

Gender and Competition

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Abstract

Laboratory studies have documented that women often respond less favorably to competition than men. Conditional on performance, men are often more eager to compete, and the performance of men tends to respond more positively to an increase in competition. This means that few women enter and win competitions. We review studies that examine the robustness of these differences as well the factors that may give rise to them. Both laboratory and field studies largely confirm these initial findings, showing that gender differences in competitiveness tend to result from differences in overconfidence and in attitudes toward competition. Gender differences in risk aversion, however, seem to play a smaller and less robust role. We conclude by asking what could and should be done to encourage qualified males and females to compete.

1. INTRODUCTION

Despite significant female educational advances, we continue to see gender differences in labor market outcomes (Goldin et al. 2006). Horizontal as well as vertical job segregation is substantial, causing men and women to have very different labor market experiences (Altonji & Blank 1999, Bertrand & Hallock 2001). Common explanations for these persistent differences are discrimination and that men and women differ in their abilities and preferences over jobs (e.g., Polachek 1981, Goldin & Rouse 2000, Black & Strahan 2001). As a complement to the latter explanation, over the past decade, economists have become increasingly interested in investigating whether gender differences in competitiveness may help explain why labor market differences persist. If women are more reluctant to compete, then they may be less likely to seek promotions or to enter male-dominated and competitive fields.

This article reviews the rapidly growing literature on gender differences in competition. A series of laboratory studies documents that, conditional on performance, women are often more reluctant to compete than men. Although far removed from the education or labor market of interest, these laboratory studies provide an environment in which factors such as discrimination or preferences for family cannot compromise any underlying gender differences in competitiveness. Other advantages of the laboratory are that it is possible to systematically control for factors that may influence competitiveness and that the results can be replicated. In branching out to examine competitiveness in the noisier and less controllable field setting, this literature has become a prime example of a fruitful interplay between experiments and more standard economic methods. It shows that the economic laboratory can be used to generate new hypotheses that then can be looked for and tested in the field.

We begin our review in Section 2 by presenting research on preferences for performing under competitive or noncompetitive incentive schemes. We start with Niederle & Vesterlund (2007), which documents large gender differences in tournament entry and shows that these largely are driven by gender differences in confidence and in attitudes toward competition. We organize the subsequent investigations of robustness and causal inference around the central explanations for the observed gender gap. In Section 3 we report on studies that have investigated how the performance of men and women responds to competitive pressure. These findings mirror those of Section 2. The gender gap in performance is often greater in a competitive environment than it is in a noncompetitive one. In particular, men respond more positively to an increase in competition than do women. Furthermore, these results are attenuated in single-sex competitions.

The field evidence on gender differences in competitive attitudes is presented in Section 4. Field studies have mostly focused on performance under various incentive schemes, although recent research also examines the decision to enter competitions. By and large, these studies show that the gender differences documented in the laboratory play an important role in the field.

A concern raised throughout this literature is that high-ability women appear to opt out of competitions. From a societal perspective, this loss of high-ability workers is costly, and it is important to ask what, if anything, may be done to address the low tournament entry. Section 5 presents research that tries to answer this question. One strand of the literature takes the gender gap in competitiveness as given and asks whether changes in institutions may encourage high-ability women to enter environments in which they are

likely to succeed. Another strand asks instead whether competitiveness is innate or learned and investigates what measures, if any, can be taken to alter the gender gap in willingness to compete. In light of this debate, we conclude in Section 6 by presenting research that questions whether it is advantageous for society and for the individual to encourage more competitive behavior.

2. DO WOMEN SHY AWAY FROM COMPETITION?

In Niederle & Vesterlund (2007), we examine whether men and women differ in their willingness to enter a competition when controlling for factors that might account for such differences.¹ We designed an experiment to examine choices between a competitive versus a noncompetitive compensation scheme while controlling for performance and for the role of the following three factors: (a) attitudes toward competition (although men may feel comfortable performing in a competitive setting, women may be more anxious about such prospects), (b) beliefs about relative performance (men may be more confident that they are among the highest-performing participants and thus be more inclined to compete), and (c) risk and feedback aversion (the tournament is not only competitive but is also more uncertain and provides more information about relative performance than the piece-rate scheme; if women are more averse to such factors, they may be less inclined to select competitive compensation).

By controlling for performance and the two latter factors, we are able to draw inference on the extent to which men and women differ in their attitudes toward competition. From the subject pool at the Pittsburgh Experimental Economic Lab, 40 men and 40 women were asked to add up sets of five two-digit numbers for five minutes under different compensation schemes. We refer to each of these five-minute trials as a task and to performance as the number of correctly solved problems on the task. Participants received details on each task only immediately before performing the task. At the end of the experiment, one task was randomly selected, and the participants were paid for their performance on that task. Participants were informed of the number of problems they had solved correctly and incorrectly on each task. They did not receive information on the performance of anyone else until the end of the study.

Participants first performed the task under a noncompetitive piece rate of 50 cents per correctly solved problem. Subsequently, they performed in tournaments of two men and two women, in which the person with the largest number of correctly solved problems was paid \$2 per correct problem and the others received no payment. Participants were only informed of the outcome of a tournament at the end of the experiment. Although gender was never mentioned during the experiment, individuals could see their competitors and determine the gender composition of the group.

¹The literature in evolutionary psychology and educational psychology suggests that boys and girls differ in their preferences for competitive games (Campbell 2002). Similarly, the research on single-sex education argues that girls may be more likely to pursue male-dominated areas when sheltered from (the competition with) boys. Finally, the evolutionary biology and psychology literature on gender differences in aggression and risk aversion also suggests that men may be more willing to enter competitive environments than women (see Daly & Wilson 1983, Campbell 2002). The literature in social psychology, however, has been relatively silent on such gender differences. For example, a special issue of the *American Psychologist* on psychological sex differences does not mention competitive attitudes, and the *Handbook of Social Psychology*, fourth edition, does not have an entry on competition in the subject index. Although the literature in biology, psychology, and education is suggestive, it fails to control for selection and performance ability, nor does it show that gender differences in competitiveness survive in the presence of economic incentives.

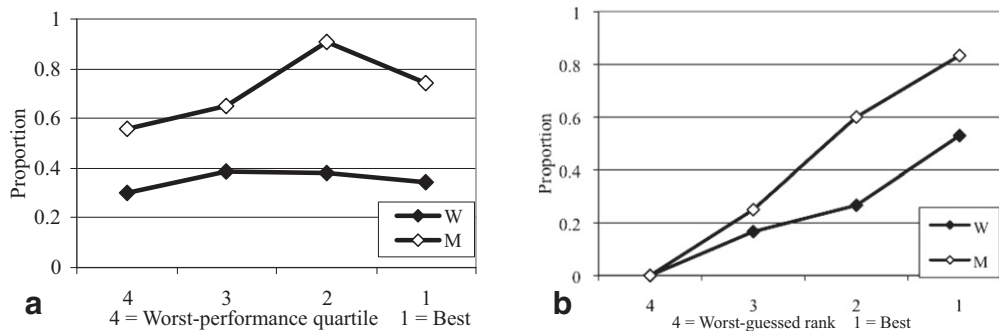


Figure 1

Proportion selecting tournament: (a) conditional on initial tournament performance quartile and (b) conditional on believed performance rank in initial tournament. Abbreviations: M, men; W, women. Figure taken from Niederle & Vesterlund (2007).

Under the piece rate, men and women solved on average 10.7 and 10.2 problems, respectively, and under the tournament they solved 12.1 and 11.8 problems. The gender difference in performance was not significant in either case. Although performance increases in the tournament, this appears to be largely driven by experience.²

Having performed under the piece-rate and the tournament-compensation scheme, participants chose which of the two they would prefer on a subsequent task. To eliminate concerns of affecting the payoffs of others, we designed the choice as an individual decision. Specifically, a participant who selected the tournament would win if his or her new performance exceeded the performance of the three other group members from the previous competition. Hence the choice could not influence the payoffs of any other participant.

Given the gender parity in performance, maximization of earnings predicts no gender difference in the choice of compensation scheme. Nonetheless, we observe a substantial and significant gender gap in tournament entry; 73% of men and 35% of women enter the tournament.

Figure 1a shows the proportion of men and women who enter the tournament for each performance quartile in the previous, initial tournament. Neither the tournament-entry decisions of men nor those of women are very sensitive to the individual's performance. Furthermore, for each performance quartile, men are much more likely to enter the tournament. On average, men in the worst-performance quartile enter the tournament more than women in the best-performance quartile. Regressions confirm substantial and significant gender differences in tournament entry, when controlling for the tournament and piece-rate performances.

