How Costly is Diversity? Affirmative Action in Light of Gender Differences in Competitiveness

PRELIMINARY

Muriel Niederle
Stanford University and *NBER*

Carmit Segal
Harvard Business School

Lise Vesterlund
University of Pittsburgh

September 29, 2007

Abstract

Recent research documents that while men are eager to compete, women often shy away from competitive environments. A consequence is that few women succeed in and win competitions. Using experimental methods we show that affirmative action entices women to compete. When a preference is given to getting women winners, more women and fewer men enter competitions, and the response exceeds that predicted by changes in the probability of winning. This change in behavior is in part explained by the fact that under affirmative action the probability of winning depends not only on one's rank relative to other group members, but also on one's rank within gender. Both beliefs on rank and attitudes towards competition change when moving to a within-gender competition. The changes in competitive entry have important implications when assessing the performance costs associated with affirmative action. Specifically it implies that the minimum performance threshold for female winners need not be lowered to the extent predicted based on ex-ante entry decisions. When initial competitive entry is not payoff maximizing, employers may not need to lower their performance requirement to achieve a more diverse set of winners

Muriel Niederle: Department of Economics, Stanford University and NBER, http://www.stanford.edu/~niederle, Carmit Segal, Universitat Pompeu Fabra, and Lise Vesterlund: Department of Economics, University of Pittsburgh, http://www.pitt.edu/~vester. We are grateful to the NSF and the Harvard Business School for generous support. We thank the following institutions for their hospitality: Institute for Advanced Study at Princeton and the Department of Economics at Harvard (Niederle), Harvard Business School (Segal) and CEBR at Copenhagen Business School (Vesterlund).

I. INTRODUCTION

Despite decades of striving for gender equality, large differences still remain between men and women in the labor market. Perhaps most noteworthy is the gender segregation across different types of jobs. While there is substantial horizontal segregation, with women more likely to hold clerical or nurturing jobs and men more visible in manufacturing, segregation is particularly striking when examining the positions held within a sector (Weeden, 2004, and Grusky and England, 2004, Ander, 1998). Across fields men are disproportionately allocated to professional and managerial occupations resulting in significant vertical segregation. In a large sample of US firms Bertrand and Hallock (2001) show that women only account for 2.5 percent of the five highest paid executives.[1] While it may be argued that such segregation in part is a result of past history, and that these differences will diminish over time, it is worth noting that women are far from well represented in the set of people who have the minimum training frequently required for senior management. Only 30 percent of students at top tier business schools are women, and many of these drop out of the work force within a few years of graduation.[2]

Corporations seem concerned by their inability to attain and recruit women, and they are increasingly developing programs to help increase the number of women employees.[3] When instituting programs to alter the gender composition in certain jobs it is of course important to understand what causes women to be absent or drop out in the first place. While it is commonly argued that discrimination, preference differences for child rearing, and ability differences can account for much of this gender difference, recent research suggests that an additional explanation for the absence of women in upper level management may be that they are more reluctant to put themselves in a position where they have to compete against others. An experimental study by Niederle and Vesterlund (2007), henceforth NV, shows that when participants have the choice between a competitive tournament compensation and a non-competitive piece rate, the majority of men select the tournament whereas the majority of women select the piece rate. While low ability men are found to compete too much, high

[1] Similarly only about 17 percent of the partners at major law firms nationwide were women in 2005 (Timothy O'Brien, *The New York Times*, March 19, 2006).
[2] See e.g., Hewlett and Luce, 2005.
[3] For example, corporations such as Goldman Sachs, Ernst and Young, and IBM have all adopted female retention and attraction programs (The Center for Work-Life Policy).

ability women compete too little, and a consequence is that few women succeed in and win the tournament.

This paper uses experiments to investigate whether affirmative action may entice more women to compete, and thereby secure greater diversity among those who enter and win competitions. Specifically, we consider a quota system which requires that out of two winners of a tournament at least one be a woman. We investigate what consequences such a system may have on the individuals who potentially participate in the tournament, and how costly it is in terms of lowering the performance threshold for women to secure that they be equally represented among those who win competitions. These questions are particularly interesting in light of the non-payoff maximizing tournament-entry decisions documented by NV.

We find that the introduction of affirmative action results in substantial changes in tournament entry. While the entry of women increases, that of men decreases, and the response exceeds that predicted by changes in the probability of winning. We attribute the excessive changes to three different factors. One is that the mere mention of affirmative action in favor of women gives rise to increased willingness by women to compete. The other two factors both relate to the fact that affirmative action makes the competition more gender specific. The requirement that at least one of two winners must be a woman implies that a woman will win the tournament if she is *either* the best performing woman in her group or among the top two performers in the group overall, in contrast a man will win the tournament if he is *both* the top performing man in his group and among the two best performers in the group overall. The more gender specific competition may affect behavior for two reasons: first participants may hold different beliefs on relative performance within versus across gender, and second, it may be that it is either less intimidating or enjoyable to compete primarily against members of your own gender. Our results suggest that all three factors help explain the change in the gender gap in tournament entry.

The substantial tournament-entry response to affirmative action has important implications when assessing the sacrifice in performance required to secure a more diverse group of winners. The costs of affirmative action depend on how much lower the minimum performance threshold will have to be to secure gender parity, compared to that found for a group in which gender is not taken into account. Without accounting for the change in entry, the anticipated performance costs associated with affirmative action are large.

The change in tournament entry implies that women become better represented among the set of entrants, and in particular that more high performing women are in the applicant pool. As a result it becomes much less costly to follow the affirmative action rule. The resulting minimum performance threshold is unchanged under affirmative action. If women shy away from competition and fail to enter when it is payoff maximizing to do so, then introducing affirmative action to achieve a more diverse set of winners need not be costly.

In the next section we explain more carefully the reasons why affirmative action may alter the tournament-entry decisions of men and women. We then describe our experimental design and how it helps us investigate the potential effects of affirmative action. We introduce our analysis of the experimental findings by first showing that the basic results of the present study replicate those of NV. We then proceed by determining the extent to which the possible explanations account for the changes in tournament entry under affirmative action. Finally we conclude by examining the extent to which changes in tournament entry mitigate the performance costs anticipated from affirmative action.

II. POTENTIAL EFFECT OF AA ON GENDER GAP IN TOURNAMENT ENTRY

Niederle and Vesterlund (2007) considers a number of possible explanations for the gender gap in tournament entry. They find that the gender gap in tournament entry in part can be explained by men being more overconfident than women, and by men and women having different attitudes towards competitions. The central question in this paper is whether an institution such as affirmative action may reduce the gender gap in tournament entry. In particular we consider a quota system which requires that out of two winners at least one will be a woman. There are several factors that may cause tournament entry to differ under affirmative action. We will discuss the most obvious ones and explain how our experiment is designed to account for them.

Factor 1. Change in the probability of winning: The direct effect of affirmative action is that it distorts the probability of winning the tournament in favor of women and against men. To the extent that participants respond to changes in incentives we anticipate that entry to the tournament increases for women and decreases for men. If the change in behavior that we observe under affirmative action is caused solely by the change in the probability of winning, then conditioning on this probability we should observe no difference in tournament entry before and after affirmative action.

Factor 2. Within-Gender Beliefs: The initial NV study documented a significant gender difference in overconfidence and showed that this difference helps to explain the gender gap in tournament entry. One of the consequences of affirmative action is that the tournament-entry decision no longer depends only on the individual's perception of their rank within the whole group, but also on the perception of rank within their gender. Specifically, a woman should enter *either* if she thinks she is the best performing woman or among the top two performers overall. In contrast a man should enter if he thinks he is *both* the best performing man and among the top two performers overall. If participants hold different beliefs about their relative performance in single versus mixed gender groups then this may cause the gender gap in tournament entry to change under affirmative action. We elicit the participant's within-gender beliefs to determine if these differ across gender and how they may affect tournament entry.

Factor 3. AA Context Effect: Another reason why participants may respond differently to the affirmative-action tournament is that the mere mention of affirmative action may discourage entry by men and encourage it by women. To control for the effect of such a response we examine compensation choices under the affirmative action rule when these choices do not require a future competitive performance. We use these as controls in the AA tournament-entry decisions.

Factor 4. Competing against own gender: Finally a factor that may influence the decision to enter and actively compete in an affirmative-action tournament is that the competition becomes more gender specific. For women the competition is no longer simply a competition against all other members of the group, but rather a competition against the other women in the group. If women do not generally shy away from competitions, but rather shy away from competing in mixed gender groups, then the gender gap in tournament entry may be quite different under affirmative action.[4] The implications of affirmative action for men differ from those of women.

[4] Gneezy, Niederle and Rustichini (2003) find that women are better at competing in single sex compared to mixed tournaments. Such differences are often emphasized by advocates of single-sex schooling: It may be that

Under affirmative action it is no longer sufficient for a man to be among the top two performers overall, he also needs to be the best performing man. Having controlled for Factors 1 through 3, we will ascribe any unexplained response to affirmative action as evidence that Factor 4 influences behavior.

III. EXPERIMENTAL DESIGN

The experiment was conducted at the Harvard Business School, using students from the CLER subject pool and standard recruiting procedures. Our experimental design builds on that of NV. One to three groups of 6 participants, three women and three men, participated in each session. The gender composition of the groups was made clear to participants as they were seated in the laboratory, and they were shown who the other 5 members of their group were. A total of 14 groups participated in the experiment that is 42 men and 42 women.[5]

Participants were asked to perform a real task under varying compensation schemes. The task was to add up sets of five 2-digit numbers. Participants were not allowed to use a calculator, but could use scratch paper. The numbers were randomly drawn and each problem was presented in the following way:

21	35	48	29	83	

For each problem participants were asked to fill in the sum in the blank box. Once the participant submitted an answer on the computer, a new problem appeared jointly with information on whether the former answer was correct.[6] A record of the number of correct and wrong answers was kept on the screen. Participants had 5 minutes to solve as many problems as they could. A stop watch was shown at the front of the room via a projector and a buzzer would go off at the end of the 5 minutes. The participant's final score was determined by the number of correctly solved problems. An attractive feature of this 5-minute addition task is that it requires both skill and effort.

---

girls do not dislike competition per se, but rather that they do not compete well against boys. This suggests that girls in all-girl schools may be more competitive (see Harwarth, Maline and DeBra 1997 for an overview on single sex education).

[5] There was one session (two groups of six participants) in which we had problems with the stop watch for the fourth task. This session was excluded from the analysis, however behavior and performances prior to the stop watch malfunctioning resembles those of the other sessions.

[6] The program was written using the software zTree (Fischbacher 2007).

Participants were told that they had to complete six tasks of which one was randomly chosen for payment at the end of the experiment. By paying only for one task, we diminish the chance that decisions in a given task may be used to hedge against outcomes in other tasks. In addition to their payment for performance each participant also received a $10 show-up fee, and an additional $5 for completing the experiment.

Participants were informed of the nature of the tasks only immediately before performing the task. While participants knew their absolute performance on a task, i.e., how many problems they solved correctly, they were not informed of their relative performance until the end of the experiment. The specific compensations and order of tasks were as follows.

Task 1 – Piece Rate: Participants are given the 5-minute addition task. If task 1 is randomly selected for payment, they receive 50 cents per correct answer.

Task 2 – Tournament: Participants are given the 5-minute addition task. If task 2 is randomly selected for payment, the two participants who solve the largest number of correct problems in the group each receive $1.50 per correct answer. The other participants receive no payment. In case of ties the winner is chosen randomly among the high scorers.

In the next task participants are once again asked to perform the five-minute addition task, but this time they select which of the two compensation mechanisms they want to apply to their future performance, piece rate or tournament. A participant with a given performance has higher expected earnings in the tournament when the probability of winning exceeds 33 percent.[7] There are two reasons for presenting participants with the compensations prior to their choice, first it provides them with experience of both, and second it provides us with performance measures which help us determine whether men and women of equal performance make similar compensation choices.

Task 3 – Choice: Before performing the 5-minute addition task, participants select whether they want to be paid according to a piece rate, i.e., 50 cents for each correct answer, or a

[7] By paying the tournament winner per correct problem we avoid the problem of choosing a high enough fixed prize to ensure that even high-performing participants benefit from entering the tournament.

tournament. A participant who selects the tournament wins the tournament and receives $1.50 per correct answer if the participant's task-3 score exceeds that of at least 4 of the other group members in task 2, otherwise the participant receives no payment. In case of ties the winner is chosen randomly.

