0.10]	[0.09]	[0.09]	[0.09]
Female * Mother went to University		0.18	0.14	0.16	0.2	0.15	0.13	0.17
		[0.16]	[0.16]	[0.18]	[0.18]	[0.17]	[0.14]	[0.15]
Female * Father went to University		-0.15	-0.16	-0.18	-0.22*	-0.16	-0.14	-0.11
		[0.12]	[0.12]	[0.15]	[0.13]	[0.12]	[0.13]	[0.14]
Female * Number of Siblings		0	-0.06	-0.04	-0.05	-0.06	-0.06	-0.09
		[0.06]	[0.07]	[0.09]	[0.08]	[0.07]	[0.06]	[0.06]
Female * Number of female siblings		0.07	0.13	0.13	0.15	0.13	0.12	0.15*
		[0.09]	[0.09]	[0.11]	[0.11]	[0.09]	[0.08]	[0.08]
Female * 14 years-old		0.26**	0.48***	0.45***	0.41***	0.48***	0.40***	0.40***
		[0.13]	[0.12]	[0.14]	[0.14]	[0.12]	[0.11]	[0.12]
Student goes to single-sex school (=1)			0.37***	0.37***	0.37***	0.37***	0.34***	*0.35****
			[0.11]	[0.11]	[0.11]	[0.11]	[0.09]	*[0.11]*
Female * Student goes to single-sex school			-0.03	0.02	0	-0.03	-0.06	*-0.12*
			[0.14]	[0.17]	[0.16]	[0.14]	[0.11]	*[0.14]*
Student in an all-girls group (=1)			0.19**	0.18*	0.19*	0.22**	0.16**	0.15**
			[0.08]	[0.10]	[0.10]	[0.10]	[0.06]	[0.07]
Student in an all-boys group (=1)			-0.17**	-0.16	-0.15	-0.15	-0.17**	-0.18*
			[0.08]	[0.10]	[0.09]	[0.10]	[0.09]	[0.09]
Less than half the group is male (=1)						0.04		
						[0.10]		
Constant							0.2	0.16
							[0.13]	[0.13]
Observations	328	327	327	239	263	327	327	309
Model Type	Probit	Probit	Probit	Probit	Probit	Probit	OLS	IV
R-Squared							0.235	0.222
F-Stat for Distance*Essex and Essex Variables								55.94

Columns [1], [2], [3], [6], [7], and [8] involve the entire sample of girls. Column [4] uses only students from Suffolk and from single-sex schools. Column [5] uses only students from Suffolk, students fom Essex who took the 11+ exam, and students from single-sex schools. Marginal Effects are reported when the model type is Probit. The standard errors reported for single-sex and female*single-sex in column [8] are bootstraped.

Robust standard errors in brackets

**** p<0.01, ** p<0.05, * p<0.1*

Table 6: Difference in Choosing the Tournament

			DIFFERENCE
Single-sex Girl in Mixed Group	Minus	Coed Boy in Mixed Group	-0.13 [.13]

			DIFFERENCE
Coed Girl in Mixed Group	Minus	Coed Boy in Mixed Group	-0.42*** [0.12]

			DIFFERENCE
Single-sex Girl in All-Girl Group	Minus	Coed Boy in Mixed Group	0.03 [0.12]

			DIFFERENCE
Single-sex Girl in All-Girl Group	Minus	Coed Boy in Mixed Group	-0.26*** [.12]

Table 7: Dependent variable = 1 if student chose to enter the tournament, zero otherwise.

VARIABLE	[1]	[2]
Female (=1)	-0.46***	-0.47*
	[0.13]	[0.26]
Number of mazes solved in Tournament Round (R2)	0.10***	0.10***
	[0.03]	[0.03]
Number of mazes solved in Tournament (R2) - number solved in Piece-Rate	-0.02	-0.02
(R1)	[0.03]	[0.03]
Mother went to University (=1)	-0.05	-0.05
	[0.12]	[0.12]
Father went to University (=1)	0.06	0.06
	[0.13]	[0.13]
Number of Siblings	0.01	0.01
	[0.05]	[0.05]
Number of Female Siblings	0.01	0.01
	[0.07]	[0.07]
Student is 14 years-old (=1)	-0.27***	-0.27***
	[0.09]	[0.09]
Female * Mother went to University	0.11	0.11
	[0.17]	[0.18]
Female * Father went to University	-0.16	-0.16
	[0.13]	[0.13]
Female * Number of Siblings	-0.08	-0.08
	[0.07]	[0.07]
Female * Number of female siblings	0.12	0.12
	[0.10]	[0.10]
Female * 14 years-old	0.48***	0.49***
	[0.13]	[0.13]
Student goes to single-sex school (=1)	0.37***	0.37***
	[0.12]	[0.12]
Female * Student goes to single-sex school	-0.02	-0.02
	[0.15]	[0.15]
Student in an all-girls group (=1)	0.23**	0.23**
	[0.09]	[0.09]
Student in an all-boys group (=1)	-0.15*	-0.15*
	[0.08]	[0.08]
Score 1-10 on how prepared a student is to take risks	0.06***	0.06**
(10 = fully perpared)	[0.02]	[0.02]
Female * Score 1-10 on how prepared a student is to take risks		0
(10 = fully perpared)		[0.03]
Observations	322	322