Although relative performance influences earnings from the tournament, participants only knew their absolute performance. Entry therefore may reflect beliefs about relative performance. To measure beliefs, we asked participants to rank their performance on the initial tournament relative to that of the other group members. Any correct guess was rewarded by \$1. Accounting for ties, at most 30% of men and women should guess that they are the best in their group of four. However, 75% of men and 43% of women held that belief. Although both genders are overconfident, men are significantly more

²This is suggested by studies that look at a sequence of tournament performances, as well as the performance change between the tournament and the next task.

overconfident than women. **Figure 1b** shows that confidence increases tournament entry. Given that men are more likely to think that they outperformed others and that such beliefs increase tournament entry, it is apparent that differences in beliefs help explain the gender gap in entry. However, a substantial gender gap in entry remains. Among those who reported that they thought they were best, 80% of men entered the tournament compared with only 50% of women. The same 30-percentage-point gender gap in tournament entry is present among those who thought they were second out of four. Given that 84% of participants reported ranking first or second, this demonstrates that the gender gap in entry remains when conditioning on beliefs. Regressions show that elicited beliefs account for about one-third of the gender gap in tournament entry, when controlling for performance.

As tournaments are more risky and result in the participant receiving feedback on relative performance, tournament entry may be reduced for individuals who are averse to either of these two factors. To jointly study the impact of beliefs and the impact of risk and feedback aversion (factors *b* and *c* above) on the gender difference in tournament entry, we asked participants to choose between two compensation schemes that mimic the initial choice, while eliminating factors that pertain to performing in a competition such as competitive attitudes (factor *a* above). Specifically, we asked participants to choose between the tournament and piece rate for their initial piece-rate performance.

We find that performance and beliefs largely account for the decisions of women and men when choosing the compensation scheme for a past performance. The remaining gender gap in choices is economically small and not significant; thus gender differences do not follow the pattern found when choosing whether to enter a tournament and then perform. A regression on the decision to enter a tournament and then perform confirms a substantial unexplained gender gap, even when controlling for performance, beliefs, and this final decision. We attribute the remaining difference to men and women differing in their attitude toward placing themselves in environments in which they have to compete against others. Thus in Niederle & Vesterlund (2007), we find that the primary explanations for gender differences in tournament entry are gender differences in confidence and in attitudes toward competition.

In terms of money-maximizing choices, low-performing men enter the tournament too much and high-performing women do not enter enough. The latter presents a substantial monetary loss and results in few women entering and winning the competition.

A series of papers presents treatments that introduce only minor modifications to the original Niederle-Vesterlund design and find similar results (e.g., Dargnies 2009a, Price 2009, Balafoutas & Sutter 2010, Cason et al. 2010, Healy & Pate 2011, Niederle et al. 2010, Sutter & Rützler 2010, Wozniak et al. 2010). A sole exception is provided by C. Price (2010), who uses the same setup and fails to find gender differences in preference for competition. However, there is also no gender difference in confidence among participants in his study. Despite the use of very different designs, a series of other papers, some of which are discussed in more detail below, also identifies circumstances in which women, conditional on performance, enter tournaments less than men (e.g., Gupta et al. 2011, Booth & Nolen 2009, Gneezy et al. 2009, Kamas & Preston 2009, Vandegrift & Yavas 2009, Andersen et al. 2010, Ertac & Szentes 2010, Herreiner & Pannell 2010, Dohmen & Falk 2011, Shurchkov 2011). These studies have established the robustness of the results and helped shed light on the factors causing the gender gap in compensation choice. We organize our discussion of these papers around what are perhaps the most commonly examined explanations.

2.1. Gender Differences in Beliefs

There is a large and extensive literature in psychology that finds women to be less confident than men about their relative ability. Economists have just recently begun to replicate and investigate this finding.³ A series of methods has been used to study the role of confidence in explaining the gender gap in tournament entry. One way is to directly measure beliefs and use them as controls in the decision to enter a tournament. An alternative way is to manipulate beliefs by changing the task. Relative performance beliefs may change when performing in a stereotypical-female rather than a stereotypical-male task. A third way of assessing the role of beliefs is to provide participants with information on relative performance before they decide whether to enter a competition, that is, manipulate beliefs directly.

In Niederle & Vesterlund (2007), we use the first approach and elicit beliefs by asking participants to guess their relative ranking on the initial tournament. This approach has been used in a number of studies. It is typically shown that men are more confident than women, that beliefs help explain the gender gap in winner-take-all tournament entry, and that a significant gender difference remains when controlling for beliefs (e.g., Dargnies 2009a, Balafoutas & Sutter 2010, Niederle et al. 2010, Sutter & Rützler 2010, Healy & Pate 2011, Shurchkov 2011). Kamas & Preston (2009) examine a ranked-order tournament in which each rank receives a different piece rate. In contrast to previous studies, they find that controlling for beliefs (and performance) fully accounts for gender differences in tournament entry. Wozniak et al. (2010) elicit beliefs on piece-rate performance, and although such beliefs affect the choice between a tournament and piece-rate scheme, they do not eliminate the gender gap. Grosse & Riener (2010) use a measure of overconfidence that does not significantly correlate with the tournament-entry decisions and find a significant gender gap in tournament entry when controlling for beliefs. Overall the evidence suggests that elicited beliefs help to explain, but do not eliminate, the gender gap in winner-take-all tournament entry.

A second way to assess the role of beliefs is to manipulate them by changing the task. In Niederle & Vesterlund (2007), we chose a math task to understand why women are reluctant to enter competitive and male-dominated fields (for a review, see Niederle & Vesterlund 2010). However, it has been argued that gender differences in beliefs are primarily present on the masculine domain (Lundeberg et al. 1994). When changing the task, most papers use a math task and a word task. Wozniak et al. (2010) use a math task similar

³Psychologists find that men tend to be more overconfident than women (see, e.g., Lichtenstein et al. 1982, Beyer 1990, Beyer & Bowden 1997, Pulford & Colman 1997, Soll & Klayman 2004). The economics literature on gender differences in beliefs has been sparse. For example, Croson & Gneezy (2009) only cite evidence published in psychology journals and Niederle & Vesterlund (2007). Mobius et al. (2011) measure beliefs precisely and find that women and men differ not only in their beliefs, but also in how they update beliefs upon receiving information. The psychology literature suggests that women incorporate negative information more than men, with the opposite occurring for positive information (e.g., Roberts & Nolen-Hoeksema 1989). Mobius et al. (2011) do not replicate this result. However, they find that women in general update beliefs less upon receiving information than men do (and both update less than a Bayesian would). Finally, it could be that women and men seek information at a different rate, or in different instances [e.g., individuals who interpret information as indicative of self-worth may be less likely to seek information (Dweck 2000, and references therein)]. Mobius et al. (2011) find that women are somewhat less likely to demand information about their performance on average. Furthermore, women demand information when they are quite convinced of their abilities (which in turn will make them potentially quite disappointed), whereas men value information slightly more when they are uncertain about their abilities. Given the importance of beliefs, more work is needed to understand how men and women update beliefs and demand information, even though there has been some recent work in the area (see also Ertac 2009, Eil & Rao 2011).

to Niederle & Vesterlund and find no gender difference in performance, although men do slightly better under a piece-rate scheme. Their second task is a word task in which participants receive a letter and have to form as many words as possible starting with that letter. In this task, women are slightly, although not significantly, better across competitive and noncompetitive compensation schemes. Although men are more confident than women in the math task, there is no significant difference in the word task. Nonetheless, conditioning on beliefs and performance, men are more likely than women to choose a tournament over a piece rate for both the math and the word task. In fact, the task has no significant impact on the gender gap in tournament entry. Kamas & Preston (2009) examine a math task of adding two two-digit numbers and a word task of composing words out of the letters of an eight-letter word. They find that everyone believes that men are better at the math task and women at the word task. In actuality, women are significantly better at the math task and are slightly but not significantly better at the word task. Nonetheless, men believe that they outperform women in both tasks. Kamas & Preston find gender differences in tournament entry in the math but not the word task, and the gender difference disappears once they control for beliefs and performance. Grosse & Riener (2010) use the Niederle-Vesterlund math task and a task in which five words have to be ordered to generate a sentence. They find that men outperform women in both tasks, although the difference is only significant in the math task. In the math task, both women and men believe their own relative performance is higher when they compare their performance with women rather than men. In the word task, there are no such differences in beliefs. Conditioning on performance, beliefs, and risk measures, Grosse & Riener find that men enter tournaments more than women in the math but not the word task. Shurchkov (2011) finds similar results when participants perform in a high-pressure task. Controlling for performance and beliefs, she notes that men enter tournaments more than women in a math task but not in a verbal task. Furthermore, she finds that women are more willing to compete on a low-pressure verbal task. Consistent with confidence playing a central role, these studies show that when performing under time pressure, the gender gap in confidence and in compensation choices is smaller in tasks that are stereotypically female. More research is needed to determine the extent to which entry depends on the task itself, beliefs about one's relative performance, or stereotypical beliefs about the relative performance of women and men.