Winners of the task-3 tournament are determined by comparing their task-3 performance to the task-2 performance of the other group members, rather than others' task-3 performance. Thus participants competed against the past performances of others.[8] As emphasized by NV this has several advantages; first, participants are competing against competitive performances of others; second, the tournament-entry decision only depends on beliefs about ones relative performance, and not on the expected tournament-entry decisions of others;[9] and third, a participant's choice does not impose any externalities on others.[10] Effectively the task-3 decision is an individual-decision problem.

Next we examine the entry into an affirmative-action tournament. That is, a tournament where we change the probability of winning in favor of women. By mentioning the gender composition of the groups at the very beginning of the experiment, we hope to isolate the effect of affirmative action.

Task 4 – Affirmative Action Choice: Before performing the 5-minute addition task, participants select whether they want to be paid according to a piece rate, i.e., 50 cents for each correct answer, or an affirmative-action tournament. A participant who selects the affirmative action tournament receives $1.50 per correct answer when winning the tournament, and receives no payment otherwise. The probability of winning the tournament is different for women and men. The two winners of the tournament are as follows: One winner is the best performing woman, and the other is the highest performer among the remaining 5 participants. That is, a woman wins the affirmative-action tournament if her task-4 performance *either* exceeds the task-2 performance of the two other women in the group or exceeds that of at least

[8] Many sports competitions are not performed simultaneously, e.g., downhill skiing.

[9] This secures that the gender composition and size of the competitive group is held constant across participants, and that the decision to enter is not influenced by beliefs about tournament-entry by others.

[10] Note that our design allows for the extreme possibility that all participants who enter the tournament lose or that they all win. The absence of externalities helps us rule out that women avoid the competition to not decrease the chance that others will win. For a discussion of possible gender differences in altruism see e.g., Andreoni and Vesterlund (2001), Eckel and Grossman (2002c), Croson and Gneezy (2005).

four other group members. A man wins the affirmative-action tournament if his task-4 performance *both* exceeds the task-2 performance of the two other men in the group and exceeds that of at least four other group members. In case of ties the winner is chosen randomly.

As argued by NV there are several reasons why men and women may differ in their willingness to enter a competition. One explanation is that preferences for performing in a competitive environment differ across gender.[11] Other more general explanations are that women may have lower expectations about their relative ability, be more averse to risk, or more reluctant to be in an environment where they receive feedback on their relative performance. While psychologist often find both men and women are overconfident about their relative performance, men tend to be more overconfident than women (e.g., Lichtenstein, Fischhoff and Phillips, 1982, Beyer, 1990, and Beyer and Bowden, 1997). Another dimension in which men and women have been found to differ is in their attitudes towards risk (see e.g., Eckel and Grossman, 2002, Croson and Gneezy, 2007, Byrnes, Miller and Shafer, 1999). As tournaments involve uncertain payoffs differences in risk attitudes are likely to also affect the choice of compensation scheme. Finally, men and women have been found to respond differently to feedback on relative performance (see e.g., Roberts and Nolen-Hoeksema, 1989, Dweck 2000). Since a consequence of entering the tournament is that the individual will learn whether he or she is among the winners of the tournament, gender differences in feedback aversion may result in differences in tournament entry.

What distinguishes gender differences in competitive attitudes from the more general differences, such as overconfidence, risk and feedback aversion, is that the former relies critically on the tournament-entry decision resulting in a subsequent competitive performance. The other explanations are more general, and should be present in other decisions as well. To jointly control for the role played by these three general factors we present the participants with two additional environments which mimic the tournament-entry decisions in Task 3 and 4, without involving an actual tournament performance. Specifically we ask participants to

[11] While the prospect of engaging in a future competition may cause women to anticipate a psychic cost and deter them from tournaments, men may anticipate a psychic benefit and instead be drawn to them. Nurture as well as nature may cause women to be relatively more reluctant to perform in a competition, see e.g., Ruble, Martin, and Berenbaum (2006), Daly and Wilson (1983), Campbell (2002).

choose between a competitive and a non-competitive compensation schemes for a past non-competitive performance, that is the choice of tournament does not require participants to subsequently perform in a competition. As the potential thrill, anxiety or fear of performing in a competition is absent from this choice, this decision will control for the effect general factors such as overconfidence, risk and feedback aversion have on the compensation choice.

Task 5 – Submit Piece Rate to a Tournament: Participants do not have to perform in this task. Rather if this task is randomly selected for payment their compensation depends on the number of correct answers they provided in the task-1 piece rate. Participants choose which compensation they want to apply to their past piece-rate performance: a 50-cent piece rate or a tournament. A participant who enters the tournament receives $1.50 per correct answer if the participant's task-1 piece-rate performance is among the two highest scores in the group, otherwise no payment is received. In case of ties the winner is chosen randomly. Before making the choice, participants are reminded of their task-1 piece-rate performance.

For the participants' last task they are asked to make a similar decision in an affirmative-action tournament, that is, they decide whether they want to submit their piece-rate performance to an affirmative-action tournament. This decision helps us control both for general factors in the affirmative-action decision. Furthermore a comparison of the last two tasks enables us to determine whether the mere mention of affirmative action encourages women to and discourages men from competing.

Task 6 – Submit Piece Rate to Affirmative-Action Tournament: Participants do not have to perform in this task. Rather if this task is randomly selected for payment their compensation depends on the number of correct answers they provided in the task-1 piece rate. Participants choose which compensation scheme they want to apply to their past piece-rate performance: a 50-cent piece rate or an affirmative-action tournament. If the tournament is selected the participant receives $1.50 per correct answer when winning the tournament, and $0 when loosing. The probability of winning the tournament is different for women and men. The two winners are the highest performing woman and the highest performer of the remaining 5 participants. That is, a woman wins the affirmative-action tournament if in task 1 she is *either* the best performing woman in the group or among the top two performers overall. A man wins the affirmative-action tournament if in task 1 he is *both* the best performing man in the group and among the top two performers overall. In case of ties the winner is chosen randomly. Before making their choice, participants are reminded of their task-1 piece-rate performance.

As in the task-3 and task-4 choices a participant's decision does not affect the earnings of any other participant, nor does it depend on the entry decisions of others. Thus tasks 5 and 6 are also individual-decision tasks.

Finally, we elicited the participants' beliefs on their relative performance to determine whether gender differences in overconfidence about tournament performance affect the decision to enter a tournament. These beliefs were elicited both for performances in task 1 and task 2, where all participants had the same incentive scheme. We asked participants both about their believed relative rank in the whole group, and within their gender.

Belief-Assessment Questions: At the end of the experiment participants are asked to guess their rank in the task-1 piece rate and the task-2 tournament both within the whole group of 6 participants, and within their own gender. Each participant picks a rank between 1 and 6 and between 1 and 3, respectively, and is paid $1 for each correct guess.[12]

Task 1, 2, 3 and 5 are very similar to those of NV, the major differences being the group size and the number of winners. Combined with the across-gender beliefs we can use behavior in these tasks to first determine whether we can replicate the findings of NV. By comparing choices in task 3 and 4, we can then move on to determine the effect of affirmative action on the gender gap in tournament entry. Of particular interest will be the extent to which such changes are caused by the affirmative-action competition being within gender (Factor 4), or if it is accounted for by factors that are not associated with the active competition. Such non-competitive factors involve the change in the probability of winning (Factor 1), the fact that under affirmative action the probability of winning does not solely depend on across-gender beliefs but also within-gender beliefs (Factor 2), and that the mere mention of affirmative

[12] In the event of ties in actual rank we counted every answer that could be correct as correct. For example, if the performance in the group was 10, 10, 11, 12, 13, 13 then an answer of last and fifth was correct for a score of 10, and an answer of best and second was correct for a score of 13.

action may result in an exaggerated response to affirmative action (Factor 3). Performance in task 1 and 2 will help us control for changes in the probability of winning (i.e., Factor 1), the within-gender beliefs serve as a test of Factor 2, and we can use the choice in task 6 as a control for Factor 3.

IV. GENDER DIFFERENCES IN COMPENSATION CHOICES

We start by characterizing the tournament-entry decisions prior to the introduction of affirmative action, and we determine the extent to which we replicate the findings of NV. Although the experimental designs are very similar there are several dimensions in which the present study differs from that of NV. First, participants in this experiment were made aware that groups were gender balanced, hence they may have anticipated that gender would be a variable of interest. Such an expectation may have altered behavior.[13] Second, we examine groups of 6 individuals with 2 winners, rather than groups of four with one winner. Third, our return from winning is \$1.5 per problem, rather than \$2 per problem as in NV. Fourth, in this study we use students from the Harvard Business School CLER lab subject pool, rather than the PEEL subject pool at the University of Pittsburgh. Finally, the show-up and completion fees were altered to follow common practice at CLER. Each or all of these factors have the potential of influencing behavior. We first describe the results in the present study, and then show that despite differences we nonetheless replicate most of the results of NV.

IV.A. Piece Rate and Tournament: Performance and Choice

In both the piece rate and tournament we find significant gender differences in performance. In the piece rate the average number of correctly solved problems is 10.3 for women and 12.9 for men, and in the tournament the number is 12.3 for women and 14.8 for men. Two-sided Mann-Whitney tests show that both of these gender differences are significant ($p = 0.03$ and $p = 0.06$, respectively).[14] While the piece rate and tournament performances are highly correlated (spearman rank correlations of 0.62 for women and 0.79 for men), participants perform better

[13] For example, women may believe there is a stereotype against them performing well in a competition against men, and experience "stereotype threat." While performing a task this additional source of anxiety (namely to conform to the stereotype and fail to compete successfully) may lead to higher instances of "choking under pressure" (Steele 1997).

[14] Unless otherwise noted the corresponding t-test yields similar results.

under the tournament than the piece-rate (matched pair sign rank tests yield $p < 0.01$ for each gender separately).[15] The average increase in performance from the piece rate to tournament does however not differ by gender (a two-sided Mann-Whitney test yields $p = 0.73$).

The gender difference in performance causes the probability of winning the tournament to differ by gender. Of the 14 task-2 tournaments with 2 winners each, 20 were won by men and 11 by women (with three cases of ties). To assess the probability of winning the tournament we randomly create six-person groups from the observed performance distributions and determine the 2 winners. Conditioning only on gender, the probability of winning the tournament is 43.2 percent for a man and 23.5 percent for a woman. Table I reveals that conditional on performance the probability of winning is quite similar for women and men.[16]

TABLE I
PROBABILITY OF WINNING TASK-2 TOURNAMENT CONDITIONAL ON TASK-2 PERFORMANCE

	8	9	10	11	12	13	14	15	16	17	18	19	21	22	25	28	29	35
Women	0	0.1	0.6	2.5	8.6	21.8	40.7	58.1	71.4	80.2	87.1	92.2	--	96.2	--	--	--	--
Men	0	0.1	0.7	2.8	11.0	28.2	48.7	65.8	77.8	85.6	91.1	--	96.6	98.1	99.2	99.6	99.9	100

Having experienced both the 50-cent piece rate and the $1.50 tournament, participants are asked which of the two they want to apply to their task-3 performance. A participant in the tournament wins if his or her task-3 performance exceeds the task-2 performance of at least 4 members of the group, thus expected earnings in the tournament exceed those of the piece rate when the probability of winning the tournament exceeds 33 percent. As seen in Table I this corresponds to participants who solve 14 or more problems. If the participant's task-3 performance is exactly the same as the task-2 performance then 28.6 percent of the women and 50 percent of the men have higher earnings in the tournament. This predicted gender gap is significant (a two-sided Fisher's exact test yields $p = 0.07$). Unless otherwise noted the reported tests statistics henceforth refer to a two-sided Fisher's exact test

[15] This improvement may be caused by learning or by the different performance incentives under the tournament. Two results suggest that learning may play a prominent role. First, NV shows that tournament entry does not influence the participant's subsequent performance. Second, DellaVigna, Malmendier and Vesterlund (2005) have participants perform six rounds of 3-minute tournaments, and find a significant increase in performance from round 1 to round 2, but no significant increase in performance in subsequent rounds. This suggests that initial learning may have some effect.

[16] For any given performance level, say 15 for a woman, we draw 1,000,000 groups consisting of 3 men and 2 women, using the performance distribution of the 42 men and 42 women with replacement. We then calculate the woman's frequency of wins in this set of simulated groups.

