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Gender and Psychological Pressure in Competitive Environments: A Laboratory-based Experiment

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Gender differences in paid performance have been found in many laboratory-based competitive experiments. They have been attributed to men and women responding differently to psychological pressure. To explore this further, we conducted a laboratory experiment comprising 444 subjects, and measured gender differences in performance in four distinct competitive situations: (i) the standard tournament game where the individual competes with three others and the winner takes all; (ii) an anonymized competition in which an individual competes against an imposed production target and is paid only if he or she exceeds it; (iii) a 'personified' competition where an individual competes against the previous performance of one anonymized person of unknown gender; (iv) a 'gendered' competition where an individual competes against a target based on the previous performance of one anonymized person whose gender is known. Only men responded to pressure differently in each situation; women responded the same to pressure no matter the situation. Moreover, the personified target caused men to increase performance more than under an anonymized target. When the gender of the person associated with the target was revealed, men worked even harder to outperform a woman but strived only to equal the target set by a male.

I. Introduction

Introducing competition into the workplace is often seen as a way of increasing workplace and individual productivity (Lazear and Rosen 1981). In the laboratory, this can generally be observed by comparing performance under piece-rate pay to performance under tournament pay; average performance is higher under the tournament. However, the introduction of competition may introduce psychological pressures that cause some people to perform worse in a tournament setting, as demonstrated by Apesteguia and Palacios-Huerta (2010). Using data from a randomized natural experiment (that does not involve women), they show that psychological or emotional effects are relevant to individual performance in a tournament setting.

In this paper, we explore how psychological pressure affects the performance of men and women in a variety of laboratory-based competitive situations. We examine psychological pressure by looking at competitive settings where we vary the information that participants receive about their competition. We find stark gender differences depending on what information was given; under competitive pressures, men respond more to information about their competitors than women. These results have implications for why gender gaps may remain in the labour market.

Since the 1980s, women have been catching up with men in the workforce, yet women still lag behind men with regard to both pay and opportunities for advancement (see, for example, Arulampalam *et al.* 2007; Blau and Kahn 2017). Reasons put forward to explain these stylized facts include discrimination and the productivity-reducing work–family conflicts that women are more likely to face than men. More recently, other hypotheses around gender differences in response to competition have been advanced: women shy away from competition; and men perform better in a competitive environment.[2] This paper adds to that literature on gender differences in competitive environments by showing that psychological pressures in different environments can lead men to perform better than women. Furthermore, by carefully varying

the environment in which the subject experiences psychological pressure, we can show where gender differences from psychological pressure are minimized.

In order to look at the effect of competition (or to mimic a competitive environment), laboratory-based research generally compares performance in a fixed-payment scheme (such as a piece rate) to performance under a variable payment scheme (such as a winner-takes-all tournament). Output is typically higher under variable-payment schemes than under fixed-payment schemes, and recent experimental evidence has found that gender affects self-selection into variable-payment schemes. When subjects are offered the choice of whether or not to enter a tournament rather than be paid by piece, a number of studies have found that women prefer to avoid such competition but men may choose to compete too much. Gneezy *et al.* (2003) find that women choose not to compete even though their piece-rate productivity is comparable to that of men. Niederle and Vesterlund (2007) show that there are gender differences in preference for competition.

Gneezy *et al.* (2009) and Booth and Nolen (2012) find that gender differences in preference for competition are not innate but vary depending on the cultural environment. Thus Gneezy *et al.* (2009) find that women are less competitive than men in a patriarchal society, but more competitive than men in a matrilineal society. Booth and Nolen (2012) find that girls from single-sex schools are as competitive as boys from either single-sex or co-educational schools, and more competitive than girls from co-educational schools. They also find an analogous result from random assignment of subjects on the day of the experiment into single-sex and mixed-sex groups. The Gneezy *et al.* (2009) and Booth and Nolen (2012) studies both suggest that social norms play an important role in affecting individual preferences. Bandiera *et al.* (2021) also mention social norms. They use a Bayesian hierarchical model to analyse a subset of laboratory and field experiments published between 1990 and 2012 that investigated performance-related pay. They conclude that women and men do not differ in behavioural traits so much as engage in 'norm-appropriate' behaviour.