Finally, several papers manipulate beliefs directly. Cason et al. (2010) have participants perform in a piece rate and then show them the piece rate of others before asking them to enter a competition against participants who competed in a previous session. The difference in a subject's own performance compared with that of his or her competitors affects tournament entry, but there is still a significant gender gap in the decision to enter a tournament. Wozniak et al. (2010) manipulate beliefs by providing participants with information on how participants in the present session performed under the piece rate. Whereas the gender gap in tournament entry is significant when participants do not receive feedback, it is not significant when they do.⁴ However, high-performing females, who from an expected-payoff perspective should have entered the tournament, are still

⁴For all regressions, Wozniak et al. (2010) order a shared group pay and a piece rate in terms of competitiveness, with the piece rate being deemed more competitive than the group pay, and the tournament being the most competitive. However, an argument could be made for the opposite as well, as the group pay provides information on relative performance.

less likely to enter the tournament than their male counterparts. With information on relative performance, 50% of high-performing women enter tournaments (compared with 31% without information) compared with 66% of men (down from 78% without information). Ertac & Szentes (2010) use the Niederle-Vesterlund design, but in one treatment provide participants with information about the performance of the winner of the tournament of their group of four. They find that this information eliminates the initially observed gender gap in tournament entry. Combined, these studies demonstrate that feedback reduces the gender gap in tournament entry.

In summary, the literature has shown that, conditional on actual performance, men and women differ in their beliefs about their relative performance. These differences in beliefs help explain the gender gap in tournament entry. However, controlling for beliefs, gender differences in tournament entry generally remain when examining stereotypically male tasks. Providing information on relative performance or changing the task to one in which women are believed to have an advantage reduces and at times eliminates the gender gap in tournament entry. More research is needed to assess the extent to which more precise belief measures can help account for gender differences in tournament entry.

2.2. Gender Differences in Risk Attitudes

With payments being more risky in a tournament, we may expect that risk aversion will influence the decision to enter a tournament. There is a large literature in psychology and economics debating whether, when, and by how much women are more risk averse than men [for summaries on gender differences in risk aversion in the experimental economics literature, see Eckel & Grossman (2008) and Croson & Gneezy (2009), who conclude that women exhibit greater risk aversion; Byrnes et al. (1999) present a meta-analysis of 150 psychology studies and show that although women are in some situations significantly more averse to risk, many studies find no gender differences]. A number of studies have examined the extent to which risk attitudes can account for gender difference in competitiveness.

One approach to controlling for risk is to have participants make a choice that mimics the risk of the tournament-entry choice. This is the approach we take in Niederle & Vesterlund (2007), when eliciting compensation decisions for a past performance. The risk of this choice is similar to that of entering a tournament and then competing. We use this decision in two ways to evaluate the role of risk. First, when selecting a compensation scheme for a past piece-rate performance, we find no gender gap in tournament entry when controlling for performance and beliefs. This suggests that risk aversion is unlikely to play a role when choosing compensation for a future performance. Second, using the selected compensation choice for a past piece-rate performance as a control, we still find substantial gender differences in tournament entry. Thus risk aversion cannot account for that gender difference. Identical results have been shown by Healy & Pate (2011) and Niederle et al. (2010). Dargnies (2009a) replicates the second result without analyzing the first.⁵ A similar approach is taken by Grosse & Riener (2010). They measure risk attitudes by having participants choose an incentive scheme for a number to be randomly drawn.

⁵Sutter & Rützler (2010), similar to Niederle & Vesterlund, find a significant gender difference when deciding whether to submit a past piece-rate performance to a piece-rate or tournament-payment scheme when controlling for performance only. In Niederle & Vesterlund (2007), the gender difference becomes economically small and fails to be significant only when beliefs were included as well (see Niederle & Vesterlund 2005).

In a regression of tournament entry for a math task, they control for performance, beliefs, and the compensation choice for a random number and find that a significant gender gap in tournament entry remains.

Another approach to control for risk aversion is to directly elicit risk preferences using choices over incentivized lotteries. Cason et al. (2010) use the Niederle-Vesterlund task and study choices between a piece rate and either a tournament in which only the winner in a group of four is paid or a proportional payment scheme in which the four group members split a fixed amount in proportion to their performance. They find that men enter tournaments more than women; however, this difference is significant only in the proportional-pay treatment in which the number of entrants is larger. They use 15 simple lottery choices to elicit risk preferences and find that this measure does not significantly correlate with entry, nor does it explain the gender gap in entry. Wozniak et al. (2010) also use lottery choices to measure risk aversion. They have participants choose among a piece rate, a tournament (with either two, four, or six competitors), and a group-sharing scheme. They find that women are less likely to enter competitions when controlling for performance, beliefs about relative performance, and some individual characteristics. They also find that risk measures do not significantly correlate with competitive entry. Sutter et al. (2010) use a series of lottery choices to classify participants (9- to 18-year-old Austrian children) as either risk loving, neutral, or averse. Sutter & Rützler (2010) use these measures to examine tournament entry in a design similar to Niederle & Vesterlund (2007). They find that risk aversion correlates significantly with tournament entry; however, when controlling for risk aversion, the coefficient on the gender gap in tournament entry does not change much and remains economically and statistically significant.

Finally, some papers use questionnaires to measure risk aversion. In Dohmen & Falk (2011), participants choose between a fixed-payment and variable-payment scheme (piece rate, tournament, or revenue sharing). Controlling for performance, the authors find that men are more likely to choose a variable-payment scheme. Risk attitudes are assessed by questions of the sort “Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?”, a measure that is correlated with risk aversion. Controlling for this survey risk measure, men are not significantly more likely to select a variable payment; significance, however, is restored when adding additional personality characteristics. Gupta et al. (2011) also use surveys to elicit risk preferences and find that women who choose the tournament are significantly less risk averse than those who chose the piece rate; in contrast, the choice by men is not influenced by risk attitudes. However, gender differences in tournament entry remain significant when controlling for performance, beliefs, and risk attitudes. In summary, a series of studies has found that incentivized measures of risk attitudes play a limited role in explaining the gender gap in tournament entry. In analyses in which risk attitudes have explanatory power, the gender gap in tournament entry is slightly reduced but typically remains significant.

2.3. Gender Differences in Other-Regarding Preferences

Finally, concerns about others' payoffs may influence the decision to enter a competition. Entering a tournament may reduce the chance that others win. Compared with selfish individuals, participants who care about maximizing social welfare therefore may enter tournaments at a lower rate. Similarly, participants that are inequity averse may enter less often, as a medium payoff reduces inequity compared with a high-winning or

very-low-losing payoff. Although it is commonly argued that women are more altruistic than men (e.g., Croson & Gneezy 2008), Andreoni & Vesterlund (2001) find that men are more altruistic at low prices of giving, whereas the reverse holds at high prices. Furthermore, they find that women are more averse to inequity, whereas men are more concerned about maximizing social surplus (see also Fehr et al. 2006, Kamas & Preston 2009). Hence it is not obvious how gender differences in other-regarding preferences can account for the gender gap in tournament entry. In the case in which tournament choices impose no negative externality on others' chances of winning, social-welfare maximizers should not be distinguishable from selfish individuals, whereas inequity-averse participants may still be reluctant to enter.

In Niederle & Vesterlund (2007), we designed our experiment to reduce the effect of other-regarding preferences by guaranteeing that an individual's choice imposed no externality on the payoffs of others. Specifically, a participant who entered a tournament wins if his or her new, subsequent, performance beats the old tournament performance of his or her competitors. Hence, if the performance of all participants is sufficiently large, then everyone who enters the tournament wins. If, despite the design, individuals incorrectly think that they influence others' payoffs, then this should also influence their choice when deciding whether to submit a past piece-rate performance to a tournament. Controlling for beliefs, we find no significant gender gap in compensation choices for a past performance, and using the choice for a past performance as a control, we continue to see that men are more likely to select the tournament for a future performance. Both these results suggest that the gender gap observed in Niederle & Vesterlund (2007) is not accounted for by gender differences in other-regarding preferences.

Kamas & Preston (2009) measure other-regarding preferences by having participants make 10 allocation decisions between themselves and two other participants. They use these decisions to classify participants as social-surplus maximizers, inequity averse, self-interested, or unclassifiable. Consistent with previous work, the authors find that men are more likely to be social-surplus maximizers. Examining choices between the piece rate and a no-externality tournament as in Niederle & Vesterlund, they find that social-surplus maximizers are most likely to select the tournament, whereas selfish and inequity-averse individuals enter at the same rate. Finally, controlling for other-regarding preferences, men remain more willing to enter math-based competitions.

Of course, other-regarding preferences may play a greater role when entry in a competition does influence the payoffs of others. Bartling et al. (2009) use four allocation decisions between self and others to classify participants as egalitarian or not egalitarian. They find that egalitarians are more likely to select a piece rate over a tournament, a result primarily driven by participants who are averse to being ahead of others. Behindness aversion, however, does not correlate with the decision to enter competitions. By contrast, it does negatively correlate with tournament entry in Teyssier (2008). Teyssier uses decisions in dictator and ultimatum games to classify other-regarding preferences and examines choices between a tournament scheme and a revenue-sharing scheme. She aims to examine whether selection improves efficiency and has participants select an effort level rather than perform a real task. She finds that individuals who are averse to receiving lower payoffs than others are less likely to enter competitions. Finally, Dohmen & Falk (2011) test whether trust and reciprocity influence compensation choices using decisions in a standard trust game. They find that neither trust nor reciprocity reliably correlates with the decision to select a tournament over a fixed payment.