The actual gender gap in tournament entry is even greater than predicted: 31 percent of women and 73.8 percent of men select the tournament. This gender gap in tournament entry is significant ($p < 0.01$) and significantly greater than expected ($p = 0.04$). While men enter significantly more than predicted by their task-2 performance ($p = 0.042$), women do not ($p = 1.0$).[17]

To compare the entry decisions of women and men, we condition their choices on their probability of winning the tournament. While prior to the introduction of affirmative action it is largely inconsequential to condition on the probability of winning rather than actual performance, this distinction is important when we study entry decisions in the affirmative-action environment where the probabilities of winning differ substantially between men and women. We regress the compensation choice on the probability of winning the task-2 tournament and on the change in the probability of winning a task-2 tournament when using the task-2 performance versus the task-1 performance.[18] Table II shows that while the probability of winning does not influence the tournament-entry decisions for women, it does increase the likelihood of entry by men. Pooling men and women and conditioning on the probability of winning, we find a significant gender gap of 36 percentage points. Specifically a man with a 33 percent chance of winning the tournament, and a change in the probability of winning from the piece rate to the tournament of 16 percentage points, would have a 36 percentage point lower chance of entering the tournament if he were a woman.[19]

[17] The over-entry of men is not significant ($p = 0.35$) when the threshold for optimal entry includes men with a performance of 13, i.e., those with a 28 percent (rather than the required 33 percent) chance of winning the tournament.

[18] Specifically, let $p_T(x)$ be the probability of winning the tournament with a performance of x (where $p_T(x)$ may differ for women and men). Then the change in the probability of winning the tournament when using the task-2 performance rather than the task 1 performance is $p_T(\textit{Task 2}) - p_T(\textit{Task 1})$.

[19] We evaluate the marginal effect at the point where a participant should be indifferent towards entering the tournament, that is, the probability of winning is 33 percent. This corresponds to having a performance of 13 and 14. The mean change in the probability of winning the tournament with the tournament rather than the piece rate equals 0.16 for participants with a performance of 13 and 14. Thus we assess the marginal effects when the change in the probability of winning the tournament to the piece rate is set to 0.16.

TABLE II
PROBIT OF TOURNAMENT CHOICE

	Task-2 Performance		
	Men	Women	All
Female			-0.36
			(0.00)
Probability of Winning	1.37	0.39	0.79
	(0.02)	(0.26)	(0.00)
Change in Prob. of	-0.62	-0.06	-0.29
Winning Tour. to PR	(0.21)	(0.88)	(0.27)
Observations	42	42	84

Dependent variable: task-3 compensation choice (1-tournament and 0-piece rate). The table presents marginal effects evaluated at a man with a 33 percent chance of winning the tournament and a change of 0.16 in the probability of winning from a piece rate tournament. *p*-values are in parenthesis.

A possible explanation for the gender difference in the decision to enter the tournament is that participants correctly anticipate a change in performance following their task-3 choice. There is, however, limited support for this explanation as a probit regression using performance in task 3 also fails to account for the gender gap in tournament entry.[20]

The gender gap in tournament entry is greatest among those with high performance. Of those who for a given task-2 performance have higher expected earnings in the tournament than the piece rate, i.e., those solving 14 or more problems, we find a significant ($p < 0.01$) gender difference in entry with entry by 100 percent of the men and only 33.3 percent of the women. In contrast the gender gap is insignificant (p=0.25) among participants who based on the task-2 performance have lower expected earnings in the tournament. For this group 47.6 percent of the men and 30 percent of the women enter.[21] From a payoff-maximizing perspective too few high-performing women enter the tournament.

IV.B. Explanations for the Gender Gap in Tournament Entry

Next we determine the extent to which we can account for the gender differences in tournament entry. As in NV we examine whether men are more overconfident than women and whether this explains why fewer women enter the tournament. Combined with beliefs we then

---

[20] When using task-3 performance to determine the probability of winning we find instead a 41 percentage point ($p < 0.01$) gender gap in tournament entry. The task-3 performance is highly correlated with the task-2 tournament performance (spearman rank correlations are 0.78 for women and 0.77 for men). The average increase in performance from task 2 is 0.5 for women, and this increase is not significant (matched pair signrank test yields p = 0.32, t-test p = 0.17). The improvement of 0.69 for men is significant (matched pair signrank test p = 0.06, t-test p = 0.07). Note however that there is no significant gender difference in the improvement (p = 0.35).

[21] The results are practically identical when using task-3 performance.

use the decision to submit the piece-rate performance to a tournament (task 5) to distinguish between the role played by gender differences in preferences for performing in a competition, and the more general explanations such as gender differences in overconfidence, risk and feedback aversion.

We first determine whether men and women of equal performance have different beliefs about their relative performance. Recall that to elicit beliefs on relative task-2 tournament performance we asked participants at the end of the experiment to guess how their performance ranked relative to the other members of their group. Participants received $1 if their guess was correct, and in the event of a tie they were compensated for any guess that could be deemed correct.[22] As men outperform women we cannot directly compare beliefs across gender. Instead we compare beliefs conditional on the participant's optimal guessed rank. A participant's optimal guessed rank is the rank that conditional on gender and performance would maximize their earnings from guessing.[23] Not surprisingly the optimal guessed ranks of women and men are significantly different (two-sided Mann-Whitney p = 0.05). Ordered probit regressions show that independent of gender, participants with a higher performance and thereby a higher optimal guessed rank, also believe that they have a higher rank.[24] However as a group, men are overconfident, while women are not.[25] These results are illustrated by Figure 1 which shows the participants' guessed rank conditional on the optimal guessed rank. The gender difference in beliefs is significant. Controlling for optimal guessed rank, men are more optimistic about their relative performance than women. An ordered probit regression of the guessed tournament rank yields coefficients of 0.39 on the optimal guessed rank ($p < 0.01$) and 0.66 on a female dummy ($p = 0.01$).

[22] A strong positive correlation between elicited ranks and tournament entry (Table III) suggests that hedging against the tournament-entry decision was not a dominant motive when reporting beliefs on relative ranking.

[23] For a given performance level, say 15 for a woman, we draw 1,000,000 groups consisting of 3 men and 2 women, sampling with replacement from the performance distribution of 42 men and 42 women. We then determine the woman's rank in each of these groups and the optimal guessed rank is the mode of these ranks.

[24] An ordered probit regression of the guessed tournament rank on the optimal guessed rank yields a coefficient of 0.42 for men and 0.34 for women, each with $p < 0.01$.

[25] For men, testing whether the distribution of guessed ranks is independent of that of the actual ranks yields p = 0.09, and comparing the distribution of guessed rank to the optimal ranks yields p = 0.04. For women, the comparisons of guessed ranks to actual ranks yields p = 0.51 and to optimal guessed ranks yields p = 0.37.

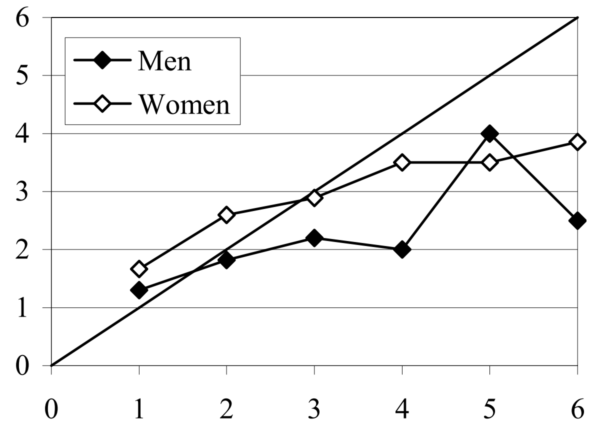


FIGURE I: The mean guessed rank for each optimal guessed rank

A method for summarizing beliefs which will prove helpful in our affirmative action analysis is to consider whether the participant's guessed rank is consistent with the belief that he or she will win the tournament.[26] We assess the participant's inferred belief on winning the tournament by comparing them to the belief on winning implied by the participant's optimal guessed rank. The results on beliefs are very similar when we use this binary belief measure, and the corresponding optimal guessed-win measure. Those who are most likely to win are also more likely to report beliefs consistent with winning. Conditional on optimal guessed win, men are significantly more likely than women to believe that they will win.[27] While men are overconfident, women are not.[28]

Next we examine the extent to which the overconfidence of men can explain why conditional on performance men enter the tournament more frequently than women. While entry decisions are positively correlated with the participants' beliefs on winning the tournament, there are still substantial gender differences.[29] Looking at the 53.6 percent of

[26] While the AA tournament entry decision conditional on guess win is predicted to be the same for men and women that is not the case when conditioning on guessed rank.

[27] A probit regression on the guess of winning the tournament yields marginal coefficients of -0.3 on a female dummy ($p = 0.01$), and 0.45 on the optimal guess of winning ($p < 0.01$), evaluated at a man whose optimal guess is to win the tournament.

[28] For men, testing whether the distribution of guessed win is independent of actual win yields $p = 0.05$, and a comparison of guessed win to optimal win yields $p = 0.07$. For women, the comparison of guessed win to actual win yields $p = 0.64$ and to optimal win $p = 0.48$. For women, the marginal coefficient of a probit regression of the guess on winning the tournament on the optimal guessed win yields a coefficient of 0.32 with a p-value of 0.06 on someone whose optimal guess is to win. For men the numbers are 0.48 ($p < 0.01$).

[29] A probit regression of the propensity to enter the tournament as a function of the guess of winning the task-2 tournament yields, for men: 0.45 ($p < 0.01$), and for women 0.45 ($p < 0.01$).

participants' who have beliefs consistent with winning the task-2 tournament, 86.7 percent of men enter the tournament, compared to 60 percent of women. Among the remaining 46.4 percent of participants whose beliefs are consistent with loosing the task-2 tournament, 41.7 percent of men enter the tournament, compared to 14.9 percent of women. While the gender gap is around 27 percentage points in both cases, the difference is only significant among those who believe that they will win ($p = 0.06$ and $p = 0.10$, respectively).

The probit regression of Table III shows tournament entry as a function of both absolute and believed performance. We see that tournament entry is more likely for men and for those who believe they are most likely to win.[30]

Table III

PROBIT OF TOURNAMENT-ENTRY DECISION (TASK 3):

	(1)	(2)
Female	-0.36	-0.25
	(0.00)	(0.03)
Probability of Winning	0.79	0.45
	(0.00)	(0.02)
Change in Prob. of Winning Tour. to PR	-0.29	-0.31
	(0.27)	(0.15)
Guess Win		0.35
		(0.01)
Observations	84	84

Dependent variable: task-3 compensation choice (1-tournament and 0-piece rate). The table presents marginal effects evaluated at a man with a 33 percent chance of winning the tournament, and a 0.16 change in the probability of winning from a piece-rate to a tournament, who thinks that he would win the tournament (i.e., ranks either first or second in his group of six) in column 2. *p*-values are in parenthesis.

Our results demonstrate that although gender differences in overconfidence help account for part of the gender difference in tournament entry a substantial portion of the gap remains unexplained. When only controlling for performance the gender gap was 36 percentage points (Column 1), this gap reduces to 25 percentage points when we also control for the participants' imputed beliefs on winning the tournament. Thus the overconfidence by men helps explain the gender gap in tournament entry.

To account for the unexplained gap in tournament entry we try to simultaneously determine the role played by gender differences in general factors such as overconfidence, risk and feedback aversion. For this purpose we rely both on the elicited beliefs and the

[30] When we use the belief on rank instead of guess win, the marginal coefficient on female in the probit regression is reduced to -0.18 ($p = 0.04$).

compensation choice in task 5. In task 5 participants choose between a competitive and a non-competitive compensation scheme for their past task-1 piece-rate performance. The decision to submit a past piece-rate performance to a tournament (task 5) and the decision to enter a tournament and perform in a competition (task 3) have similar characteristics. In both cases the choice is between a piece-rate versus a tournament-payment scheme, and in both cases the decision depends on the participants' beliefs about relative performance. Furthermore in both cases a choice of tournament will provide participants with feedback on their relative performance.[31] The difference between the two decisions is that only when participants enter the tournament do they subsequently have to perform in a tournament. Thus while general factors, such as overconfidence, risk and feedback aversion, can influence the compensation choices in task 3 and 5, only in task 3 can differences in preferences for performing in a competition play a role.[32]

Combined with the elicited beliefs we use the task-5 decision to determine if the act of performing in a competition creates a gap in tournament entry that cannot be explained by these general factors. That is, we determine whether an explanation for the tournament-entry gap may be that women, relative to men, are more averse to choices that require a future performance in a competitive environment. As seen in Table IV the effect of controlling for the task-5 decision is substantial. While adding beliefs reduced the gender gap in tournament entry from 36 to 25 percentage points (Columns 1 and 2), the gender gap is further reduced to 17 percentage points when controlling for the decision to submit the piece rate (Column 3). This decrease may be explained both by the control for risk and feedback aversion, and by the fact that the decision to submit the piece rate serves as an additional measure of the individual's general degree of confidence. It is therefore not surprising to see that the coefficient on Guess Win decreases as we move from Column 2 to Column 3.[33] While we see that gender differences in overconfidence, risk and feedback aversion help explain the gender gap, a substantial gap still remains. The remaining gender gap in tournament entry suggests that the

[31] That is they will learn whether they are among the two top performers.