Using experimental evidence, Dohmen and Falk (2011) show not only that higher productivity individuals self-select into variable-payment schemes, but that preferences and attitudes play a role. These preferences are likely to include confidence and a liking for competition. High-productivity individuals may choose to avoid competition if they dislike the psychological pressure that competition can induce.

Studies in the economics of education literature have also considered the role of psychological pressure on male and female performance in competitions, usually in the context of data from the field. For instance, Jurajda and Münich (2011) analyse data from an entire cohort of Czech students graduating from secondary schools and applying to universities. They find that, compared to men of similar general skills and subject-of-study preferences, women do worse only when applying to very selective universities. Analogously, Ors *et al.* (2013) examine the performance of women and men in an entry exam to a highly selective French business school. They conclude that observed gender differences in test scores reflect differential responses to the psychological pressure of competitive environments rather than differences in skills. Studying gender differences in performance in multiple-choice university entrance examinations, Pekkarinen (2015) uses data from Finnish universities where wrong answers are penalized with negative points and omissions yield zero points. He shows that, controlling for starting points, women perform worse than men in the entrance exam and are less likely to gain entry, and concludes that this relates to gender-different responses to pressure. For a study using data from experiments, see Buser *et al.* (2014), whose experimental measures of willingness to compete partially explain female students' choices to enter less prestigious academic tracks.

More recently, studies have begun to utilize field data to explore the role of psychological pressure in two-stage competitions involving men and women. For example, Cai *et al.* (2019), Iriberri and Rey-Biel (2019), and Booth and Lee (2021) each show that the performance of females drops off in the second stage when competitive pressure is higher. Iriberri and Rey-Biel (2019) use data from a two-stage maths competition in Madrid in Spain, while Cai *et al.* (2019) use data from the college entrance exam (*Gaokao*) in China, the first stage of which is a mock exam, and Booth and Lee (2021) use data from the set of high-ability adolescent girls and boys who participated in a long-running Korean television quiz show, *Janghak*!. All three studies show that female performance drops off with psychological pressure. In a related study that also touches on psychological pressure, Booth and Yamamura (2018) show that there are gender differences in performance that depend on the gender mix of the environment to which participants are randomly assigned: men perform better than they usually do when competing against women, whereas the reverse happens for women. Booth and Yamamura (2018) find that women's race time is slower in randomly-assigned mixed-sex races than in all-women races, whereas men's race time is faster in mixed-sex races than in men-only races. Moreover, in mixed-sex races, male racers are found to be more 'aggressive'—proxied by changing out of the randomly-assigned lane—whereas women follow less aggressive strategies.

Few experimental studies have considered explicitly the role of information revelation on individual performance with peer effects and how this varies with gender. In a laboratory-based experiment, Bellemare *et al.* (2010) investigate paying subjects under fixed wages then under piece rates, and subsequently generated peer pressure by revealing private information about the productivity of their peers. The task performed by subjects was gender-neutral, and consisted of entering scorecards of professional golfers into a database. The study found that while male performance was affected by information revelation, the productivity of women was little affected by peer pressure under either fixed wages or piece rates. However, while Bellemare *et al.* (2010) consider the role of psychological pressure, it is in a context very different to that in our present paper. In another study that also considered the role of information revelation on individual performance, Iriberri and Rey-Biel (2017) use data obtained from laboratory experiments in which various types of information were provided to subjects prior to a competition treatment. Their tasks were of two types: a male-favouring task that involved mental symbol rotation, and a digit-substitution task (involving memory and codification abilities) that is thought to favour women. The authors found a gender difference in performance in competitive environments only when the task being done was considered to favour men and when the presence of a rival was primed prior to competing. More recently, Cahlikova *et al.* (2020) examine male and female competitive performance in an experiment where individuals are exposed to psychological stress in the form of a 'psychosocial stressor' (that is, a stressor involving social interaction, evaluation, or a threat to social status). They found that the effects are gender-specific.