In summary, there is mounting evidence of a gender gap in tournament entry when controlling for performance. Gender differences in confidence seem to play an important role in explaining this gap, which is consistent with the finding that the gap is attenuated in stereotypical-female tasks. However, there is little evidence that gender differences in risk aversion and in other-regarding preferences play a systematic and robust role in explaining the gap. Simultaneously controlling for these factors generally leaves a significant gender gap in tournament entry. This suggests that differences in attitudes toward competition also help explain why men and women differ in their willingness to compete.

3. DO WOMEN PERFORM LESS WELL IN A COMPETITION?

Above we focus on the decision of women and men to enter a tournament. To allow for repeat measurements, studies used environments in which the performance is measured on very short tasks. Performance on such tasks is not very responsive to the incentive scheme. As a result, the majority of papers discussed suggest that the relative performance of women and men is independent of the incentive scheme at hand. This observation may lead to erroneous inferences when deciding whether to encourage competition. If the competitive pressure of a longer-lasting task can affect performance, then we need to use caution when recommending that women with a high noncompetitive performance enter competitions. In this section we summarize studies that ask whether the relative performance of women and men changes when the incentive scheme is changed.

The first paper in that vein is Gneezy et al. (2003). They conducted an experiment at the Technion in Israel in which women and men solved mazes on the Internet for 15 minutes under different compensation schemes. Three men and three women participated in each session of the experiment. Although gender was not explicitly mentioned, participants could see each other and determine the gender composition of the group. Each treatment had 30 women and 30 men, and no one participated more than once; that is, every participant performed only under one incentive scheme. At the end of the experiment, participants were informed only of their own earnings.

Under a piece-rate payment with a compensation of about \$0.5 per completed maze, the average performance of men was 11.2 mazes, whereas it was 9.7 for women. The difference of 1.5 mazes is not significant. This gap is compared with that in a competitive-pay treatment in which the highest-performing participant was paid six times the piece-rate payment, i.e., about \$3 per maze, while the remainder of the group was paid nothing. In the case of a tie, the winners shared the payment equally. The average competitive performance of men of 15 mazes was significantly higher than in the piece rate, whereas the average performance by women of 10.8 mazes was not different from that in the piece rate. The gender gap in performance of 4.2 mazes under competitive pay is significant and is significantly higher than the gap of 1.5 under the piece rate.

The increase in the gender gap in performance may be attributed to gender differences in competitiveness and/or in risk attitudes. The tournament payment is both competitive and uncertain. In the previous section, we show that gender differences in risk aversion do not have a robust effect on tournament entry and in general fail to eliminate the gender gap in tournament entry. However, when deciding whether to perform highly in a tournament, gender differences in risk aversion may nonetheless have a significant impact.

Because the use of a real effort task makes it hard to assess the impact of risk aversion, Gneezy et al. (2003) opt for an approach in which they examine performance in a risky

but noncompetitive environment. In a random-pay treatment, they randomly select one participant who is paid \$3 per maze, and the remaining participants are not paid for their performance. The uncertainty of this payment scheme is similar to that in the tournament. In the random-pay treatment, the average performances of women and men are similar to those in the piece rate. Furthermore, when making comparisons with the tournament performance, the results are the same whether we use the random-pay or the piece-rate performance.

Therefore, it seems that men and women differ in their response to the competitive-payments scheme. There are three classes of explanations for the results above. First, women simply may not perform well under competition. More mundanely, this could be because women cannot solve more mazes without incurring very high costs. Second, women may compete, but not against men. This could be because women perform somewhat less well in this task than do men (and/or believe they do), and hence they may decide not to exert effort to increase their performance. Third, it may not be the performance of women that needs explaining, but the performance of men. It could be that men compete too much.

A treatment with single-sex tournaments, in which groups of either six men or six women compete, suggests that the second hypothesis is the most plausible. The average performance of men (14.3 mazes) is not significantly different from that in mixed-sex tournaments, and it is significantly higher than those in the piece-rate and random-pay treatments. More importantly, women do seem to be competitive: Their average performance in the single-sex tournament (12.6 mazes) is significantly higher than in either the piece-rate or the random-pay treatment.

To determine whether the male and female response to competition is comparable in single-sex groups, Gneezy et al. (2003) evaluate the average gender gap in performance across treatments. The gender gap in performance is 1.5 mazes in both the piece-rate and the random-pay treatment, and 1.7 in the single-sex tournament. The gender gap of 4.2 mazes in mixed-sex tournaments is significantly higher than in the single-sex tournaments and in all other treatments (see Figure 2).

The result is that this gender gap in performance is significantly larger in mixed-sex competitive environments than in noncompetitive payment schemes or single-sex

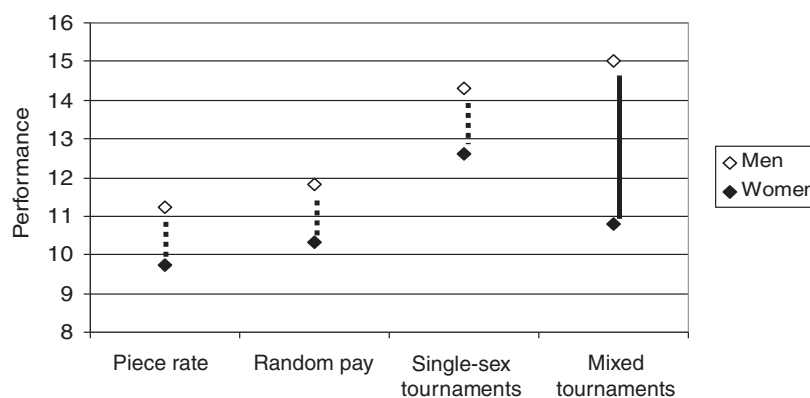


Figure 2
Average performance of 30 men and 30 women in each treatment in Gneezy et al.'s (2003) experiment.

competitive environments. This is driven largely by women not performing highly when competing against men. Furthermore, the fraction of women among the top 40% of performers varies a lot. In the noncompetitive treatments and in the single-sex tournament, pooling data from males and females, women account for 40% of participants who performed in the top two quintiles. Hence if tournaments were run in single-sex groups, one may falsely conclude that men and women have similar responses to competition. However, running mixed-sex tournaments significantly decreases the fraction of women with a performance in the top two quintiles from 40% to 24%. Thus mixed-sex competitions result in a decrease in the relative performance of women and in the fraction of women in the top two performance quintiles.

Gneezy & Rustichini (2004) consider the performances of 10 year olds in competitive and noncompetitive environments. In their experiment, children first run 40 meters separately and are then paired so that the two fastest kids run against each other, and so on. The authors find no initial gender difference in speed. In competition, boys on average increase their speed, whereas girls become slightly slower, a difference that is significant. Boys and girls both improve the most when competing in mixed groups; boys competing against boys also run faster, but girls competing against girls slow down. This suggests that although competition makes boys improve more than girls, girls do not improve when competing against girls. However, kids ran simultaneously against each other, so another variable of interest may be whether they won the competition. The initially faster kid won the competition 10 out of 17 times (59%) in boy pairs and 6 out of 12 times (50%) in girl pairs. That is, in single-sex groups, the initially faster runner is almost as likely to win as the initially slower child. In contrast, in mixed-sex groups, the boy won 8 out of 11 times when he was slower (73%) and 15 out of 18 times (83%) when he was faster. Viewed this way, the results suggest that girls do not compete well against boys. Indeed, girls have a higher chance of winning when running against a girl compared with a boy, even if the girl was initially faster than the boy. Boys, however, have an easier time winning against a girl, both when the girl initially was slower or faster. Thus Gneezy et al.'s (2003) findings that girls compete better against girls than boys are replicated when examining who wins the head-to-head competition.

Similar to the literature on compensation choice, the literature examining how the performance of men and women responds to competition has tested robustness by changing the task or by providing feedback on relative performance. Günther et al. (2010) replicate Gneezy et al.'s design by comparing six-person tournaments with a random-pay treatment. They use mazes and a word task, in which participants receive a letter and have to form as many words as possible that start with that letter. For the maze task, the authors replicate Gneezy et al.'s results in that competition improves the performance of men but does not affect the performance of women. Men outperform women in the tournament but not in the random-pay treatment. For the word task, the authors do not replicate the result. Both women and men have a higher performance in the tournament than in the random-pay treatment; thus both increase performance on the word task in reaction to competition. Shurchkov (2011) also compares two different tasks. In the verbal tasks, participants receive a word and have to form new words using a subset of the letters of the original word, with proper nouns not allowed. In the math task, participants receive a string of numbers and a target number; using numbers from the initial string, they are asked to find additions that yield the target. When performing under pressure (two minutes per problem), Shurchkov finds that in the math task, men

significantly outperform women in the tournament but not in the piece rate. This result is driven by women reducing their performance in the tournament. In the verbal task, however, there are no gender differences in performance under either incentive scheme. Furthermore, both women and men believe women to outperform men in the verbal task, whereas the opposite is predicted in the math task. Shurchkov also has a low-pressure treatment, in which participants have 10 minutes per problem. In the low-pressure treatment, she finds that the relative performance of women increases in the tournament such that there is no gender difference in the math task and women outperform men in the verbal task.