[32] An indication of the differences between task 3 and task 5 is that conditional on the probability of winning a task-1 tournament there are no gender differences in tournament entry in task 5.

[33] When we use the belief on the rank instead of guess win, the marginal coefficient on female in the probit regression is -0.15 (p = 0.04). That is, in this case, adding the decision to submit the piece-rate result to a tournament only yields a minor reduction of 3 percentage points in the gender gap in tournament entry.

decision to enter the tournament is explained in part by men and women differing in their preference for performing in a competitive environment.

TABLE IV
PROBIT OF TOURNAMENT-ENTRY DECISION (TASK 3)

	(1)	(2)	(3)
Female	-0.36	-0.25	-0.17
	(0.00)	(0.03)	(0.04)
Prob. Of Winning	0.79	0.45	0.22
	(0.00)	(0.02)	(0.08)
Change in Prob. of Winning Tour. to PR	-0.29	-0.31	-0.11
	(0.27)	(0.15)	(0.45)
Guess Win		0.35	0.25
		(0.01)	(0.01)
Submit the Piece Rate			0.15
			(0.10)
Observations	84	84	84

Dependent variable: task-3 compensation choice (1-tournament and 0-piece rate). The table presents marginal effects evaluated at a man with a 33 percent chance of winning, a 0.16 change in probability of winning, who submitted his piece rate to the tournament, and thinks that he wins the tournament (i.e., ranks first or second in his group of six). *p* -values are in parenthesis.

IV.C. Comparison to NV

Although there are several differences between this study and that of NV, the overall findings of the two studies are nonetheless very similar. While NV found no significant gender differences in performance, in the present study men on average outperform women by 2.5 problems in both the piece rate and the tournament. Interestingly the female performance in the present study is in line with that of NV, where on average men and women solve 10.4 problems in the piece rate and 12 problems in the tournament.[34] The gender differences in tournament entry are however similar in the two studies. In NV the gender gap in tournament entry is 38 percentage points when controlling only for the probability of winning the tournament, controlling also for the participant's belief on winning the task-2 tournament this gap reduces to 26 percentage points, and finally the addition of the decision to submit the piece

[34] Our design does not enable us to determine what causes this gender gap in performance, in particular we do not know if it is caused by participants knowing that gender will be a variable of interest in this study.

rate to a tournament reduces the gap to 14 percentage points. In comparison the present study finds that the corresponding gender gaps become 36, 25, and 17 percentage points.[35]

Thus the results of NV are both qualitatively and quantitatively similar to those found here. The only difference between the two studies is that while NV find that low-performing men enter the tournament more often than low-performing women, this difference is not significant in the present study.[36]

V. AFFIRMATIVE ACTION

To examine the effects of affirmative action we start by determining how the requirement that at least one of two winners be a woman influences tournament entry and the extent to which this response can be accounted for by changes in the probability of winning.

V.A. Entering the AA tournament (Task-4 Choice)

The introduction of affirmative action increases the probability of winning the tournament for women whiled decreasing it for men. If participants in an AA tournament had performances as in task 2 then the predicted probabilities of winning would be 36.2 percent for women and 30.4 percent for men. Conditional on both gender and individual performance, the probabilities of winning the AA tournament are as reported in Table V.[37]

TABLE V

PROBABILITY OF WINNING TASK-4 TOURNAMENT CONDITIONAL ON TASK-2 PERFORMANCE:

	9	10	11	12	13	14	15	16	17	18	19	21	22	25	28	29	35
Women	1.8	4.9	10.5	25.3	46.9	64.6	77.3	85.7	91.1	94.7	97.3	--	99.3	--	--	--	--
Men	0.1	0.4	1.6	5.5	14.2	26.8	39.6	50.6	58.6	66.8	--	75.3	79.6	84.0	88.5	93.0	97.6

As noted earlier, anyone with a 33 percent or higher chance of winning the tournament has higher expected earnings from the tournament than from the piece rate. Thus, as seen in Table V women with a performance of 13 or more and men with a performance of 15 or more are in

[35] To conform with the present study we control for the probability of winning and the participants guess win. Including all participants these numbers are therefore not exactly the same as those reported in NV.

[36] Subsequent experiments at Harvard suggest that this difference is significant in a second sample, and when using the larger combined sample (Niederle, Segal, Vesterlund, in preparation).

[37] Following the procedure of Table I: For any given gender and performance level, say a woman with a performance of 15, we draw 1,000,000 groups consisting of 3 men and 2 women, using the performance distribution of the 42 men and 42 women with replacement. We then calculate the frequency of wins for the individual in question.

expectation better off selecting the AA tournament than the piece rate. While affirmative action changes the probability of winning for all participants relative to the standard tournament, it is worth noting that the cut-off performance at which it becomes profitable to enter the tournament only decreases by one correct problem for women and increases by one correct problem for men. If the participants' task-4 performance is just like the task-2 performance, then it is payoff maximizing to enter the AA tournament for 40.5 percent of women and 38.1 percent of men.[38] This predicted gender gap of 2.4 percent is not significant ($p = 1.0$).

Contrary to this prediction we observe a substantial gender gap in entry into the AA tournament. With 83.3 percent of women and 45.2 percent of men entering, the entry of women is significantly greater than predicted while that of men is not ($p < 0.01$ and $p = 0.66$, respectively).[39] The excessive entry by women results in a significant gender gap in tournament entry ($p < 0.01$), which differs significantly from that predicted ($p < 0.01$).[40]

Our findings in the AA tournament therefore contrast sharply with those of the standard tournament. While men in the standard tournament enter more than predicted and more than women, this result is reversed under affirmative action as women enter more than predicted and more than men. Next we examine the extent to which these changes between the standard and AA tournament can be accounted for by the changes in the probability of winning.

V.B. The Effect of Changes in the Probability of Winning on AA Tournament Entry

Relative to the entry in the standard tournament, affirmative action causes a significant increase in entry by women ($p < 0.01$) and simulations show that this increase is significantly greater than what one would have expected based on the increase in the probability of winning ($p < 0.01$). By contrast, affirmative action causes a significant decrease in the tournament entry by men ($p = 0.01$) and this reduction is significantly larger than predicted by the decrease in the probability of winning ($p = 0.04$). A consequence of the differential responses under affirmative action is a significant change in the gender gap in tournament entry ($p < 0.01$) which exceeds the predicted change ($p < 0.01$).

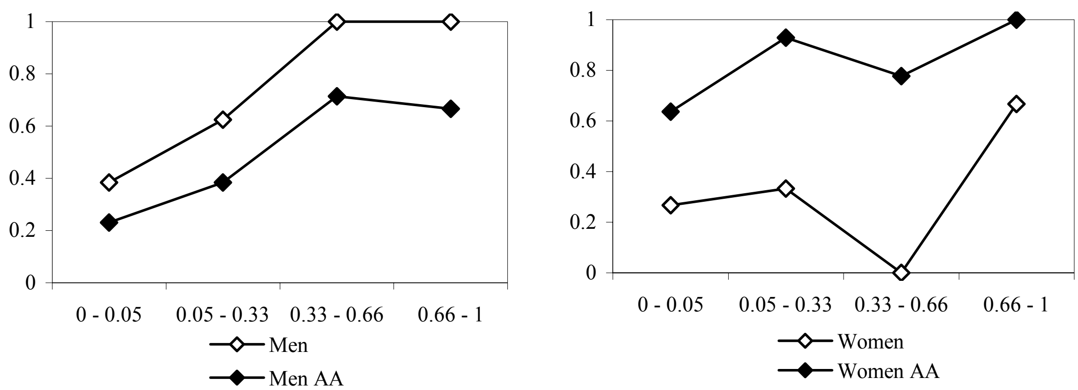
---

[38] Using the task-2 performance distribution five more women and five fewer men are above the cutoff.

[39] When we include women who solve 12 or more problems as potential entrants, we still find that women enter at a higher rate than predicted, $p = 0.08$.

[40] The values for the predicted gender gap are calculated by simulations. We calculate the expected minus the actual gender gap in the decision to enter the AA tournament for 1.000.000 simulations in which we draw 42 women and 42 men with replacement (where we use the thresholds implied by Table V). We report the percentage of strictly positive differences.

To assess how the change in the probability of winning under affirmative action affects tournament entry, we compare the entry decisions under the standard and AA tournament. Figure II panel A shows the proportion of men who enter the standard and the AA tournament conditional on their probability of winning each tournament. Panel B shows the corresponding figure for women. Both figures use the task-2 performance prior to the entry decision to determine the probability of winning, the figures are similar if we instead use ex-post performance (i.e., task 3 and 4). If changes in tournament entry solely were driven by changes in the probability of winning, then the two propensities to compete should coincide for the standard and AA tournaments.



Panel (A) Panel (B)

FIGURE II: Proportion of participants entering the standard or the AA tournament conditional on probability of winning the tournament given ex-ante performance (task 2).[41]

Figure II shows that affirmative action causes men to reduce their propensity to enter the tournament beyond what is warranted by changes in the probability of winning the tournament. The overreaction by women appears even greater, as they are much more likely to compete under affirmative action.

[41] The bin size was chosen to secure similar numbers of participants in each bin. The number of individuals in each bin is as follows: In panel A, in the standard tournament there are 13, 8, 8, and 13, in each of the four bins with 13 in 0-0.05. In the AA tournament there are 13, 13, 7, and 9. In panel B, in the standard there are 15, 15, 6, and 6, and in the AA there are 11, 14, 9, and 8.

This result is confirmed by a probit regression of the decision to enter a tournament on the probability of winning as well as an affirmative action dummy (Table VI). We use two observations for each participant, specifically we use both the decision to enter the task-3 tournament, and the decision to enter the task-4 AA tournament. To account for the fact that these two observations are not independent, we cluster on the participant. For each individual we condition the tournament-entry decision on the probability associated with winning the tournament in question. If the entry decisions of women and men depend solely on the probability of winning the tournament, then the marginal coefficient on the affirmative action dummy (AA) should be zero. Consistent with Figure II we see that conditional on the probability of winning the effect of affirmative action on entry is negative for men, and positive for women.[42]

TABLE VI
PROBIT OF TOURNAMENT CHOICE

	Task 2 Performance		
	Men	Women	All
Female			-0.37
			(0.00)
Female*AA			0.26
			(0.00)
AA	-0.29	0.51	-0.27
	(0.01)	(0.00)	(0.01)
Prob. of Winning	0.90	0.28	0.64
	(0.00)	(0.28)	(0.00)
Change in Prob. of Winning Tour. to PR	-0.35	0.30	-0.09
	(0.22)	(0.25)	(0.61)
Observations	84	84	168

The table presents marginal effects evaluated at a man in the standard tournament, with a probability of winning of 0.33 and a change in the probability of winning of 0.16. We cluster on participant to account for there being 2 observations for each of the 84 participants. *p*-values are in parenthesis.

[42] The result is the same if we instead condition on the probability of winning after the entry decision, that is on task 3 and task 4. Relative to task 2, both women and men improve their performance in task 4, however there is no gender difference in the improvement. The significant improvements in performance are 0.62 for women and 0.83 for men (matched pair signrank tests $p = 0.04$ and 0.05 respectively). The resulting gender difference is not significant ($p = 0.95$). Furthermore the improvement in performance does not vary by the task-4 choice ($p = 0.91$ if enter, $p = 0.36$ if piece rate), nor is there a difference when conditioning both on gender and task-4 choice ($p \geq 0.35$). The improvement in performance is primarily driven by the increase in performance between task 2 and 3. The improvement between task 3 and 4 is insignificant and equals 0.12 for women and 0.14 for men (matched pair signrank test yields $p = 0.79$ and 0.97, respectively), the gender difference in improvement is not significant ($p = 0.91$). Neither men nor women who enter the tournament have a significantly different improvement in performance in the AA choice task (task 4) relative to the former (task 3) choice ($p \geq 0.14$).

In the pooled regression we find that affirmative action causes a significant change in the gender gap in tournament entry, as seen by the significant female and affirmative action interaction. The introduction of affirmative action causes an increase in entry by women and a decrease by men. And these changes are larger than what would be predicted based on the change in the probability of winning.