In the laboratory experiment reported in this paper, we model psychological pressure by giving subjects targets or thresholds that they have to reach in order to get paid, and we vary the salience of different aspects of the competitive environment. The tasks are gender-neutral, and the four environments are: (i) the standard tournament game where the subject competes with three other anonymous individuals and the winner takes all; (ii) a competition in which an individual competes against an imposed production target and is paid only if he or she meets or exceeds the target; (iii) a competition where an individual competes against a target based on the previous performance of an anonymous person; (iv) a competition where an individual competes against a target based on the previous performance of an anonymous person whose gender is also known. The reader will notice that the amount of information

about competitors increases as the experiment proceeds, beginning from no information and ending with knowledge of both the gender and the performance of the competitor, although the order of the last two rounds is varied randomly.

In the workplace, it is common for individual bonuses to be tied to performance against other people in the firm (roughly mimicking scenario (i) above). However, in other settings, workers may be set targets that they have to reach for payment or promotion (roughly mimicking scenario (ii) above). Given how commonplace goals and targets are in the workplace, we vary the way they are set in scenarios (iii) and (iv) to examine the role that pressure plays when more information is known about the person against whom one is competing. Therefore these four environments mimic closely many situations that individuals may face in the labour market.

We find that only men respond to the differences in environment when they are under psychological pressure. Men increase performance more when they know that they have to meet or exceed a target reached by someone else previously than when they are told to meet a target that was set in an unknown manner. However, if men know that the target that they have to reach was set previously by a woman, then they do even better than if they know that it was set by a man. That is, they are more likely to meet and exceed the target if they are told that it was reached previously by a woman rather than a man. Men appear to work harder to outperform a woman, but strive to only equal the target set by a male. In contrast, however, women do not respond to any of the environmental changes when they are under psychological pressure.

These results show that men are more likely to thrive in competitive environments than women—they increase their performance with the introduction of targets, whereas women do not. However, the other implication is that as women enter the workforce (and men have to compete against them), their presence will drive men to perform even better. Therefore, while women may shy away from competition or not perform as well if forced to enter a competitive environment, having females compete with men could lead to an overall increase in productivity.

II. Experiment Design

Objectives

We designed our experiment to explore the extent to which gender differences in competitive performance can be explained by gender-differentiated responses to environments when an individual is facing psychological pressure. Psychological pressure can arise through management-imposed targets as well as through non-cooperative peer effects, and we consider a number of these in our experiment.

Experiment location and subjects

After obtaining approval from University of Essex Ethics Committee, we conducted our experiment at ESSEXLab, the purpose-built University of Essex social science laboratory (full details available at https://www.essex.ac.uk/essexlab, accessed 20 February 2022). The laboratory has 32 networked workstations. Each of these is located in a soundproofed three-sided booth, with no vision lines to other booths, thus distraction is minimized.

ESSEXLab holds a database of all University of Essex students who have registered their interest in participating in social science laboratory experiments. Students registering are required to have read and understood ESSEXLab policies before signing up to the participant database.

For our experiment we were seeking only undergraduate students. All undergraduates who had registered their interest with ESSEXLab were invited by the laboratory manager to participate in our experiment. Drawing from this subject pool, we had a total of 444 students participate, and we conducted 20 laboratory sessions over the two-week period. On arrival at their particular session, students were checked in and randomly assigned (through numbered balls picked by the laboratory manager out of an urn) to a booth. Although participants could not see into the other booths, they were aware that others were participating in the experiment because they saw the other students while waiting to sign in and enter the laboratory. The average session comprised 23 students (the smallest session size was 12 students, and the largest was 28). Around 60% of the sample was female, and 40% was male.

Experiment

At the start of the experiment, students were told that they would be performing a sequence of rounds each involving a number of tasks. They were also informed that their performance from one of these rounds would be chosen randomly for payment at the end of the experiment.

In each round, students had three minutes to complete as many tasks as possible. Each task involved looking for two differences between a pair of matrices. Specifically, we asked students to compare a pair of matrices comprising five columns and six rows, and to click on the two letters in the right-hand matrix that differed from those in the left-hand matrix. (The experimental protocol is included in the Online Appendix.)