Examining the role of beliefs and feedback, Kuhnen & Tymula (2011) have participants perform in 18 rounds in which, before each performance, participants learn whether they will receive information about their relative performance with a 0%, 50%, or 100% chance. The feedback provides information on one's ranking and the scores of all group members. Participants have no other incentives to perform. The authors find that participants have a higher performance when there is a positive chance to receive feedback. Furthermore, the number of men in the group affects the productivity of women. The women's expected and actual rankings are worse and their absolute performance is lower the more men there are in the groups. Men, however, are not affected by the gender composition of the group.

It therefore seems that the task and maybe the way the task is administered may matter when looking for gender differences in changes in performance across incentive schemes. However, in a stereotypical-male task, gender differences in competitiveness have been confirmed. When examining the effect of competition on performance, it is crucial that the task examined is one for which performance can respond to incentives; thus the tasks examined in Section 2 are not well suited.

The two strands of literature, choosing to enter a tournament compared with a piece-rate scheme as in Niederle & Vesterlund (2007) and performing well in a tournament incentive scheme as in Gneezy et al. (2003), paint similar pictures. Suppose we refer to the decision to enter the Niederle-Vesterlund tournament as being competitive. Similarly, we refer to the decision to perform highly under the Gneezy et al. tournament as being competitive. Then both strands of literature lead to the same conclusion. Women are often less competitive than men in mixed-sex tournaments. Note that Shurchkov (2011) finds that whenever there is a gender difference in performance in the tournament that is not present in a piece rate, the same gender difference arises in tournament entry, even after controlling for performance. Furthermore, risk aversion does not seem to play a large role in accounting for those differences, whereas gender differences in beliefs may play an important role. This seems to be the reason that in stereotypical-female tasks the effect of competition does not seem to generate a large gender gap in performance. Finally, gender differences in competitiveness are reduced when women compete against other women, a result we replicate for the choice of incentive scheme in Section 5.

4. FIELD EVIDENCE

Recent research has begun to examine whether gender differences in competitiveness also arise in the field. Research has centered on sports competitions, competitions for selective educational programs or fellowships, and the labor market in general.

4.1. Sports

There are two reasons why we may not find large gender differences in sports competitions. First, sports competitions are typically within gender, and evidence from laboratory studies suggests that the gender gap in competitiveness is smaller or absent in single-sex competitions. Second, performance in a sports competition is rather precisely measured, and it may be argued that at least elite athletes have a good sense of how their performance ranks relative to that of others. Hence gender differences in overconfidence may be smaller in these environments, resulting in a smaller gender gap in competitiveness.

Paserman (2010) uses data from Grand Slam tennis tournaments to investigate the response to stakes and competition. Examining aggregate set-level data, he finds that an increase in stakes decreases the quality of the game for both men and women, and although the decrease is greater for women in the decisive set, the gender gap in performance is not significant. However, the gender gap is significant when evaluating the point-by-point data. Each point is ranked by the effect it has on the probability of winning the match. Arguing that the competitive pressure of a match increases with the importance of a point, Paserman finds that the importance of a point does not influence the unforced errors by men, while it increases them for women. Thus the effect of competition on performance differs by gender, with women more likely to make unforced errors at crucial junctures of the match.

Sport competitions have also been used to evaluate gender differences in willingness to compete. Garratt et al. (2011) examine choices in the State Street Mile race in Santa Barbara, California. Participants with running times above a certain qualifying standard were encouraged to sign up for a more competitive and prestigious race that offered cash prizes. Despite the competition being within gender, the authors find that among those who qualify for the more competitive elite race, women (and older runners) are much less likely to enter. Although this is particularly pronounced for older women, qualified young women are two-thirds as likely to enter as qualified young men. The results are different, however, for the fastest young women as they always enter the more competitive race. Thus female athletes who may be well aware of their superior performance do not shy away from competition against other women.⁶

4.2. Educational Competitions

Another environment that has been used to examine competitive attitudes is education, specifically competitions for admission to selective educational programs or fellowships. As in the initial laboratory studies described above, these are mixed-sex competitions among individuals who likely are uncertain of their relative performance.

Consistent with the expectation that women may underperform on admission tests to selective education programs is that they tend to report higher levels of exam anxiety (e.g., Bors et al. 2006) and that the overconfidence of men may lead them to pursue more challenging and rewarding extra-credit questions (Bengtsson et al. 2005). To determine whether test scores reflect differential responses to competitive environments rather than differences in skills, Örs et al. (2008) use performance on an entry exam to a very selective French business school (HEC). This entry exam is very competitive: Only about 13% of

⁶The results on competitive entry for elite runners are also in line with those shown in an elite Swedish 10,000-meter race. Nekby et al. (2008) find that in this very competitive race, women are as likely as men to opt for starting groups that have running times superior to their own.

candidates are accepted. A comparison of entry-exam scores reveals that the performance distribution of males has a higher mean and fatter tails than that of females. The authors then compare this gender gap in performance with the outcome of the national high school exam, and for admitted students to their performance in the first year. Although both are stressful environments, they are less competitive than the entry exam. The performance of women dominates that of men, both on the high school exam and during the first year at HEC. Females from the same cohort of candidates performed significantly better than males on the national high school graduation exam two years prior to sitting for the entry exam, and within the first year of being admitted to the master of science program, females outperform males.⁷ Furthermore, it does not appear that the results are due to individuals using different test-taking strategies as the variance of grades across different subjects in the entry exam is not higher for males than females. The authors conclude that the differences in the gender gap between the entry exam and the high school exam as well as the first-year performance result from a differential response to competition. Although no comparable study has been conducted in the United States, Örs et al. (2008) note that their results are consistent with the observation that female grade point averages in both high school and college exceed those of males when controlling for their SAT scores (e.g., Rothstein 2004).

In a related study, Jurajda & Münich (2008) examine an entire cohort of Czech students who apply to tuition-free universities with substantial variation in the selectivity of various programs. Using variation in acceptance rates as a measure of competitive pressure, they examine gender differences in applications to programs and whether the competitive pressure of a program appears to influence performance on the associated admission test. An individual's skills are measured by test scores on a comprehensive exam, and the admission test score is inferred from the admission decision. The authors find that men and women with the same field of interest and comprehensive test scores are equally likely to apply to more competitive programs; however, men are more likely to be accepted.⁸ This suggests that performance on admission tests does not reflect that of the comprehensive tests. Although such a difference may be explained by discrimination, the authors note that many of the admission tests are judged anonymously. Finally, the sensitivity to the program's competitiveness remains when one controls for the gender composition of the program in question. Thus the gender gap in acceptance is the same in male- and female-dominated programs, suggesting that discrimination is unlikely to be the cause of the observed difference. The authors conclude that the observed difference is consistent with women having a lower relative performance on admission tests for more competitive programs.

Attali et al. (2010) compare performance on the GRE with that on a voluntary experimental section of the GRE. The gender gap in performance is greater in the real and very competitive GRE than in the experimental and low-stakes GRE.⁹ The authors attribute

⁷Some caution should be used in this second comparison, as relative to the sample of entry exam takers, that of actual HEC students is truncated because some students may have opted to exit.

⁸The result on applications may be sensitive to the fact that individuals can apply to multiple programs.

⁹The experimental section of the GRE was conducted immediately after the real GRE, with the reward for participation being a possible prize of \$250 to those who have the largest relative improvement from their real GRE performance. To the extent that men may have been more overconfident about their relative performance in the real GRE, this may have caused them to believe that a greater absolute increase in performance would be required for them to win the competition.

this difference to men responding more strongly to the decrease in incentives in the experimental GRE. In fact a larger fraction of men than women opt to leave the experimental GRE within the first 10 minutes of the allowable time.¹⁰ Although some participants respond to the reduced pressure in the experimental GRE by improving performance, there is no evidence that women are more sensitive to such a change. The authors therefore attribute the larger gender performance gap on the real GRE to men responding more to high stakes.