VI. EXPLANATIONS OF THE CHANGES IN TOURNAMENT ENTRY UNDER AA

Given that the change in the probability of winning does not fully account for the changes in tournament entry under affirmative action, we continue by considering the other explanations we proposed in Section II. Specifically we examine if one reason for the substantial response may be that the participant's belief on the probability of winning changes beyond the actual change introduced by affirmative action. As the chances of winning the AA tournament are sensitive to relative performance within gender we are particularly interested in determining whether the gender differences in beliefs on rank within one's own gender are similar to those observed across gender. Having controlled for changes in beliefs we proceed to use the decision to submit a past piece-rate performance to an AA tournament (task 6) to determine if merely mentioning affirmative action gives rise to excessive changes in tournament entry. This decision also serves as an additional control for the effect of beliefs, and it accounts for the possibility that the response to risk and feedback aversion differs under affirmative action.

VI.A. Do Beliefs Explain Changes in Tournament Entry under AA?

In the standard tournament we found that beliefs about relative performance played an important role in explaining the gender gap in entry. Conditional on optimal guessed rank, men were significantly more optimistic about their relative performance than women, and this difference in beliefs helped explain the gender gap in tournament entry. If participants' beliefs on winning are similar in the AA and standard tournament then it is unlikely that beliefs will help explain the change in tournament entry under affirmative action. In fact, if men remain more confident than women, then the gender gap in tournament entry will instead be exacerbated when controlling for beliefs.

We first analyze beliefs on relative ranking within gender.[43] We then impute beliefs on having a winning task-2 AA-tournament performance using both beliefs on rank within gender and across gender. We refer to this measure as guess AA win. For both measures of beliefs we determine the extent to which beliefs differ between the standard and AA tournaments. Finally, we investigate the effect changes in beliefs have on explaining the change in tournament entry under affirmative action.

To analyze beliefs on within gender ranking in task-2, we determine, for women and men, the guess which would be money-maximizing given the individual performance.[44] Neither women nor men seem overconfident. The distributions of guessed ranks within gender are not significantly different from the actual or the optimal guessed rank (p = 0.60 and p = 0.21 for women, and p = 0.45 and p = 0.45 for men, respectively).[45] Ordered probit regressions confirm that the guessed ranks within gender are correlated with optimal guesses, and that there is no gender difference in beliefs about relative tournament performance within one's gender. That is, women seem as confident in their relative performance among women, as men do among men.[46]

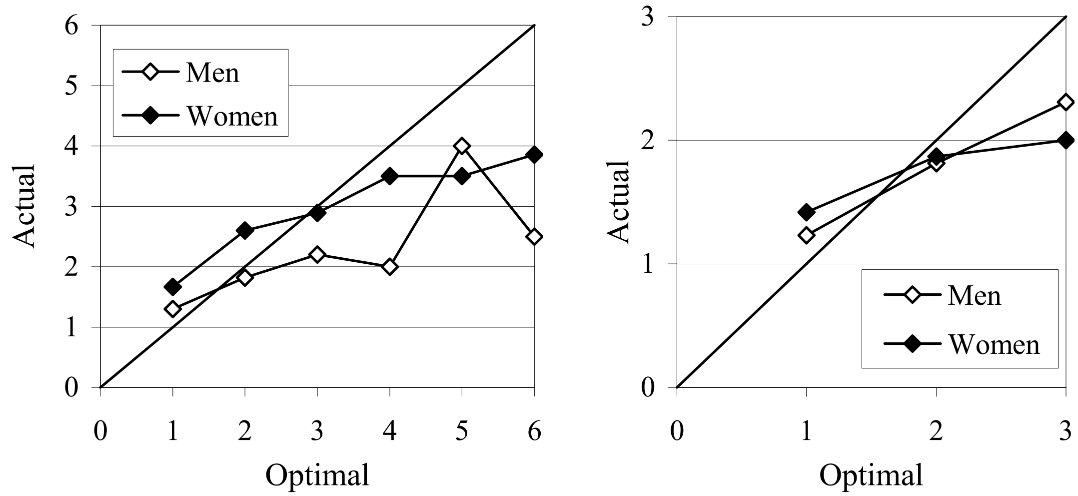
While men are significantly more confident than women when assessing relative ability in a mixed gender group, there is no gender difference in beliefs within one's own gender. Figure III shows for each optimal-guessed rank the average guessed rank of women and men. Panel A shows the rankings among all 6 participants, while Panel B shows rankings within one's gender.

[43] At the end of the experiment we first elicit the participants' beliefs about their relative task-2 tournament performance within the whole group and then relative to the other group members of the same gender. Participants receive $1 if their guess is correct, and in the event of ties they are compensated for any guess that can be deemed correct.

[44] For a given gender with a given performance level, say a woman with a performance of 15, we draw 1,000,000 groups consisting of 2 other individuals of the same gender, where we use the sample of 42 men or 42 women with replacement. In each simulated group we determine the rank for the individual in question, and the modal rank for the simulated groups is reported as the optimal guessed rank.

[45] The actual rank corresponds to the highest actual rank possible in case of ties The distributions of optimal rank and actual rank within gender do not differ (p = 0.74 for men and p = 1.0 for women).

[46] An ordered probit regression of guessed rank on optimal rank within gender yields coefficients for men of 0.99 (p < 0.01), and 0.46 (p = 0.04) for women. Pooling all 42 women and 42 men yields coefficients of -0.04 on a female dummy (p = 0.87), and 0.70 on optimal rank (p < 0.01).



Panel (A) Panel (B)

Figure III: Average guessed rank as a function of optimal tournament rank in the whole group of 6 participants (A), and among group members of one's gender (B).

Due to the differential number of people in the overall group and among group members of the same gender, it is not obvious how one is to compare the two sets of beliefs. One approach is to categorize the elicited beliefs across gender into three categories which may correspond to the three possible ranks within gender. Let the first category contain those who thought they would win the tournament (i.e., rank 1 and 2), the second category those who thought they were third or fourth, and the third category those who thought they were fifth or sixth. Using these re-categorized ranks and comparing them to the within-gender beliefs, we find that men appear more confident across gender than within gender, whereas women seem to hold the same beliefs on relative ranking in the overall group as among group members of the same gender.[47]

Another approach to evaluating beliefs is to instead construct the participants' beliefs on whether they would have won the task-2 tournament under AA rules (guess AA win). Recall that a woman wins the AA tournament if she is *either* the best performing woman or

[47] Grouping according to rank 1, 2, and 3, the numbers of men who guess each category are 30, 10, and 2 across gender versus 17, 17, and 8 within gender. This difference is significant (p = 0.011). For women the numbers are 15, 19, and 8 across gender, versus 17, 17, and 8 within. This difference is not significant (p = 0.958). Similar results are obtained when we regress the guessed ranks on their respectively formed optimal ranks and a dummy for within gender beliefs where for each participant we use two observations and cluster on the participant. These data make clear that the differential gender differences in beliefs in across versus within gender are not caused by there being six versus three possible ranks. The gender difference in across gender beliefs remains significant when the data is grouped in three categories (p = 0.003) .

among the two best performing participants in the group. A man, on the other hand, wins the AA tournament if he is *both* the best performing man and among the top two performers overall. We compare guess AA win both to the actual outcomes as well as to the belief on winning that is consistent with the participant's optimal guessed rank. We refer to this measure as optimal guess AA win. Similar to our results on guessed rank within gender we find for guess AA win that neither women nor men are overconfident.[48] Furthermore, we find no gender differences in guess AA win when conditioning on optimal guess AA win.[49] This result contrasts that of the standard tournament where conditional on optimal guess win, men are significantly more likely than women to believe that they will win. As expected when comparing the beliefs on winning between the standard and the AA tournament we find that under affirmative action men become less confident that they will win, whereas women become somewhat more confident. Note however that this change in confidence is only significant for men.[50]

To evaluate the impact of beliefs on changes in tournament entry we condition on the guess win measure, see Table VII.[51] Looking at the first four columns, we see that, controlling for performance, individuals who have beliefs consistent with winning are more likely to enter the tournament, however in a two-sided test this effect is only significant for women. Nonetheless, as seen by the coefficient on the AA dummy, for both men and women including a measure of beliefs on relative performance reduces the change in the propensity to enter a tournament with affirmative action by about 20 percent.

---

[48] On average the guessed AA win is not significantly different from actual AA win ($p = 0.50$ for men, and $p = 0.51$ for women), or the optimal guess AA win ($p = 1.0$ for men and $p = 0.49$ for women).

[49] A probit regression of guess AA win for the 84 participants delivers the following marginal effects evaluated at a man with an optimal guess of winning: 0.08 on female ($p = 0.43$); 0.40 on optimal guess AA win ($p < 0.01$). Examining men and women separately yields coefficients on optimal guess AA win of 0.53 ($p < 0.01$) for men, 0.27 ($p = 0.12$) for women. Furthermore, there are no significant gender differences in distributions of optimal guesses ($p = 1.0$), actual chances of winning ($p = 0.65$), nor guessed AA win ($p = 0.66$).

[50] In the standard tournament 30 men (70%) guess they will win the tournament, compared to only 17 (40.5%) in the AA tournament. In comparison 15 women (35.7%) guess that they will win the standard tournament, while 20 (47.6%) guess that they will win the AA tournament. The marginal effects of a clustered probit regression of guess win (standard or AA) evaluated in the standard tournament for someone who optimally should guess they win are for men 0.40 ($p < 0.01$) on optimal guess and -0.15 ($p < 0.01$) on AA dummy. For women the coefficients are 0.36 ($p = 0.03$) and 0.08 ($p = 0.10$) respectively. A pooled regression shows a significant gender difference in the response to affirmative action, the marginal coefficient on a female and AA interaction is 0.06 ($p = 0.00$), when controlling for optimal guesses, AA and female dummies, and evaluating coefficients at a man in the standard tournament whose optimal belief is to win the standard tournament.

[51] As in Table VI we have two observations per participant.

TABLE VII

PROBIT OF TOURNAMENT CHOICE

	Men	Men	Women	Women	All	All
Female					-0.37	-0.29
					(0.00)	(0.01)
Female*AA					0.26	0.18
					(0.00)	(0.00)
AA	-0.29	-0.23	0.51	0.40	-0.27	-0.18
	(0.01)	(0.04)	(0.00)	(0.00)	(0.01)	(0.07)
Prob. Of Winning	0.90	0.70	0.28	0.06	0.64	0.40
	(0.00)	(0.00)	(0.28)	(0.83)	(0.00)	(0.00)
Change Prob. Winning	-0.35	-0.38	0.30	0.23	-0.09	-0.15
Tour. to PR	(0.22)	(0.15)	(0.25)	(0.41)	(0.61)	(0.31)
Guess to win		0.19		0.38		0.27
		(0.16)		(0.00)		(0.00)
Observations	84	84	84	84	168	168

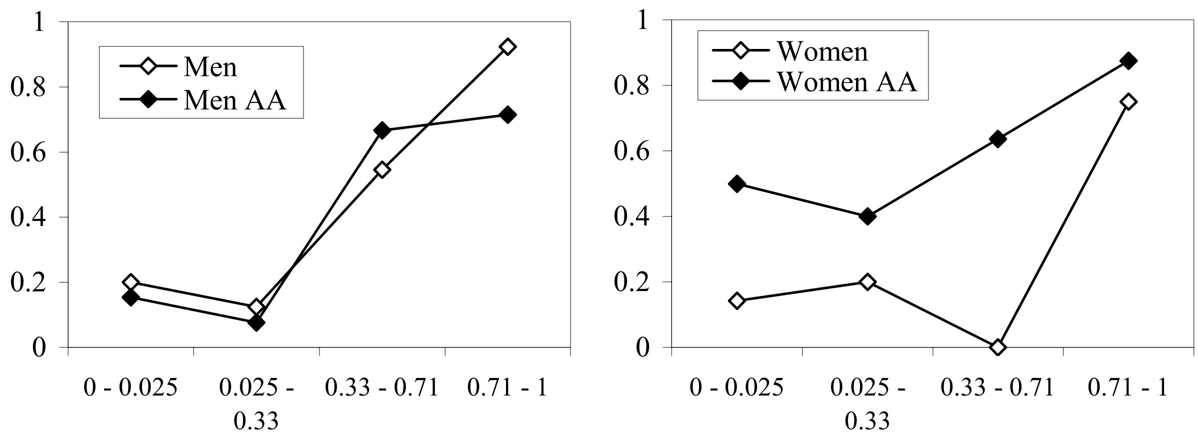
The table presents marginal effects evaluated at a man, in the standard tournament, with a 0.33 percent probability of winning and a change in the probability of winning of 0.16, with a guess of winning. We cluster on the participant to account for there being 2 observations for each of the 84 participants. *p*-values are in parenthesis.