Before the games began, students received instruction in how to complete the task and were allowed to ask questions. The instruction began with students being shown by one of us (Patrick Nolen) a pair of matrices and told to click on the two letters in the right-hand matrix that differed from those in the left-hand matrix. After this, they were told to complete a practice round, in which they should try to complete as many tasks as possible, lasting three minutes. Once this instruction was completed, the paid experiments began. The procedure was that immediately before each round, students were told the nature of the task to be carried out and the payment for that round. At this stage, subjects were permitted to ask questions of clarification about that round. The purpose of the experiment was not explained to students, however.

The specific incentive structures are described below. Note that Round 5 was conducted *before* Round 6 for half of the subject pool (where these individuals were randomly chosen), and *after* Round 6 for the remaining subjects. We also conducted a Holt and Laury (2002) type of risk game at the conclusion of the rounds described below, followed by a questionnaire to obtain demographic information and the Big Five personality traits. (As noted, the questionnaire, also shown in the Online Appendix, was not completed by subjects until they had completed all the tasks in the experiment.)

- *Round 1 (Piece rate)*: Students had three minutes to complete as many tasks as possible, and received £0.60 per correct answer.
- *Round 2 (Standard tournament)*: Students were assigned randomly to groups of four but were not told who was in their group. Students had three minutes to complete as many tasks as possible. Students received £2.40 per correct task *if* they completed the most correctly; otherwise, they received £0. Ties were broken randomly.
- *Choice before Round 3*: Students were next asked to *choose* a payment mechanism for Round 3 before playing that round. They could get *either* £0.60 per correct task if they chose the piece rate, *or*, for the tournament, £2.40 per correct task *if* they got more correct than the other three people did in the previous round.

- *Round 3*: Students were given three minutes to complete as many tasks as possible, and were paid according to their choice.
- *Round 4 (Imposed threshold)*: Students were given a random number from a distribution matching that of the number of correct answers from Round 2, obtained from the laboratory session in which the subject was participating. This was their threshold. Students were not told the source of the threshold. They were then given three minutes to complete as many tasks as possible. Students received £2.40 per correct task provided that the number of tasks completed was greater than or equal to the threshold number, and £0 otherwise.
- *Round 5 (Personified threshold)*: Students were told how many tasks another randomly chosen subject *from within the laboratory* had completed correctly in Round 2. The identity of this individual was not revealed. Students were then given three minutes to complete as many tasks as possible. Students received £2.40 per correct task provided that the number of tasks completed was greater than or equal to the Round 2 performance of the randomly chosen competitor, and £0 otherwise.
- *Round 6 (Gendered-personified threshold)*: Students were told how many tasks another randomly chosen subject *from within the laboratory* had solved correctly in Round 2. While the identity of this individual was not revealed, their gender was. The gender cues were given using a stylized symbol like those appearing on Women's and Men's restroom doors, as shown in the Online Appendix. We chose not to have realistic images as we did not want subjects to be influenced in their behaviour by subjective evaluations of beauty and the like. Students were then given three minutes to complete as many tasks as possible. Students received £2.40 per correct task provided that the number of tasks completed was greater than or equal to the Round 2 performance of the competitor, and £0 otherwise.

Data description

As noted above, for our experiment we have 444 subjects, all of whom were registered for an undergraduate degree at the University of Essex. In the UK, undergraduate degrees take three years to complete; 40% of our subjects were in their first year, 30% were in their second year, and the remaining 30% were in their third year. The gender breakdown was 60% female and 40% male. The proportion who were female varied across sessions, ranging from a low of 49% female to a high of 79%. (We included session dummy variables in the main regression, and the results were the same with and without these.)

Table 1, describing the data, shows estimates from regressions where we include in each specification only a constant and a dummy variable for female gender. In columns (1) and (2), we show subjects' performance in Rounds 1 and 2—the mandatory piece rate and tournament, respectively. Column (3) gives the improvement in scores in Round 2 compared with Round 1. Column (4) shows how improvement in the tournament varied with piece-rate performance. Column (5) presents the marginal effect estimates from a probit model, where the dependent variable takes value 1 if the individual chose to be paid in Round 3 by the tournament mechanism, and 0 otherwise. In column (6), the dependent variable is the number of risky options chosen by our subjects using data from the risk game, whose format is given in the Online Appendix, Slide 22.