J. Price (2008) also documents gender differences in performance under competitive pressure. He examines how the time to completion and graduation rates in graduate school vary in response to a competitive fellowship program (the Mellon Foundation's Graduate Education Initiative). When initially instituted, the selection criterion of the fellowship was the student's progress toward a degree, and indeed when examining initial awardees, there is evidence that the awards were given to students who had made a quick advance to candidacy. This competition on speed caused a substantial and significant decrease in the time to candidacy for eligible male students, whereas it had no effect on the time to candidacy for eligible female students. Furthermore, the reduction in time to candidacy was sensitive to the gender composition of the competing cohort, with improvements for both males and females being greater in programs in which a larger fraction was female.¹¹

4.3. Labor Market

Together with education, the labor market is an area in which we are particularly interested in identifying gender differences in competitive behavior. Unfortunately, the complex interactions of these markets often make it difficult to directly identify competitive behavior.

Lavy (2008) examines competition among math, English, and language teachers who participated in rank-order tournaments that rewarded teachers with cash bonuses based on improvements in the test performance of their classes. The competitions were done within the field and school, which resulted in variation in gender composition across competitions. Measuring performance by average ranking, winning rate, and awarded prize, he does not find evidence of gender differences in improvement nor does it appear that the gender composition of those competing influences outcomes.¹² Lavy notes that perhaps the difference relative to Gneezy et al. (2003) results from this study examining experienced teachers competing on a familiar task against well-known colleagues. It may

¹⁰The study was initially conducted to examine the effect of time limits on GRE performance; the substantial early exit from the study caused Bridgeman et al. (2004) to drop participants who did not spend at least 30 minutes on a 45-minute test or 20 minutes on a 40-minute test.

¹¹Looking at data from the game show *The Weakest Link*, Antonovics et al. (2009) do not find that the gender of the opponent influences the performance of women; instead they find that men are more likely to correctly answer a question when competing against a woman, with the difference arising for men over the age of 33. This insensitivity to the opponent's gender is replicated for high-stakes one-on-one competitions in the laboratory, in which individuals take turns answering questions; however, for low stakes, both men and women perform worse in mixed than in same-sex competitions.

¹²Delfgaauw et al. (2009) document that an increase in sales, resulting from a competition between retail stores, is greatest when the manager and the workers have the same gender. Although consistent with men and women potentially having different competitive attitudes, the study more directly addresses the issue of female- and male-led teams potentially being equally successful in competitions.

be that gender differences in confidence and competitiveness played less of a role in this environment. He also suggests that the competitive attitudes of teachers, in particular male teachers, may differ from the population at large. An alternative explanation may be related to this competition being based on the performance of others—each teacher's student. Just as women have been found to opt out of negotiations and yet be willing to negotiate on behalf of others, it may be that they are more eager to compete when doing so benefits others (Bowles et al. 2005). Consistent with previous work, the study finds that men tend to be overconfident about the likelihood that they will win the rank-order bonus. This suggests that when faced with a choice of compensation scheme, men might be more likely to select a competitive-compensation structure.

Beckmann & Menkhoff (2008) conduct a survey to directly assess individual differences in competitive attitudes. Focusing on a cohort in which women tend to be underrepresented, they surveyed mutual-fund managers in the United States, Germany, Italy, and Thailand. Although they do not find substantial gender differences in risk attitudes or overconfidence, they do find female financial experts to be more averse to competition. At the end of a given year, female fund managers are more likely to select a strategy that follows the market than they are to opt for a strategy that may enable them to outperform the market. This result is consistent with the finding by Niessen & Ruenzi (2008) showing that female fundraisers are less likely to have a very good or a very poor performance.

4.4. Summary

The field studies presented above are excellent examples of how researchers, based on evidence from the laboratory, have identified environments in which, despite limited access to controls, it is nonetheless possible to identify gender differences in competitiveness. In many instances, the field evidence confirms the findings of the laboratory. In environments in which it is likely that there are gender differences in confidence, many studies confirm that the performance gap between men and women increases with competitive pressure. The performance of men rises in response to competition; that of women does not. Although the research on willingness to compete in the field is more limited, the initial studies are consistent with women opting not to enter competitions for which they are qualified. Of course, a difficulty in examining field evidence is that although performance measures are available, we rarely know anything other than that. Hence many results may be explained by what appear to be reasonable ad hoc assumptions on the participants' underlying beliefs. It will be interesting in future studies to combine field observations with belief measures on relative performance. Once we have proper controls for beliefs, it will be easier to determine why in certain settings we may not find the anticipated gender difference in competitiveness.

5. CHANGING THE GENDER GAP IN TOURNAMENT ENTRY

The finding that high-ability women choose not to compete is of substantial concern from a societal perspective. It is costly if those with the highest ability do not apply for the jobs for which they are best suited. Can anything be done to encourage more women to enter competitions? One approach is to take the gender gap in competitiveness as given and examine whether institutional changes may encourage more women to enter

environments in which they are likely to succeed. Another approach is to ask whether preferences for competition are malleable. Specifically, is an individual's willingness to compete a result of nature or nurture? And if the former plays a role, how may we and should we influence such preferences? We review both these lines of research in this section.

5.1. Institutional Changes

Research to date shows that confidence plays an important role in influencing the choice of compensation scheme. Thus tournament entry may be affected through institutions that alter an individual's confidence. Although gender gaps in confidence and entry have been shown to be smaller on stereotypical-female tasks, changing the characteristics of the task may not be feasible. Our discussion therefore focuses on institutional changes that can alter entry into tournaments with a stereotypical-male task in which many competitors are male.¹³

We show in Section 2.1 that feedback on relative tournament performance may be used to affect confidence and thus entry. One possible obstacle to providing information on relative tournament performance is that such information may not be available. For example, past performance measures may not reflect the relative ranking in the tournament of interest, as the competitive pressure of the tournament may change the previously observed relative ranking.¹⁴

As an alternative to manipulating beliefs, consider institutional changes that influence both the participant's beliefs on relative performance and attitudes toward performing in a competition. One such example is the single-sex competitions examined in Section 3. A less extreme modification is considered by Niederle et al. (2010), who examine the effect of affirmative action in the form of a soft quota, in which at least half the tournament winners are required to be female. The setup is similar to that in Niederle & Vesterlund (2007). However, the experiment was run at Harvard instead of the University of Pittsburgh, and the gender composition of the group was mentioned explicitly. In the experiment, groups of three men and three women perform a series of five-minute addition tasks. The first three tasks are as in Niederle & Vesterlund, with the exception that in the tournaments the two highest-performing participants receive \$1.50 per correct answer. After the piece rate, the tournament, and the choice of compensation scheme, an affirmative-action tournament is introduced. The two winners of the affirmative-action tournament are chosen as follows. One winner is the highest-performing woman, and the second winner is the person with the highest performance in the remainder of the group. That is, a woman wins the tournament if either she is the highest-performing woman or if she has one of the two

¹³Another change that does not seem to be feasible is to alter the time pressure of the task. However, we note that Shurchkov (2011) finds that when performing under low pressure, women not only outperform men in the tournament in a verbal task, they are then also more likely to enter a tournament, even controlling for performance. The question of interest here is how we can encourage high-ability women to enter male-dominated and high-intensity competitions.

¹⁴In Section 3 we demonstrate that relative rankings on performance may depend on the incentive scheme used to measure those performances. Furthermore, in a series of papers on stereotype threat, Steele and colleagues show that the performance of minorities who may suffer from a stereotype that they may not be as able as others differs in a test described as predictive of abilities (and, maybe here, the ability to perform well in the next competition) rather than simply a difficult test (Steele & Aronson 1995, Steele 1997, Spencer et al. 1999). This may especially be the case if women are averse to receiving information about their relative performance and employ self-handicapping techniques (Keller 2002).

highest performances. A man wins if he is both the highest-performing man and has one of the top two performances.

Although men outperform women, results on tournament entry mimic those of Niederle & Vesterlund (2007).¹⁵ The subsequent introduction of affirmative action causes the tournament to become more gender specific, as a woman needs only to outperform the other women to win. This change may influence both beliefs and attitudes toward competition. Thus there are three channels through which affirmative action may influence tournament entry. First, the gender-specific competition may alter the pleasure or fear of competition. Second, beliefs about relative performance within gender may differ from those across gender. Gender differences in confidence may be exacerbated in mixed compared with single-sex groups. Third, there may be an effect of mentioning affirmative action: Women may feel they should enter such a tournament, whereas men may view the change as unfair and decide not to enter.

The introduction of affirmative action increases entry by women and decreases it for men, with both changes being greater than predicted by the altered probabilities of winning under affirmative action. The analysis suggests that each of the proposed channels helps explain the response. First, the gender gap in confidence is reduced as there are no gender differences in beliefs within gender. Second, simply mentioning affirmative action appears to increase entry by women, whereas the adverse effect for men is small at best. Finally, women seem to enter tournaments at a higher rate, controlling for all other effects. This suggests that women are more willing to compete when competing against women. These results confirm that confidence and attitudes toward competition are central to explaining the gender gap in tournament entry.