Guess win is also significant in the pooled regression. Thus part of the change in the gender gap is explained by men being overconfident about their relative performance when competing in mixed gender groups, and less so when competing only against men. Accounting for beliefs the coefficient on the female and affirmative action interaction remains significant, indicating that the change in the gender gap in tournament entry under affirmative action is not fully accounted for by changes in beliefs.

VI.B. Effects of Submitting the Piece-Rate Results?

Next we use the decision to submit a piece rate to an AA tournament (task 6) to control for the possibility that merely mentioning affirmative action can increase the entry for women and decrease it for men. In task 6 participants are asked whether they want to apply their task-1 piece-rate performance to the 50-cent piece rate or the $1.50 AA tournament. The decision to submit a past piece-rate performance to an AA tournament may depend on the participant's beliefs about relative performance, risk and feedback aversion, and on the response to affirmative action being mentioned. Because there is no tournament performance involved, the task-6 decision does however not depend on the thrill a participant may receive from performing in a competition. Thus in explaining the change in tournament entry under AA we use the task-6 decision as a control for confidence, risk and feedback aversion, and as a control for the effect of mentioning affirmative action per se.

Figure IV shows the proportion of women and men who submit their task-1 piece-rate performance to the standard tournament (task 5) or the AA tournament (task 6), as a function of their chance of winning each tournament. While women are much more likely to submit to an AA tournament, the change in the decision by men appears limited to changes in the probability of winning.



Panel (A) Panel (B)

Figure IV: Proportion of participants who submit their piece-rate performance to a standard or an AA tournament conditional on the task-1 probability of winning the tournament.[52]

To account for changes in the decision to submit the piece-rate result as we introduce affirmative action, we condition the decision on both the actual probability of winning, as well as the participants' guess win.

[52] The number of individuals in each bin is as follows: In panel A, in the standard tournament there are 10, 8, 11, and 13, in each of the four bins with 10 in 0-0.025. In the AA tournament there are 13, 13, 9, and 7. In panel B, in the standard there are 12, 20, 4, and 4, and in the AA there are 8, 15, 11, and 8.

TABLE VIII

PROBIT OF SUBMITTING THE PIECE RATE

	Men	Women	All
Female			-0.17
			(0.11)
Female*AA			0.10
			(0.00)
AA	-0.04	0.28	-0.06
	(0.12)	(0.00)	(0.17)
Prob. of Winning	0.04	0.35	0.17
	(0.52)	(0.096)	(0.06)
Guess to win	0.83	0.55	0.72
	(0.00)	(0.00)	(0.00)
Observations	84	84	168

The marginal effects are evaluated at a man, in the standard tournament, with a probability of winning of 0.33, with a guess of winning. We cluster on the participant to account for there being 2 observations for each of the 84 participants. *p*-values are in parenthesis.

The probit regression in table VIII confirms that even controlling for beliefs Figure IV provides the correct impression. The introduction of affirmative action does not cause men to change their decision to submit a piece-rate result to a tournament, the coefficient on the AA dummy is very small and at best marginally significant. Women on the other hand are 28 percentage points more likely to submit their piece-rate performance when we introduce affirmative action. Thus in the pooled analysis the coefficient on the female and affirmative action interaction is significant, demonstrating that the gender gap in submitting the piece rate differs significantly between the standard and affirmative-action tournament.

While simply mentioning affirmative action does not affect men, it does for women. We need to control for this gender difference when trying to understand the effect affirmative action has on tournament entry. Table IX examines changes in the decision to enter a tournament under affirmative action, when we control for the probability of winning, beliefs, as well as the decision to submit the piece-rate result to a tournament. This decision controls for the effect of mentioning affirmative action per se, as well as risk and feedback aversion, and it also adds an additional measure of beliefs.

TABLE IX
PROBIT OF TOURNAMENT CHOICE

	Men	Men	Men	Women	Women	Women	All	All	All
Female							-0.37	-0.29	-0.18
							(0.00)	(0.01)	(0.02)
Female*AA							0.26	0.18	0.07
							(0.00)	(0.00)	(0.00)
AA	-0.29	-0.23	-0.09	0.51	0.40	0.25	-0.27	-0.18	-0.09
	(0.01)	(0.04)	(0.09)	(0.00)	(0.00)	(0.00)	(0.01)	(0.07)	(0.11)
Prob. of Winning	0.90	0.70	0.19	0.28	0.06	-0.09	0.64	0.40	0.13
	(0.00)	(0.00)	(0.01)	(0.28)	(0.83)	(0.71)	(0.00)	(0.00)	(0.03)
Change Prob. Winning	-0.35	-0.38	0.01	0.30	0.23	0.43	-0.09	-0.15	0.06
Tour. to PR	(0.22)	(0.15)	(0.92)	(0.25)	(0.41)	(0.11)	(0.61)	(0.31)	(0.42)
Guess to win		0.19	0.05		0.38	0.35		0.27	0.12
		(0.16)	(0.39)		(0.00)	(0.01)		(0.00)	(0.02)
Submit Piece Rate			0.30			0.29			0.24
			(0.00)			(0.07)			(0.00)
Observations	84	84	84	84	84	84	168	168	168

The marginal effects are evaluated at a man, in the standard tournament, with a probability of winning of 0.33 and a change in the probability of winning of 0.16, with a guess of winning. We cluster on the participant to account for there being 2 observations for each of the 84 participants. *p*-values are in parenthesis.

Conditioning on these factors we see that the introduction of affirmative action decreases the probability that a man enters a tournament by 9 percentage points. This remaining effect may represent the reduction in the thrill of competing mostly against men as compared to competing against women as well. For women, the remaining effect of affirmative action is a 25 percentage points increase in tournament entry. Examining men and women jointly we find that the decision to submit the piece rate to the affirmative action tournament helps explain the change in the gender gap. However controlling both for beliefs and the task-6 decision we still find a significant interaction between the affirmative action and female dummies. Thus the gender gap in tournament entry differs significantly between AA and standard tournament.[53] This remaining difference may be ascribed to the competition being more gender specific under affirmative action. Men may feel more pressure to compete primarily against other males, while women may feel less performance pressure in all female groups.

[53] Note that the coefficient on the female-affirmative action interaction does not capture the change in the gender gap between the standard and the affirmative action tournament. The change in the gender gap is given by [Pr(AA=1, F=1, AA·F=1;X) - Pr(AA=1, F=0, AA·F=0;X)] – [Pr(AA=0, F=1, AA·F=0;X) - Pr(AA=0, F=0, AA·F=0;X)]. Conditioning only on the probability of winning the change in the gap equals 0.76. The additional controls for beliefs and the decision to submit the piece rate reduces the gap to 0.31, thus 41 percent of the change in the gap is not accounted for.

VII: How Costly is Affirmative Action

Needless to say the introduction of affirmative action will be beneficial for some and disadvantageous for others. Since behavior is not payoff maximizing it is not obvious who will and will not benefit from affirmative action. We start by examining the consequences on earnings for the participants themselves. We then examine the effect affirmative action has on the quality and gender composition of the pool of entrants and winners of tournaments. That is the cost of diversity in terms of performance.

VII.A. Consequences for Participants

The effect of affirmative action on individual payoffs is driven both by institutional and behavioral changes, that is, payoffs will be influenced both by the change in the probability of winning and by the resulting changes in tournament entry. A comparison of participant's expected earnings in the standard and affirmative action environments provides an estimate of the combined effect of these two factors. To decompose the two we also determine what the participants' payoffs would have been had they simply been subjected to the change in the probability of winning, but not changed their tournament-entry decisions. That is, we determine what expected earnings would have been had they stuck with the standard-tournament entry decisions (task 3) and been given the affirmative action probability of winning (task 4). The three expected payoff measures are reported by gender in Table VII. As anticipated, we see that on average women are better off while men are worse off under affirmative action. For women the overall effect on earnings is an increase from 6.8 to 8.4. Had the tournament-entry decision under affirmative action been as in the standard tournament, then the change in the probability of winning alone would result in expected payoffs of 7.5. Thus 45 percent of the increase in payoffs is accounted for by changes in the probability of winning, while the remainder results from changes in tournament entry. By comparison the decrease in payoffs of men from 13.4 to 10.0, is primarily caused by changes in the probability of winning. The institutional change in of itself results in payoffs decreasing to 10.5, and thus account for 85 percent of the decrease in payoffs. A similar pattern is seen for the subgroup of participants who have higher expected earnings from entering the AA tournament. For women in this group we see that 75 percent of the increase in payoffs is due to behavioral changes, whereas 70 percent of the decrease in payoffs for men is due to changes in the probability of wining. Finally we notice that the men and women who in expectation are better off not entering the tournament are worse off under affirmative action. For women this decrease in payoffs is driven by them making inferior tournament-entry decision under affirmative action, whereas the behavior of men actually improves their earnings. The change in payoffs is however rather small for participants who in expectation should avoid the AA tournament.

TABLE X

EXPECTED PAYOFFS

Participants	Prob. of winning	Entry decision	Men	Women
All				
	Standard	Standard	13.4	6.8
	AA	Standard	10.5	7.5
	AA	AA	10.0	8.4
w/ positive exp. earnings from AA entry				
	Standard	Standard	27.1	10.8
	AA	Standard	21.4	12.2
	AA	AA	18.9	16.5
w/ negative exp. earnings from AA entry				
	Standard	Standard	5.0	4.0
	AA	Standard	3.7	4.3
	AA	AA	4.5	2.9

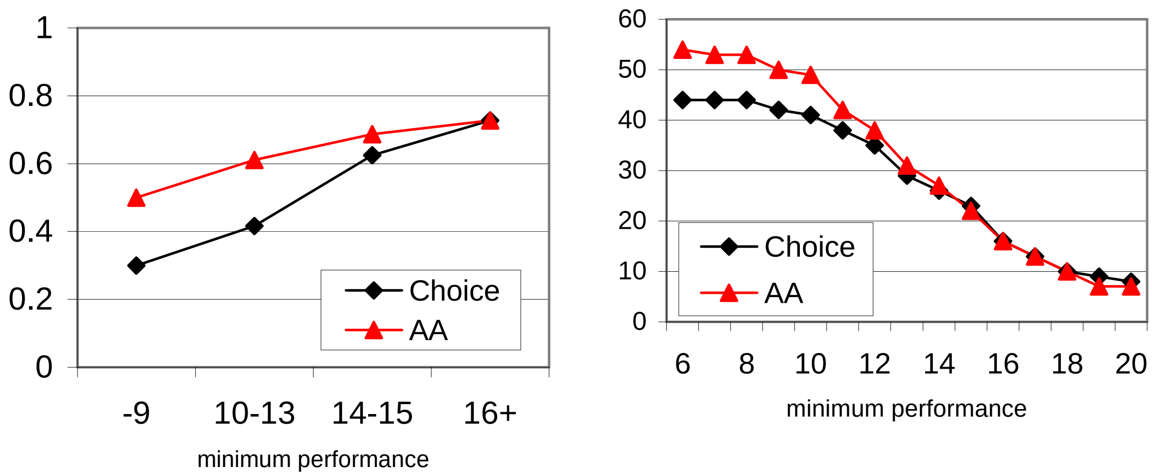
VII.B. Consequences for Diversity and Performance

The primary objective of introducing affirmative action is the desire to secure that a more diverse pool of applicants be selected. While it is clear that affirmative action by mere design will result in greater diversity among the winners it is less clear how costly it will be to achieve this goal. If we view the winners of the competition as those who will be hired by the firm, then the costs of affirmative action depend critically on how many better performing men a firm will have to pass by in order to select at least one female winner for every male. Passing by better performing candidates will not only be viewed as inequitable, but impose a cost on the firms who no longer are able to hire the best available candidates. These costs can be assessed by determining the effect affirmative action will have on the threshold at which a winner gets selected. That is when the firm wants to hire, say 10 candidates, how much lower will the minimum performance of the selected winners have to be. Crucial for determining these performance costs is of course the gender and performance of those who enter the competition. Given the changes in entry into the tournament, there is reason to believe that the anticipated performance costs calculated before the changes in entry decisions may differ substantially from those actually experienced.