Table 1 shows that our sample has the same properties that are generally seen in the literature looking at gender differences in competitive environments (see, for example, Niederle and Vesterlund 2007; Booth and Nolen 2012). We have a task where there are no gender differences in performance under the tournament or piece-rate settings, yet women shy away from entering the tournament and are more risk averse than the men. However,

TABLE 1
GENDER DIFFERENCES IN PERFORMANCE, RISK PREFERENCES AND PREFERENCE FOR COMPETITION

	Piece Rate Score	Tournament Score	Tournament - Piece Rate Score		Chose To Compete (=1)	No. Risky Options
VARIABLES	[1]	[2]	[3]	[4]	[5]	[6]
Female (=1)	0.311	0.165	-0.146	-0.051	-0.192***	-1.419***
	[0.305]	[0.312]	[0.243]	[0.228]	[0.047]	[0.371]
Piece Rate Score				-0.305***		
				[0.036]		
Constant	12.655***	13.649***	0.994***	4.858***		13.241***
	[0.244]	[0.249]	[0.189]	[0.474]		[0.298]
Regression Type	OLS	OLS	OLS	OLS	Probit	OLS
Observations	444	444	444	444	444	444
R-squared	0.002	0.001	0.001	0.143		0.033

Notes
Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

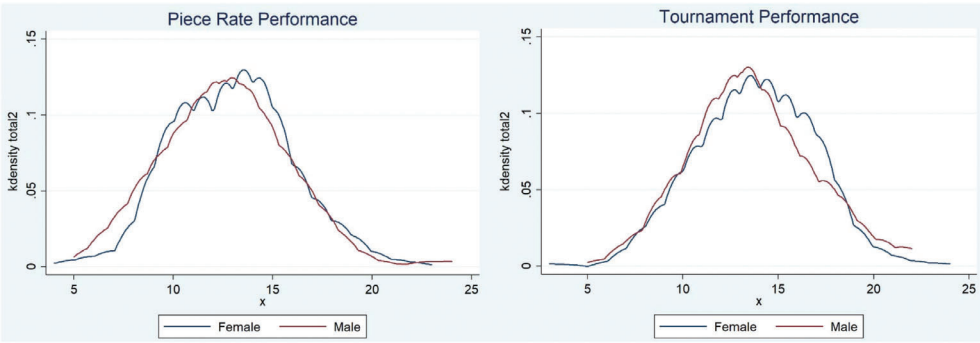

FIGURE 1. Performance distribution by gender for piece-rate and tournament rounds.

controlling for risk—not reported here—does not explain the gender gap in the preference for competition.

Table 1 shows that there are no differences in mean outcomes for either the piece-rate or tournament settings. However, given that we are looking at how environmental changes can have gender-differentiated impacts, we also want to look at the entire distribution and see if performance varies at different parts.

As seen in Booth *et al.* (2018), environmental changes may help women in the lower part of the distribution more, and we wished to see if this was also the case here. Figure 1 presents the performance distributions by gender for both piece-rate (Round 1) and tournament (Round 2) performance. The figure shows that there is no statistical difference in the distribution of performance by gender for piece-rate and tournament rounds.

In summary, we find that—although there are no gender differences in the task performance in the first two rounds of our experiment—there are statistically significant gender differences in preferences. Women are less willing to enter a competitive environment, and make fewer risky choices than men. To explore these findings further, we next compare the differences in scores between the standard tournament round (Round 2) and our various treatments.

Table 2 shows the difference in scores between Round 2—the standard tournament round—and the three treatments (Rounds 4, 5 and 6), disaggregated by gender. The first row shows that the average tournament score was 13.814 for women and 13.649 for men, and that the difference between them is not statistically significant. Moving down the columns, we see that for two of the three treatments—the target threshold and the personified threshold—there was a small increase in performance for both women and men. But once the personified threshold was gendered, a male competing with another male slackens off his performance (second to last row, column (2)). However, when a male is informed that he is competing with *a female* (last row, column (2)), his performance increases.