Does the policy encourage high-ability women to enter the competition, and if so, how costly is such a change in terms of reverse discrimination? To understand the effect of affirmative action on the gender composition of the group of entrants, we focus on the performance of entrants in both the standard and the affirmative-action tournament. **Figure 3a** shows the number of entrants who have performances at or above a certain level. Affirmative action increases entry for participants who solve 13 problems or less but does not affect the number of entrants with a higher performance. However, affirmative action drastically changes the gender composition of tournament entrants, with more high-ability women entering. To assess this change and the cost of the policy, suppose that among the participants who chose to enter the tournament, we can impose the affirmative-action rule that for every man, at least one woman has to be hired and that the hiring of candidates relies on them meeting a minimum performance threshold. Then the costs of affirmative action can be assessed by determining the number of higher-performing men that will be passed by when hiring a woman at a particular performance level to satisfy the affirmative-action requirement.

These costs can be assessed using either entrants to the standard tournament or entrants to the affirmative-action tournament (**Figure 3b**). The latter represents the ex post cost of the policy after individuals have reacted to the affirmative-action policy and is represented by the (AA w AA) graph. The former represents the expected costs of the policy or

¹⁵The only difference is that low-performing men do not enter the tournament too much. However, in a second experiment at Harvard, we do find overentry by low-performing men, and this result also holds in the combined sample. Note that the primary attraction of environments in which there are no gender differences in performance is that they facilitate unconditional comparisons.

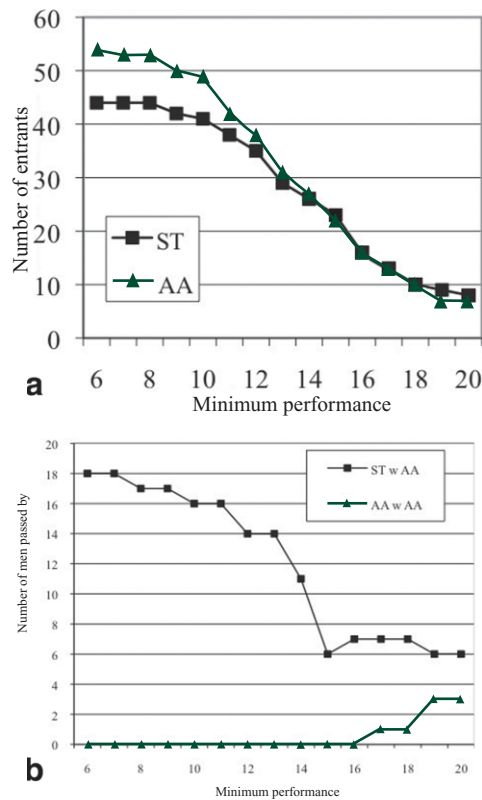


Figure 3

The effects of affirmative action. (a) The number of entrants with a performance above a minimum threshold in the standard (ST) and affirmative-action (AA) tournaments using performance on the third task. (b) The cost of affirmative action, represented by the number of better-performing men passed by to secure equal representation of women given the entrants to the standard tournament (ST w AA) and the entrants to the affirmative-action tournament (AA w AA). Figure taken from Niederle et al. (2010).

the costs that would result if the policy were implemented secretly after participants had made their entry decisions. This is represented by the (ST w AA) graph. This figure shows for each approach the number of strictly higher-performing men that are passed by when hiring a woman at a particular performance level, while satisfying the affirmative-action requirement. The gender gap in the decision to enter standard tournaments predicts substantial reverse discrimination. However, the introduction of affirmative action causes many high-ability women to enter the competition, and greater diversity is secured among those who win the tournament, without the anticipated reverse discrimination.

Balafoutas & Sutter (2010) also examine the role of affirmative action. Using the Niederle-Vesterlund setup, they compare entry decisions across, as opposed to within, subjects. After participants perform in a piece rate and a tournament, the treatments include a standard tournament choice, a quota setting (as in Niederle et al. 2010), and a preferential treatment in which the performance of women is increased by one or two problems, respectively. For the standard tournament, they replicate the gender gap in

tournament entry. Furthermore, entry rates among high-performing male and female participants are only similar in the treatments that use affirmative action, either in the form of the quota or the preferential treatment. Thus the authors confirm and extend the results of Niederle et al. (2010).

Some studies manipulate the composition of the groups in which individuals are competing directly by comparing single- and mixed-sex groups. Sutter & Rützler (2010) study the choice of compensation scheme of Austrian children aged 9 to 18. With a design similar to Niederle & Vesterlund (2007), participants are told either that their group of four would be a group of two boys and two girls or that it would be a same-sex group. In their sample, the performance of boys is not significantly different from that of girls. They do not find that the gender composition of the group affects choices. Booth & Nolen (2009) study children just under 15. In their sample, boys outperform girls. They randomly generate groups of four participants. Their results show that girls in single-sex groups enter the tournament more than girls in groups that contain at least one boy when controlling for performance. (They find that additional boys do not further affect the entry decision.) Choices by boys, however, are not affected by the gender of their competitor when deciding whether to enter a tournament. In Gupta et al. (2011), subjects are in pairs and receive a pseudonym that corresponds to their gender. Through these pseudonyms, participants are in one treatment implicitly informed of the gender of their opponent when solving mazes for 15 minutes, whereas in a second treatment that connection is made explicit. Participants choose between a piece rate and a tournament. The rules are such that if only one participant chooses the tournament, then that person wins automatically. In both cases, the authors find a significant gender difference, with men choosing the tournament about twice as often as women. Although each gender believes that women enter at a much lower rate than men, tournament entry for neither men nor women depends on the gender of the opponent. The only difference in entry rate, albeit not significant, is in the explicit treatment, in which men compete twice as much when competing against a woman as opposed to another man. However, when allowing participants to choose the gender of their competitor, Gupta et al. find that participants mostly choose a woman. This increases the proportion of participants that enter the tournament by about 20 percentage points for women and 15 percentage points for men, with only the former difference being significant. Grosse & Riener (2010) also examine the choice of competitors. They allow participants (in Germany) to choose among a set of attributes according to which their competitors should be chosen. The attributes include age, gender, number of siblings, distance of birth town, number of sport practices per week, and membership in societies. When deciding on the attribute of three competitors in the math task (as in Niederle & Vesterlund 2007), 22.50% of participants made no choice. However, when making a choice, gender was the most chosen attribute (28.75%) of which only 3.75% chose men, whereas the remaining 25.00% chose women.¹⁶

Research suggests that the gender composition of a group influences the individual's willingness to compete. Participants prefer to compete against women, and when given this choice, they are more willing to compete. Because the goal often is to encourage women to enter male-dominated environments, it may be hard to allow participants to choose the gender of their competitors or to have single-sex competitions. However, policies that rely

¹⁶In comparison, for the word task in which gender is also the most chosen attribute, half the participants chose women and the other half chose men, with participants being slightly more likely to choose their own gender.

on similar mechanisms may be worth considering. Affirmative action proved to encourage high-ability women to compete, and this increase in entry helped obtain greater diversity without introducing substantial reverse discrimination.

Another institutional change to consider is to ask whether competitions for promotion need to be designed as tournaments in which individuals compete against one another. It may be that the gender gap in tournament entry is lower when individuals compete in teams. Healy & Pate (2011) compare the entry decisions into four-party tournaments in which a party is an individual or a team of two. In both cases, participants have information about the gender of every participant. For teams, participants make choices individually, and each team member's choice has an equal chance of determining the compensation scheme for the team. Individuals decide between a piece rate and an individual competition, while team members decide between a team competition and a team piece rate in which a team's performance is always the aggregate performance of its two members. They find that women are more likely to enter a tournament when in a team, whereas men compete somewhat less, and the gender gap in tournament entry is reduced by about two-thirds when participants are in teams. They control for beliefs and risk aversion as in Niederle & Vesterlund (2007) and find that these factors, by and large, have only a minor effect in accounting for changes in tournament entry between individuals and teams.¹⁷

Dargnies (2009a) also studies the effect of teams on tournament entry. The major difference is that in her experiment participants decide between a team competition and an individual piece-rate performance. Team members are randomly drawn among other participants who choose the team tournament. She finds that the gender gap in tournament entry is significantly reduced, although the effect is primarily driven by men entering at a lower rate.¹⁸ Men, however, enter the tournament at a higher rate when they know they will be matched with participants whose individual tournament performance is close to theirs. This suggests that aversion to lower performance by a team member is what drives men to opt out of team competitions. Despite the increase in entry when paired with a comparable teammate, the gender gap in tournament entry remains lower than when participants enter individual tournaments. Dargnies (2009b) finds another factor that reduces the chance of men dropping out of competitions when in teams. Using an identity-building exercise, she divides participants into two identity groups and finds that men participate in team tournaments when the fellow team member is from the same identity group. Ivanova-Stenzel & Kubler (2005) report a related result: Gender differences in performance in a team depend on one's teammates. Specifically, women perform best in teams with other women. Overall, teams may in and of themselves reduce the gender gap in tournament entry; however, the effect is sensitive to the characteristics of the team members.

Although this literature is still in its infancy, it appears that the gender gap in tournament entry is sensitive to the institution one uses to select winners of a tournament. Particularly successful may be institutions that simultaneously improve women's beliefs about their relative performance and increase the comfort they experience when competing.