To asses the performance costs associated with fulfilling the affirmative-action requirement, we will focus on the actual performances after the compensation choice. Since the task-4 performance is slightly higher than the task-3 performance, we rely on the task-3 performance.[54] We start by examining how changes in tournament entry under affirmative action affect the performance distributions of the pool of entrants. Figure V Panel A shows the proportion of people with a given task-3 performance who choose to enter the standard or the AA tournament.[55] Conditioning on performance we see that affirmative action primarily increases entry for those who solve less than 14 problems, whereas there is little or no effect on entry for those with a performance of 14 problems or more. This finding is confirmed by Panel B, which shows the number of entrants who have performances at or above a certain level. While affirmative action does not affect the number of entrants who have a minimum performance of 14 and higher, the pool of entrants under affirmative action is greater when we examine those with a lower minimum performance.

[54] The results are similar when we use performances in task-2 or task-4, or if we use the task-3 performance for entrants in the standard tournament and the task-4 performance for the entrants in the AA tournament. Given the higher task-4 performance this later comparison would bias the results in favor of affirmative action.

[55] The figure using either only task-2 or only task-4 performance or the performance after the entry decision is similar to the one that uses the actual performance after each entry decision.

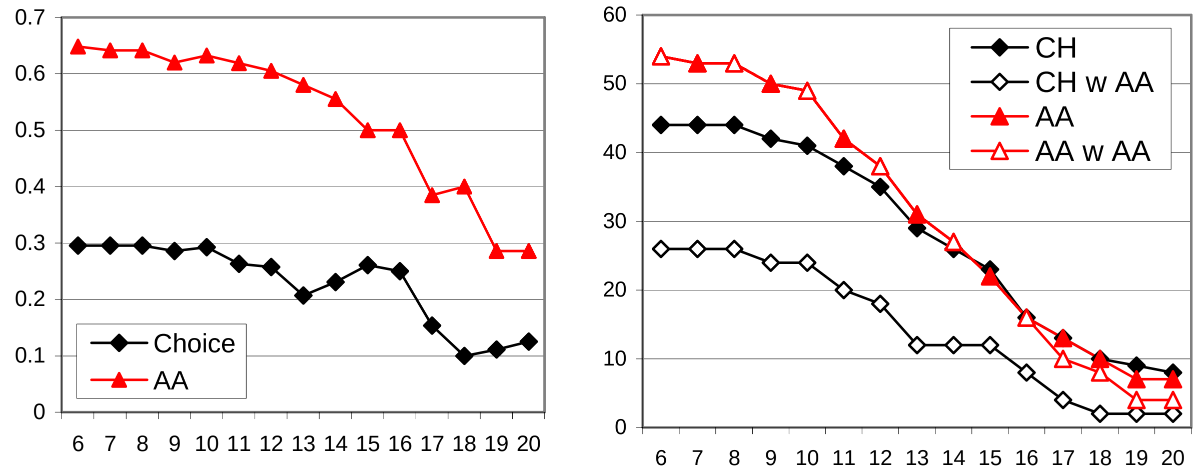


Panel A: Proportion of participants at a given performance who enter the tournament.

Panel B: Number of entrants with performance above a minimum threshold.

Figure V Tournament Entry

Importantly affirmative action changes both the performance distribution and the gender composition of the pool of entrants. Figure VI panel A shows the proportion of women among entrants whose performance is above a specified performance level. While the overall number of high-performing entrants is quite similar in the standard and AA tournament, the proportion of these entrants who are female is very different. For example, of the entrants in the standard tournament with a performance of 16 and higher only 25 percent are women, in contrast in the AA tournament 50 percent of these entrants are women. Furthermore of those with a performance of 16 or lower, there is never an equal representation of women in the standard tournament, whereas at least 50 percent of these entrants are women in the AA tournament. This difference in gender composition implies that while in the standard tournament it will be costly to fulfill the affirmative action requirement that women at least be equally represented when choosing participants with a performance of 16 and higher, this requirement will not be costly when choosing among entrants into the AA tournament. That is ex-post the affirmative action requirement will not imply that more qualified men will have to give way to less qualified women. Figure VI Panel B shows these performance costs of affirmative action, when choosing among entrants in the standard tournament (task-3), and in the AA tournament (task-4).



Panel A: Proportion of entrants above a minimum performance level who are women in Choice (task-3) and AA (task-4)

Panel B: Number of entrants above a minimum performance threshold in task-3 (CH), in task-3 with AA requirement of equal representation of women (CH w AA), and for task-4 without (AA) and with AA requirement (AA w AA).

Figure VI Performance of Entrants

Panel B shows for each task-3 performance level, say 11, the number of entrants in the task-3 standard tournament (CH) whose task-3 performance is 11 or higher, and similarly the number of entrants in the task-4 AA tournament (AA) above this performance. Thus the CH and AA lines are identical to those of Panel B of figure V. In addition we also show the number of entrants above each performance level, when we require that there be at least one woman included in the group for every man. For task-3 entrants this is shown by (CH w. AA). Given the few high-performing women who enter the standard tournament, the enforcement of the affirmative action rule, implies that very few participants of a given minimum performance can be hired among task-3 entrants. For example, for performances above 18, there are 10 entrants in both the standard and the AA tournament. However, when we require that for every man one woman has to be included, then only 2 people can be hired among the standard entrants (in the standard tournament there is only one female entrant with a performance of 18 and higher). In contrast, 8 entrants can be hired in the AA tournament (4 women have a performance of 18 and higher). Furthermore, to hire another pair of participants in the standard tournament under the affirmative action rule, one has to lower the minimum performance requirement to 17 to add a woman, while passing over 8 men with a higher performance. Whereas in the AA tournament, the same requirement implies that only 2 men of higher performance are passed over to hire an additional woman. Similarly consider entrants who have a performance of 15 and higher. While there are 23 such entrants in the standard tournament (CH) and 22 in the AA tournament (AA), the gender composition is quite different. Enforcing the affirmative action rule, we can only hire 12 of the entrants in the standard tournament, while all 22 can be hired in the AA tournament. In fact, if we were to hire 22 entrants in the standard tournament and fulfill the affirmative action requirement, then we would have to lower the minimum acceptable performance threshold to 10.

Thus the perceived inequity of affirmative action will be exaggerated if evaluated based on entry prior to the institutional change. While affirmative action in the standard tournament implies that many more qualified men will be passed by to secure equal representation of women, such inequity does not arise once affirmative action is introduced and the minimum requirement for performance is 16 or less.

Our results suggest that it may be very expensive, in terms of performance loss and inequity, to apply the affirmative action rule ‘secretly’ or to introduce affirmative action after the participants have decided to enter a standard tournament. Furthermore, the costs of affirmative action may be vastly overestimated, if we fail to take into account that the pool of entrants will change along with a well-announced introduction of affirmative action. As many more women, and in particular many high-performing women, elect to enter the AA tournament the gender composition of tournament entrants is very different under affirmative action. These changes in the entry pool imply that there are circumstances where it need not be costly to secure a more diverse set of winners, certainly it may be much cheaper than suggested by the pool of entrants into a standard tournament.

VII. CONCLUSION

This paper contributes to a literature that tries to understand why women are underrepresented in many high-profile jobs and across whole professions. While discrimination and gender differences in preferences and ability help explain this gender difference, it has been argued that another explanation may be that men and women respond differently to competitive environments. In this paper we have examined, how and at what cost, one can alter the institution used to select winners to entice more women to compete. Specifically we investigate a quota-like affirmative action environment where we require that women be at least equally represented among those hired. Our analysis provides a deeper understanding of the causes that lead women to shy away from competition, and helps us understand which mechanisms we may use to change this behavior. Furthermore we are able to provide an explicit analysis of the performance costs associated with such an institutional change.

While changes in the probability of winning are expected to alter the tournament-entry decisions, there are three additional channels that can affect entry. First, decisions may change simply because we mention affirmative action. The two other channels both relate to the competition being more gender specific under a quota style affirmative-action tournament. For example, under the quota system a woman will win as long as she is the best performing woman. A more gender specific competition may reduce gender differences in beliefs about relative performance, as well as gender differences in the willingness to compete. We find that affirmative action causes a large increase in the tournament entry by women and a decrease in the entry by men. This change in behavior is not fully explained by changes in the probability in winning, rather the three suggested factors all help explain why the gender gap in tournament entry differs under affirmative action.

An interesting aspect of this paper is that we are able to examine the effect affirmative action has on tournament entry. In particular we are able to characterize how the composition of the applicant pool changes with affirmative action. Replicating the NV finding that women shy away from competition, we find that prior to affirmative action only few high-performing women choose to compete. Thus it is very rare that women succeed in winning the tournament. Using this initial applicant pool and introducing the affirmative action requirement to hire at least one woman for every man implies that very few participants can be hired when a minimum standard of performance has to be reached, or equivalently it implies that to hire the same number of people the minimum performance standard has to be lowered substantially. Based on tournament entry in the standard tournament it is clear that the under representation of women causes it to be very costly to achieve equal representation, as many more qualified men would have to be passed by to fulfill the quota. The expected costs of affirmative action would still be substantial if the response to the institution only result from the changes in the probability of wining. However as mentioned above we show that the introduction of affirmative action causes a response which is greater than that predicted by the probability of winning alone. While some high-performing men drop out of the competition many women come in, and the overall number of high-performing participants in the entry pool is barely affected. This change in the gender composition of the applicant pool causes the ex-post performance costs of affirmative action to be substantially smaller than those predicted ex ante. Thus self-selection substantially reduces the performance costs of affirmative action.

Our results can be interpreted as suggesting that even in an environment in which there is no discrimination, such as in our experiments, large gender differences can be found. Given these non-payoff maximizing decisions to compete, we find that affirmative action is one way of reducing this gender gap in willingness to compete. Interestingly the performance costs associated with this institutional change is limited when the change in policy is announced. However note that it would not be cost-effective to require affirmative action without allowing participants to react to it.

References:

Altonji, Joseph G., and Rebecca Blank "Race and Gender in the Labor Market" in O. Ashenfelter and D. Card, (eds), Handbook of Labor Economics Volume 3c Elsevier Science B.V. (1999): 3144-3259.

Ander, Richard, Gender and Jobs: Sex Segregation of Occupations in the World, 1998, International Labor Office: Geneva.

Andreoni, James, and Lise Vesterlund, "Which is the Fair Sex: Gender Differences in Altruism," *Quarterly Journal of Economics*, CXVI, (2001), 293 – 312.

Babcock, Linda and Sara Laschever, Women Don't Ask: Negotiation and the Gender Divide by (Princeton University Press, 240 pp., September 2003).

Black, Sandra, and Philip E. Strahan, "The Division of Spoils: Rent-Sharing and Discrimination in a Regulated Industry," American Economic Review, XCI (2001), 814–831.

Blau, Francine D., and Lawrence M. Kahn, 2004, "The US Gender Pay Gap in the 1990s: Slowing Convergence," NBER working paper 10853.

Bertrand, Marianne and Kevin F. Hallock, "The gender gap in top corporate jobs," Industrial and Labor Relations Review, LV (2001), 3-21.

Beyer, Sylvia, "Gender Differences in the Accuracy of Self-Evaluations of Performance," Journal of Personality and Social Psychology, LIX (1990), 960 – 970.

Beyer, Sylvia, and Edward M. Bowden, "Gender Differences in Self-Perceptions: Convergent Evidence From Three Measures of Accuracy and Bias," Personality and Social Psychology Bulletin, XXIII (1997), 157 - 172.

Byrnes, James P., David C. Miller, and William D. Schafer, "Gender Differences in Risk Taking: A Meta-Analysis," Psychological Bulletin, LXXV (1999), 367-383.

Croson, Rachel and Uri Gneezy, "Gender differences in preferences", working paper, 2005.

Dweck, Carol S., Self-Theories: Their Role in Motivation, Personality, and Development, 2000, Psychology Press, Philadelphia.

Eckel, Catherine C. and and Philip J. Grossman, 2002a, "Sex differences and statistical stereotyping in attitudes towards financial risk," Evolution and Human Behavior 23:281-295.

Eckel, Catherine C. and Philip J. Grossman, 2002b, "Sex and Risk: Experimental Evidence", forthcoming, Handbook of Experimental Economics Results, Amsterdam, Elsevier Science, North-Holland.

Eckel, Catherine, and Philip J. Grossman, 2002c, "Differences in the Economic Decisions of Men and Women: Experimental Evidence." Forthcoming in Handbook of Experimental Results, edited by C. Plott and V. Smith. New York, Elsevier.

Felder, Richard M., Gary N. Felder, Meredith Mauney, Charles E. Hamrin and E. Jacquelin Dietz, (1994), "A Longitudinal Study of Engineering Student Performance and Retention," Report NCSU-94A.

Fischbacher, Urs (2007), "z-Tree: Zurich Toolbox for Ready-made Economic experiments," *Experimental Economics*, 10(2), 171-178.