Table 2 shows us that the performance of men varies more in response to the competitive environment than does the performance of women. However, we need to examine if these findings hold once we control for ability and the magnitude of the threshold that a subject was shown. (Recall that each subject was given, as their target, a random number from a distribution matching that of the number of correct answers from Round 2.) Clearly, if a subject is given a higher threshold, then he or she will have to provide more effort to cross it, and will also be less likely to meet the target. In the next section, we will see if our findings from Table 2 carry through to the regression analysis.

TABLE 2
DIFFERENCE IN SCORE BETWEEN TOURNAMENT ROUND AND TREATMENTS

	Female	Male	Difference	SE of Dif
Tournament Score	13.814	13.649	0.165	[0.312]
Difference Between Score in Treatment Below and Tournament:				
Target	0.7	0.552	0.148	[0.255]
Personified Target	0.826	0.920	-0.094	[0.253]
Male Personified Target	0.933	0.164	0.769*	[0.438]
Female Personified Target	0.828	1.204	-0.376	[0.337]

III. RESULTS

Next, we present one of the main results of our paper, which is that men respond more than women to the environment when under psychological pressure.

Table 3 presents the results by round. The estimating sample is pooled observations from three rounds, namely Rounds 4, 5 and 6. Thus in column (1) we have 1332 person−round observations, while in column (2), estimated for women, we have 810 person−round observations, and in column (3), estimated for men, we have 522 person−round observations. For each of the three 'waves' of data, the dependent variable is the difference between the treatment score and the score in the standard baseline tournament (winner-takes-all) setup of Round 2. (Recall that the treatment scores are: Round 4, the imposed threshold; Round 5, the personified threshold; and Round 6, the gender-personified threshold.) We include dummy variables to indicate the round for which the difference variable was constructed, with Round 4 as the base. We also control for a subject's ability when under psychological pressure by including the score that subject got in the baseline. The target value that a person faced was also controlled for; the higher the target value, the less likely a subject will meet the target. The standard errors are clustered at the person level, and we are looking at the within-person differences to account for time-invariant subject-specific factors.

In columns (1)−(3) of Table 3, the difference between the student's score in that round compared to the baseline tournament is shown for all individuals, for all women, and for all men. Column (1) shows that when a target is used (Round 4), male and female subjects do not increase their performance when compared to the standard competitive environment studied (Round 2); the coefficient on Female (=1) is not statistically different from zero. The coefficient on 'Target value shown' also shows that setting targets does not increase performance when compared to the baseline setting of Round 2. The coefficient is nearly zero in each of columns (1)−(3), and is always statistically insignificant. When a target is personified or gender-personified, however, performance goes up significantly, by 0.220 and 0.284, respectively. However, the effect for the gender-personified target disappears when a male competitor is shown (the total effect for showing male is $0.284 - 0.214 = 0.070$). Male subjects perform better when they know that they have to hit a target set by a female.

By looking at females and males separately (columns (2) and (3) of Table 3, respectively), we see that the results in the overall sample are driven by males. Column (2) shows no significant response by females to the different environments; females do not vary their performance with regard to how a target was set when under psychological pressure. However, column (3) shows that men respond to how a target was set when under psychological pressure. First, men perform better when presented with personified targets. Second, when we show the gender of the person hitting the target, there is a differential response: a man

TABLE 3
PERFORMANCE DIFFERENCE BY THRESHOLD TYPE

	Score - Score in Tournament Round			Dependent Variable (=1) If Subject Met Target		
VARIABLES	[1]	[2]	[3]	[4]	[5]	[6]
Female (=1)	0.076			-0.002		
	[0.195]			[0.038]		
Personified Target (=1)	0.220*	0.129	0.383*	0.077***	0.032	0.153***
	[0.119]	[0.145]	[0.208]	[0.029]	[0.036]	[0.048]
Gender Personified Target (=1)	0.284*	0.093	0.602**	0.099***	0.090**	0.122**
	[0.155]	[0.197]	[0.250]	[0.035]	[0.045]	[0.055]
Male Shown for Gender Personified Target	-0.214	0.190	-0.900**	-0.013	-0.010	-0.024
	[0.249]	[0.312]	[0.406]	[0.058]	[0.072]	[0.100]
Target Value Shown	0.010	0.053	-0.060	-0.136***	-0.128***	-0.151***
	[0.026]	[0.032]	[0.041]	[0.008]	[0.011]	[0.013]
Score in Tournament	-0.297***	-0.351***	-0.222***	0.091***	0.089***	0.096***
	[0.037]	[0.041]	[0.063]	[0.007]	[0.010]	[0.010]
Sample	All	Females	Males	All	Females	Males
Estimation Model	OLS	OLS	OLS	Probit	Probit	Probit
Constant	4.534***	4.825***	4.418***			
	[0.569]	[0.696]	[0.959]			
Observations	1,332	810	522	1,332	810	522
R-squared	0.123	0.155	0.098			