¹⁷When considering the decision to submit a past piece-rate performance to a competitive payment scheme, there are no gender differences in choices, nor any significant differences between individual and team decisions when controlling for performance and beliefs.

¹⁸This paper replicates the finding of Healy & Pate (2011) demonstrating that when eliminating performance in the competition (i.e., when deciding whether to submit a former piece-rate performance to a tournament), decisions are not different whether participants decide between a team or an individual performance.

5.2. Changing Preferences for Competition

Instead of changing the institutions under which men and women compete, it may be possible to alter preferences for competition. Central to this discussion is whether such preferences are innate or learned. The biology and psychology literature suggest that competitiveness results both from nurture and nature (see Niederle & Vesterlund 2007 for a discussion).

Gneezy et al. (2009) compare the compensation choices by men and women in the patriarchal Maasai society in Tanzania and the matrilineal Khasi society in India. Participants had 10 chances to throw a tennis ball into a bucket and chose whether to perform under a piece-rate or a tournament-incentive scheme. The behavior in the patriarchal society replicates that of the Western world: Maasai men are significantly more likely to select the tournament than the Maasai women. However, the gender gap in tournament entry reverses in the matrilineal society. This reversal of the gender gap between the patriarchal and matrilineal society may be seen as evidence that it is possible to nurture women to be more competitive.

There is, however, also evidence that nature influences attitudes toward competition. Specifically, biological traits or states have been shown to affect competitiveness. Using the Niederle-Vesterlund design in women-only tournaments, Buser (2011) finds that women are less competitive both when taking contraceptives that contain progesterone and estrogen and during the phase of the menstrual cycle when the secretion of these hormones is particularly high. Furthermore, it seems that levels as well as changes in levels are relevant. Finally, Buser shows that the effect of hormones on tournament entry is not mediated by risk aversion, confidence, or performance, although risk aversion and confidence correlate with tournament entry in the expected way. This result contrasts with that of Wozniak et al. (2010) who find that in high-hormone phases women are more rather than less competitive. This difference in results may arise from Wozniak et al. (2010) examining mixed-sex competitions or from providing participants with three alternatives: a tournament, a piece-rate, or a group-payment scheme. Although both studies suggest that hormones influence the tournament entry by women and thus suggest that nature matters, there is at present no consensus on the direction of such an effect.

An alternative approach is to examine the effect of testosterone on competitiveness. Whereas Apicella et al. (2011) find no relationship between self-selection into a tournament and current testosterone levels, a recent study by Hoffman & Gneezy (2010) takes advantage of the fact that left-handedness is thought to be an indicator of prenatal testosterone and finds evidence that such exposure increases competitiveness.

Finally, there is a series of studies that investigate how the gender gap in competitiveness changes with age. Sutter & Rützler (2010) examine compensation choices of 1,000 Austrian children and teenagers aged 3 to 18 years. Using a math task for the older participants and a running task for the younger subjects, they find a stunningly persistent gender gap in tournament entry. Despite there being no gender gap in performance on either of these tasks, males, independent of age, are 20 percentage points more likely to enter the competition than girls. Thus the gender gap in competitiveness is already present by age three. Taken alone, this study may be seen as evidence that preferences for competition are innate. However, two other studies on competitive performance by children suggest that nurture also plays a role. Whereas Gneezy & Rustichini (2004) find a significant gender gap in competitive performance among 10-year-old Israeli children, Dreber et al. (2011) find no

gender difference in competitive performance among Swedish children aged 7 to 10. They argue that this may be seen as evidence that gender differences in competitiveness are cultural and may arise later in life. This conclusion is also consistent with that of Andersen et al. (2010) who find that the gender differences in competitiveness observed among adults in Indian matrilineal and patriarchal societies do not arise until puberty.

Economic research to date is consistent with nature, nurture, and the interaction between the two influencing an individual's attitude toward competition. Although it is unclear, and likely to remain unclear, how much of this drive to compete can be attributed to nurture, there appears to be room for manipulating the preferences for competitions. Indeed, gender stereotypes held in a society have been shown to affect the performance of females on a stereotypical-male task such as math (Niederle & Vesterlund 2010, Pope & Sydnor 2010). If stereotypes can be changed, then it may be possible to encourage more women to compete on stereotypical-male tasks. Single-sex education is a possible remedy. Indeed, a cross-country study by Fryer & Levitt (2009) suggests that single-sex education may improve the confidence of girls and cause them to hold less stereotypical views of gender roles.¹⁹ Booth & Nolen (2009) directly compare tournament-entry decision by boys and girls in mixed- and single-sex schools. They find that, conditional on performance, girls from selective single-sex schools are more likely to enter competitions against boys than girls from nonselective mixed-sex schools. In considering single-sex education as the avenue to changing the gender gap in tournament entry, it will be of interest to determine the extent to which the gender composition of the classroom influences the individual's confidence and attitude toward competition and whether such changes are robust when the child subsequently enters a mixed-sex environment.

6. CONCLUSION AND DISCUSSION

Over the past decade, economists have become increasingly interested in determining whether a potential explanation for the persistent gender differences in the labor market may result from men and women differing in their attitudes toward competition. Of particular interest has been whether such differences help explain why men tend to hold jobs for which competition is required either to satisfy the daily demands of the job or to secure the job itself (e.g., Kleinjans 2009). In stereotypical-male tasks, there is consensus that men and women with the same ability differ in their willingness to compete. Whereas men prefer to be compensated under a tournament scheme, women prefer a noncompetitive piece-rate scheme. Perhaps the most robust explanations for this difference are that men tend to be more confident in their abilities than women and that they differ in their attitudes toward competition. Whereas men are eager to compete, women appear to shy away from competitions. The differential response to competitive pressure seems to influence the decision to enter competitions as well as performance in the competition. Laboratory as well as field evidence shows that there are environments in which an increase in competitive pressure causes the gender gap in performance to increase, with the performance of men increasing relative to that of women. Evidence from the field also suggests

¹⁹The U.S. evidence of single-sex schooling is far from conclusive (Campbell & Sanders 2002); as single-sex schools in the United States are private, self-selection may play a significant role, and identification of an effect of single-sex schooling is difficult.

differences in compensation choices in environments in which confidence plays a large role. Although field studies have begun to document gender differences in competitiveness, more work is needed to assess the magnitude of such effects.

From a societal view, it is disconcerting that high-ability women opt not to enter competitions that they are likely to win. The cost associated with not having the best talent among the applicants may be substantial. Research therefore has begun to ask whether and how more high-ability women can be encouraged to enter competitions. One option is to alter the institutions that select winners of the tournament. Although only a limited number of institutions have been investigated to date, it appears that institutions that augment the individual's confidence and attitude toward competition are likely to be particularly successful. One such examined institution is an affirmative action quota. Another option is to affect confidence and preferences for competition directly. Evidence suggests that preferences for competition are not fully innate but may be influenced by the manner in which we are raised. Thus it may be possible to nurture women to become more competitive. A less explored, but related option is instead to tackle gender differences in confidence and its sources directly.

Independent of the ability to nurture competitive preferences, it is important to ask whether competitiveness, generally speaking, is a desirable attribute. Although overconfidence and eagerness to compete may help secure promotions, such attributes may present a disadvantage in other settings. They may have a detrimental effect in cooperative settings in which one needs to sacrifice resources to secure the success of a team rather than oneself. Eagerness to compete and win competitions may also negatively influence the individual's ability to reach beneficial agreements with others. Although there is evidence that women suffer in negotiations because "women don't ask" (Babcock & Laschever 2003), it may be that men are more likely to view negotiations as two-person competitions and thus be less likely to give into demands, even when doing so is beneficial for both parties (see Niederle & Vesterlund 2008 for a discussion of the relationship between negotiations and competitions).

Indeed, both laboratory and field experiments suggest that male-to-male negotiations may result in outcomes that are inferior to those seen in male-to-female negotiations. For example, Sutter et al. (2009) examine convex ultimatum games in which one party first takes a share of a pie and the other party then has the opportunity to shrink the pie at a cost to both parties. Consistent with men being more competitive in dealings with other men, the authors find that men claim a larger share of the pie and retaliate more by shrinking the pie when they are paired with men rather than women (see also Eckel & Grossman 2001 on ultimatum game bargaining). Related field evidence is found by Castillo et al. (2010) who investigate how male professional taxi drivers in Lima, Peru, respond to male and female passengers who use the same aggressive bargaining script. Despite using similar bargaining scripts, women achieve superior outcomes than men. Women obtain better initial and final prices and are rejected less frequently than men.

Overall, the past decade has seen a new avenue of work in studying gender differences in competitiveness. Although the phenomenon has been quite robustly established, more work is needed to assess the importance of gender differences in competitiveness in accounting for gender differences in educational and career outcomes. This new and vibrant literature has made some strides in asking when competitiveness is harmful, when it is useful, how valuable it is, and how to change it; however, many open questions remain.

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