Marginal effects are reported.

Robust standard errors in brackets

**** p<0.01, ** p<0.05, * p<0.1*

Table 16: Dependent variable is the number of mazes solved in the lowest performer round in columns [1], [2], and [4]; number of mazes solved in the Round 3 Tournament in column [3].

VARIABLES	[1]	[2]	[3]	[4]
Female (=1)	-0.19	-0.21	-1.7	0.45
	[0.33]	[0.33]	[1.59]	[0.47]
Number of mazes solved in Tournament Round (R2)	0.67***	0.36	-2.02*	0.26
	[0.08]	[0.22]	[1.02]	[0.23]
Number of mazes solved in Tournament Round (R2),		0.04	0.29***	0.07**
Squared		[0.02]	[0.09]	[0.03]
Number of mazes solved in Tournament Round (R2),				-0.03*
Squared * Female				[0.02]
Number of mazes solved in Tournament Round (R2),				-0.04**
Squared * Single-sex				[0.02]
Number of mazes solved in Tournament Round (R2),				0.05*
Squared * Female * Single-sex				[0.03]
Number of mazes solved in Tournament (R2) - number	-0.21**	-0.21**	-0.45	-0.21**
solved in Piece-Rate (R1)	[0.10]	[0.10]	[0.27]	[0.10]
Mother went to University (=1)	-0.22	-0.24	0.52	-0.24
	[0.28]	[0.28]	[1.42]	[0.26]
Father went to University (=1)	0.04	0.03	-0.48	0.01
	[0.31]	[0.30]	[1.69]	[0.28]
Number of Siblings	0.05	0.04	0.06	-0.03
	[0.15]	[0.15]	[0.39]	[0.15]
Number of Female Siblings	-0.08	-0.06	-0.24	0.02
	[0.18]	[0.18]	[0.49]	[0.19]
Student is 14 years-old (=1)	0.07	0.03	-0.55	-0.05
	[0.25]	[0.25]	[0.82]	[0.25]
Female * Mother went to University	0.73*	0.75*	-1.17	0.74*
	[0.42]	[0.42]	[1.59]	[0.41]
Female * Father went to University	0.01	-0.02	0.81	0
	[0.40]	[0.40]	[1.79]	[0.38]
Female * Number of Siblings	-0.12	-0.1	-0.07	-0.02
	[0.18]	[0.18]	[0.49]	[0.18]
Female * Number of female siblings	0.17	0.14	-0.35	0.05
	[0.26]	[0.26]	[0.67]	[0.27]
Female * 14 years-old	-0.06	-0.06	0.77	0
	[0.35]	[0.35]	[1.07]	[0.36]
Student goes to single-sex school (=1)	0.46*	0.42	-0.33	1.50***
	[0.27]	[0.27]	[0.94]	[0.56]
Female * Student goes to single-sex school	-0.51	-0.42	1.42	-1.62**
	[0.35]	[0.36]	[1.18]	[0.71]
Constant	2.12***	2.73***	10.64***	2.32***
	[0.37]	[0.58]	[2.85]	[0.59]
Observations	327	327	122	327
R-squared	0.556	0.56	0.858	0.569

Columns [1], [2], and [4] use the entire sample. Column [3] includes only those students who entered the tournament in round three.

Robust standard errors in brackets

**** p<0.01, ** p<0.05, * p<0.1*

Table 9: Percent of each group tha performed the worst in the lowest performer round.

Coed Girls	41%
Coed Boys	33%
Single-Sex Girls	37%
Single-Sex Boys	20%