Notes
Robust standard errors in brackets
*** p < 0.01, ** p < 0.05, * p < 0.1

will increase his performance when he is competing against a woman, but not when he is competing against a man.

Columns (4)–(6) of Table 3 show the marginal effects from the probit regressions for the likelihood that a subject hits the target shown in any round. In these columns, we control for a subject's ability when under psychological pressure by including the score that subject got in the tournament round. Furthermore, we control for the target value shown; the higher the target value, the less likely a subject will meet the target. Again, consistent with the performance results, the overall effects are driven primarily by the men. However, as seen in column (5), while women do not increase their performance in a gender-personified round, they are more likely to meet their target—regardless of whether they are told the target had been reached by a man or a woman. Column (6) shows that men are more likely to meet the target in the personified and gender-personified settings than in the exogenous threshold setting—which is also when they perform better. However, unlike in column (3), there is no statistically significant differential effect from the gender of the person shown.

Table 3 clearly shows that when they are under psychological pressure, men perform better when they are told that they are competing against a target set by another (anonymous) person or a female. Furthermore, in both of those cases, the increase in performance means that men are much more likely to make their target. With women, while we see that changing the environment does not lead to a change in performance, when they are in a gender-personified environment, they are more likely to meet their target.

These results show us that when individuals are under psychological pressure, the environment in which they are competing matters. Furthermore, while males increase performance and hit the target more in some situations, we know from the descriptive situations in Table 2 that women are more likely to be close to the target, whether they miss or surpass it. Therefore we will next explore this differential effect by examining the estimates presented in Table 4.

Table 4 presents the results from Tobit regressions estimating individuals' performance above or below the target. In all the rounds in which a target was shown, a person received no money if he or she was below the target, but received £2.40 for each task solved correctly if he or she hit or exceeded the target. Therefore subjects faced non-linear rewards for performance. However, on reaching a target, the marginal incentive was constant in each case. Despite this, we again have differential responses for males and not females when looking at performance above the target. Column (1) shows that for a personified or gender-personified target, subjects were, roughly, as likely to increase their performance. However, if a male was shown, then the effect of the gender-personified target was negated, and this was driven entirely by male subjects (as columns (2) and (3) show). Column (2) shows that once a female had hit a target, she continued to do well if the target was personified, regardless of which gender was shown. Column (3) shows that men had a differential effect. If a target was personified, then they continued to put in effort even if they passed the threshold. However, if a female was shown as hitting the target, then they put in even more effort, while if a male was shown, then the men did not solve any additional tasks beyond the target. That means that men responded to personified targets and strived to surpass them only if a woman had achieved that score. Once they hit the male target, the men just stopped working.

Columns (4)–(6) of Table 4 show that those who finished below the target did not look different depending on the environment: people were not more likely to barely miss the target in some situations rather than others. There is some evidence than men did try harder when they faced a personified target or when they were told that they were competing against a female (0.825 and 0.545 are not statistically different); this is consistent with the way men performed in each environment, and how they strived to meet targets.