Fischbacher, U. (1999), z-Tree - Zurich Toolbox for Readymade Economic Experiments - Experimenter's Manual, mimeo

Gneezy, Uri, Muriel Niederle, and Aldo Rustichini, "Performance in Competitive Environments: Gender Differences," *Quarterly Journal of Economics*, August 2003, p. 1049-1074.

Gneezy, Uri and Aldo Rustichini, 2004, "Gender and competition at a young age", *American Economic Review Papers and Proceedings*, 377-381.

Gneezy, Uri and Aldo Rustichini, "Executive versus Teachers: Gender, Competition and Self-Selection", November 2005, working paper.

Goldin, Claudia, and Cecilia Rouse, "Orchestrating Impartiality: The Impact of "Blind" Auditions on Female Musicians," American Economic Review, XL (2000), 715–742.

Goodman, Irene F., Christine M. Cunningham, and Cathy Lachapelle, "The Women's Experience in College Engineering," Goodman Research Group, Inc., 2002.

Grusky, David B. and England, Paula, *Occupational Ghettos*, 2004, Stanford University Press: California.

Gupta, Nabanita Datta, Anders Poulsen and Marie-Claire Villeval, "Male and Female Competitive Behavior – Experimental Evidence", November 2005, GATE working paper, Ecully, France.

Harwarth, Irene, Mindi Maline, and Elizabeth DeBra, "Women's Colleges in the United States: History, Issues, and Challenges," Office of Educational Research and Improvement at the U. S. Department of Education report, 1997.

Hewlett, Sylvia Ann and Carolyn Buck Luce "Off Ramps and On-Ramps, Keeping Talented Women on the Road to Success," *Harvard Business Review*, March 2005

Hyde, Janet Shibley, Elizabeth Fennema, and Susan J. Lamon, "Gender Differences in Mathematics Performance: A Meta-Analysis," Psychological Bulletin (1990), 107:2, 139-155.

Jan, Tracy; "A new gender divide: Coed school experiments with gender gap Coed Catholic school will try separating boys, girls in class," Boston Globe, April 9, 2005. Not cited right now

Larson, Lia Christine, 2005, "When Girls Stop Competing Against Boys: An Experimental Analysis of the Competitive Behavior of Young Children", Harvard Honors Thesis.

Lichtenstein, Sarah, Baruch Fischhoff, and Lawrence Phillips, "Calibration and Probabilities: The State of the Art to 1980", in Judgment Under Uncertainty: Heuristics and Biases, Daniel Kahneman, Paul Slovic and Amos Tversky, eds., (Cambridge University Press: 1982)

Ledyard, John O., "Public Goods: A Survey of Experimental Research", in Handbook of Experimental Economics, John H. Kagel and Alvin E. Roth, eds. (Princeton, NJ: Princeton University Press, 1995).

Lundeberg, Mary A., Paul W. Fox, and Judith Punccohar, "Highly Confident but Wrong: Gender Differences and Similarities in Confidence Judgments," Journal of Educational Psychology, LXXXVI (1994), 114–121.

Niederle, Muriel and Lise Vesterlund, "Do Women Shy Away From Competition? Do Men Compete Too Much?", forthcoming *Quarterly Journal of Economics*, August 2007.

Roberts, Tomi-Ann and Susan Nolen-Hoeksama (1989), "Sex Differences in Reactions to Evaluative Feedback", Sex Roles, Vol.21, Nos11/12, 725-747.

Steele, Claude M., "A Threat in the Air: How Stereotypes Shape Intellectual Identity and Performance," American Psychologist, LII (1997), 613 – 629.

Steele, Shelby, The Content of Our Character, 1990, HarperCollins, New York, New York.

Weeden, Kim, "Profiles of Change: Sex Segegration in the United States, 1910-2000," in Grusky and Paula eds.

INSTRUCTIONS

WELCOME

In the experiment today you will be asked to complete six different tasks. None of these will take more than 5 minutes. At the end of the experiment you will receive $5 for having completed the experiment. In addition, we will randomly select one of the tasks and pay you based on your performance in that task. Once you have completed the six tasks we determine which task counts for payment by drawing a number between 1 and 6. The method we use to determine your earnings varies across tasks. Before each task we will describe in detail how your payment is determined.

Your total earnings from the experiment are the sum of your payment for the randomly selected task, your $5 payment for completing the experiment, and a $10 show up fee. At the end of the experiment you will be asked to come to the side room where you will be paid in private.

Task 1 – Piece Rate

For Task 1 you will be asked to calculate the sum of five randomly chosen two-digit numbers. You will be given 5 minutes to calculate the correct sum of a series of these problems. You cannot use a calculator to determine this sum, however you are welcome to write the numbers down and make use of the provided scratch paper. You submit an answer by clicking the submit button with your mouse. When you enter an answer the computer will immediately tell you whether your answer is correct or not. Your answers to the problems are anonymous.

If Task 1 is the one randomly selected for payment, then you get 50 cents per problem you solve correctly in the 5 minutes. Your payment does not decrease if you provide an incorrect answer to a problem. We refer to this payment as the piece rate payment.

Please do not talk with one another for the duration of the experiment. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

Task 2 – Tournament

As in Task 1 you will be given 5 minutes to calculate the correct sum of a series of five 2 digit numbers. However for this task your payment depends on your performance relative to that of a group of other participants. Each group consists of six people, 3 men and 3 women. The five other members of your group are located in the same row as you, that is, you are paired with the people sitting in front of you and those sitting behind you.

If Task 2 is the one randomly selected for payment, then your earnings depend on the number of problems you solve compared to the five other people in your group. The two individuals who correctly solve the largest number of problems will receive $1.5 per correct problem, while the other participants receive no payment. We refer to this as the tournament payment. If there are ties the winner will be randomly determined. You will not be informed of how you did in the tournament until all six tasks have been completed.

Please do not talk with one another. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

Task 3 – Choice

As in the previous two tasks you will be given 5 minutes to calculate the correct sum of a series of five 2-digit numbers. However, you now have to choose which payment scheme you want for your performance on the third task. You can either choose to be paid according to the piece rate, or according to the tournament.

If Task 3 is the one randomly selected for payment, then your earnings for this task are determined as follows. If you choose piece rate you receive 50 cents per problem you solve correctly. If you choose tournament your performance will be evaluated relative to the performance of the other five participants of your group in the Task 2-tournament. Task 2-tournament is the task you just completed. If you correctly solve more problems than 4 participants did in the task 2-tournament, then you receive three times the payment from the piece rate, that is, $1.5 per correct problem. That is, at most only one participant in your group can have a higher task 2-tournament performance than your task-3 performance. Otherwise, you receive no earnings for this task. If there are ties, then the ranking is determined randomly. Remember, your group consists of all individuals that sit in the same row as yourself. Every group has 3 men and 3 women. You will not be informed of how you did in the tournament until all six tasks have been completed.

The next computer screen will ask you to choose whether you want the piece rate or the tournament applied to your performance. You will then be given 5 minutes to calculate the correct sum of a series of five randomly chosen two-digit numbers.

Please do not talk with one another. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

Affirmative-Action Tournament

Before we start the next task we explain the rules of an affirmative-action tournament. In an affirmative-action tournament the winners are determined as follows. One winner will be the best performing woman in a group. The other winner is the best performing individual among the rest of the group members (i.e., excluding the best performing woman).

Let us look at a concrete example that illustrates how the winners in an affirmative-action tournament are determined. We order the group members within each gender according to their performance such that w1 is the best performing woman, w2 is the second best performing woman, etc. We order the men in a similar manner, i.e., m1 is the best performing man, m2 is the second best performing man, etc. The best performing woman, w1, is always one of the two winners in the affirmative-action tournament. To determine the second winner we need to find out who is the best performing individual among the remaining members of the group (i.e., all group members excluding w1). Since there is going to be only one other winner it can only be w2 or m1. Thus, if the performance of w2 is higher than the performance of m1, then she is the second winner. If w2 performed worse than m1, then m1 is the second winner.

To summarize a woman will win an affirmative-action tournament if she is the best performing woman or if she is among the two best performing individuals in the group. A man wins an affirmative-action tournament if he is the best performing man and if he is among the two best performing individuals in the group. Thus there is at least one woman and at most one man among the winners in an affirmative-action tournament.

NEXT PAGE

Task 4 – Choice II

As in the previous three tasks you will be given 5 minutes to calculate the correct sum of a series of five 2-digit numbers. Again, you now have to choose which payment scheme you want for your performance on the fourth task. You can either choose to be paid according to the piece rate, or according to the affirmative-action tournament.

If Task 4 is the one randomly selected for payment, then your earnings for this task are determined as follows. If you choose the piece rate you receive 50 cents per problem you solve correctly. If you choose the affirmative-action tournament your performance will be evaluated relative to the performance of other participants in your group in the Task 2-tournament. Task 2-tournament is the second task you completed. The instructions for women are that you receive $1.5 per correct problem if (1) you correctly solve more problems than 4 participants did in the task 2-tournament, or (2) you correctly solve more problems than the other 2 women did in the task 2-tournament. Otherwise, you receive no earnings for this task. The instructions for men are that you receive $1.5 per correct problem if (1) you correctly solve more problems than 4 participants did in the task 2-tournament, and (2) you correctly solve more problems than the other 2 men did in the task 2-tournament. Otherwise, you receive no earnings for this task. For both, women and men, if there are ties, then the ranking is determined randomly. Remember, your group consists of all individuals that sit in the same row as yourself. Every group has 3 men and 3 women. You will not be informed of how you did in the tournament until all six tasks have been completed.

The next computer screen will ask you to choose whether you want the piece rate or the affirmative-action tournament applied to your performance. You will then be given 5 minutes to calculate the correct sum of a series of five randomly chosen two-digit numbers.

Please do not talk with one another. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

Task 5 – Submit Piece Rate

You do not have to add any numbers for the fifth task of the experiment. Instead you may be paid one more time for the number of problems you solved in the Task 1. However, you now have to choose which payment scheme you want applied to the number of problems you solved in Task 1-Piece Rate. You can either choose to be paid according to the piece rate, or according to the tournament.

If the fifth task is the one selected for payment, then your earnings for this task are determined as follows. If you choose the piece rate you receive 50 cents per problem you solved in Task 1. If you choose the tournament your performance will be evaluated relative to the performance of the other five participants of your group in the Task 1-piece rate. If you correctly solved more problems than 4 participants did in the task 1-piece rate, then you receive three times the payment from the piece rate, that is, \$1.5 per correct problem. That is, at most only one participant in your group can have a higher task 1 performance than you. Otherwise, you receive no earnings for this task. If there are ties, then the ranking is determined randomly.

Remember, your group consists of all individuals that sit in the same row as yourself. Every group has 3 men and 3 women. You will not be informed of how you did in the tournament until all six tasks have been completed.

The next computer screen will tell you how many problems you correctly solved in Task 1, and will ask you to choose whether you want the piece rate or the tournament applied to your performance.

Please do not talk with one another. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?

Task 6 – Submit Piece Rate II

You do not have to add any numbers for the sixth and final task of the experiment. Instead you may be paid one more time for the number of problems you solved in the Task 1. However, you now have to choose which payment scheme you want applied to the number of problems you solved in Task 1. You can either choose to be paid according to the piece rate, or according to the affirmative-action tournament.

If the sixth task is the one selected for payment, then your earnings for this task are determined as follows. If you choose the piece rate you receive 50 cents per problem you solved in Task 1. If you choose the affirmative-action tournament your performance will be evaluated relative to the performance of other participants in your group in Task 1-piece rate. The instructions for women are that you receive \$1.5 per correct problem if (1) you correctly solved more problems than 4 participants did in the task 1-piece rate, or (2) you correctly solved more problems than the other 2 women did in the task 1-piece rate. Otherwise, you receive no earnings for this task. The instructions for men are that you receive $1.5 per correct problem if (1) you correctly solved more problems than 4 participants did in the task 1-piece rate, and (2) you correctly solved more problems than the other 2 men did in the task 1-piece rate. Otherwise, you receive no earnings for this task. For both, women and men, if there are ties, then the ranking is determined randomly.

Remember, your group consists of all individuals that sit in the same row as yourself. Every group has 3 men and 3 women. You will not be informed of how you did in the tournament until all six tasks have been completed.

The next computer screen will tell you how many problems you correctly solved in Task 1, and will ask you to choose whether you want the piece rate or the tournament applied to your performance.

Please do not talk with one another. If you have any questions, please raise your hand.

ARE THERE ANY QUESTIONS BEFORE WE BEGIN?