TABLE 4
NONLINEAR EFFECT ON PERFORMANCE AROUND THE TARGET

	Number Of Correct Answers Above Target if Score>=Target			Number Of Correct Answers Below Target if Score<Target		
VARIABLES	[1]	[2]	[3]	[4]	[5]	[6]
Female (=1)	-0.101			0.247		
	[0.219]			[0.268]		
Personified Threshold (=1)	0.516***	0.503***	0.559**	0.167	-0.260	0.825**
	[0.140]	[0.174]	[0.238]	[0.202]	[0.242]	[0.350]
Gender Personified Threshold (=1)	0.559***	0.391*	0.863***	0.359	0.231	0.545
	[0.177]	[0.226]	[0.285]	[0.258]	[0.340]	[0.379]
Male Shown for Gender Personified Target	-0.424	-0.040-1.094**	0.152	0.342	-0.133	
	[0.281]	[0.351]	[0.474]	[0.403]	[0.513]	[0.629]
Threshold Shown	-0.998***	-0.981***	-1.034***	-1.166***	-1.087***	-1.267***
	[0.038]	[0.047]	[0.063]	[0.051]	[0.067]	[0.076]
Score in Tournament	0.750***	0.714***	0.802***	0.744***	0.696***	0.802***
	[0.048]	[0.051]	[0.087]	[0.044]	[0.055]	[0.070]
Sample	All	Females	Males	All	Females	Males
Constant	4.794***	4.985***	4.497***	7.090***	6.929***	7.596***
	[0.664]	[0.822]	[1.115]	[0.893]	[1.185]	[1.252]
Observations	1,332	810	522	1,332	810	522

Tables 3 and 4 provide a picture of how psychological pressure affects men and women differently in competitive environments. When targets are set, men perform better than when there is a standard tournament. When people are told that those targets have been achieved by someone beforehand (i.e. in the personified target setting), men perform better and are more likely to meet their targets, whereas women do not respond. In fact, females show little change in performance depending on how their target is set.

In sum, in our experiment, men are much more sensitive to informational manipulation than are women. Men increase their performance if they know that a woman or someone else was able to achieve the target beforehand. However, if they are told that a male achieved that goal, then they will work to hit the target but not push to exceed the target despite the same financial incentives as in other cases. It is interesting that broadly similar results were found by Bellemare *et al.* (2010) in their very different experimental situation.

IV. Discussion

Gender differences in paid performance under competition have been found in many laboratory-based experiments, and it has been suggested that these may arise because men and women respond differently to psychological pressure in competitive environments. The goal of our laboratory experiment reported in this paper was to explore the impact on men and women of the introduction into a competitive environment of psychological pressure. We modelled psychological pressure by giving subjects randomly generated targets or thresholds that they had to reach in order to get paid. We varied the salience and informational content of those thresholds by using three types: an anonymized target, a personified target and a gender-personified target. We found that the personified target caused men to increase performance more than under an anonymized exogenous target. The personified target—where the subject was notified that the target that they have to match or beat is the performance of someone else in the same laboratory—increased average performance more for men, and caused men to hit the target more often than in the anonymized case. In contrast, women did not respond to the target whether it was personified or not. However, if the gender of the person whose performance sets the personified target was also revealed, then there are mixed effects: women again did not appear to respond, but men worked much harder to outperform a woman and aimed only to equal the target set by a man. Men wanted to avoid being beaten by a woman.

Given these differential responses to psychological pressure in competitive environments, are there any predictions for policy? While women shy away from competition, once in a competitive environment their performance is not worsened, while men will respond positively. Therefore policies that increase the probability that females enter into competitive environments will likely increase output and productivity. However, according to the results of our experiment, there will be greater variability in men's productivity depending on whom they are competing against. We hope that future research will further explore these issues and their external validity.

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ENDNOTES

1. Patrick Nolen passed away unexpectedly in October 2020. He is remembered with great affection by those who knew him, and his intellect, humour and lively presence are sadly missed.
2. Studies investigating gender differences in performance in competitive environments include Gneezy *et al.* (2003), Niederle and Vesterlund (2007), Dreber *et al.* (2011), Booth and Nolen (2012) and Booth and Yamamura (2018). Studies exploring gender differences in preference to enter a competition include Gneezy *et al.* (2009), Booth and Nolen (2012), Apicella and Dreber (2015), Florey *et al.* (2015), Buser *et al.* (2014), while studies analysing attitudes towards risk include Dreber *et al.* (2014), Booth *et al.* (2016). Buser *et al.* (2014) explore how preference for competition across genders affects academic task choice.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Supporting Information