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Priming and the gender gap in competitiveness

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Abstract

A substantial body of literature has shown that women shy away from competition against men, which has been put forward as an explanation for the significant gender differences observed in career promotions and salary negotiations. It is therefore of crucial importance to understand the conditions under which the gender gap in competitiveness can be reduced. In this study, we explore the role of priming. Our findings replicate previous work showing that, in the absence of primes, women compete less than men. By contrast, introducing a priming task can eliminate gender disparities in competitiveness, *ceteris paribus*; however, the effects are stronger when neutral primes are used. We perform sentiment analysis and attribute this to the more negative emotions triggered in the neutral priming condition, making women more competitive. Overall, our results indicate that costless and simple tools such as priming can be adopted by organisations aiming at reducing gender inequalities in the workplace.

Keywords: competitiveness; gender differences; priming; laboratory experiment.

JEL: C92, D03.

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1. Introduction

Modern organizations employ a broad range of incentive schemes in order to boost employees' productivity and promote their career prospects (see Prendergast, 1999). Traditionally, these incentive plans rely on extrinsic rewards (see, for example, Lazear (2000) on piece-rates and Harbring and Irlenbusch (2003) on tournaments). While tying behavior to monetary pay might have positive effects, there is by now significant evidence showing that financial incentives are not always an ideal motivator and can be ineffective or even backfire (e.g., Deci, 1971; Gneezy et al., 2011; Gneezy and Rustichini, 2000; Graf et al., 2021; Mellsröm and Johannesson, 2008). This naturally raises the question of whether non-monetary incentives can alternatively be used to influence employees' behavior. Our study contributes to this debate.

An increasing number of studies have demonstrated that nonpecuniary incentives and aspects of the workplace environment can bring about significant changes in employees' job satisfaction, productivity, and labour supply (for a literature overview, see Cassar and Meier, 2007 and references therein). Such interventions include the use of recognition incentives (e.g. Kosfeld et al., 2017), the introduction of symbolic awards (e.g., Kosfeld and Neckermann, 2011; Gallus, 2016), strengthening social relations at work (Morgeson and Humphrey, 2006) or linking performance with charitable donations (e.g. Tonin and Vlassopoulos, 2015). We concentrate on the role of priming as a causal non-monetary force that may reduce gender disparities with respect to a key employment aspect: willingness to compete. Priming is defined as "the procedural feature that some previously activated information impacts on the processing of subsequent information" (Hertel and Fiedler, 1998). Its effects have been widely explored in psychological research, demonstrating that it can generally impact individuals' psychological processes (Bargh, 2006). More recently, priming has attracted the interest of behavioral economists who have investigated its causal effects on a wide range of economic behaviors (for a review, see Cohn and Marechal, 2016).

The key advantage of priming techniques is that they are less intrusive, more cost-effective, and relatively easier to adopt, without requiring organizations to introduce major changes that may not be feasible to implement on practical grounds. Our focus is on how subtle priming interventions can affect individuals' willingness to compete – an important economic indicator which has been shown to predict career choices and labour market outcomes (see Buser et al. (2014); Reuben et al. (2015)). The main takeaway from the extant literature is that women shy away from competition when competing against men and a substantial part of the literature has devoted efforts on how we can eliminate such gender disparities. Most of the

literature has concentrated on policies that require significant changes in the functioning of organizations including the introduction of quotas, preferential treatment of women (Balafoutas et al., 2012; Villeval, 2012; Niederle et al., 2013), competing for the benefit of off-springs (Cassar et al., 2016) or giving an option to cooperate (Cassar and Rigdon, 2021). We propose an alternative cost-effective way – namely, priming – which may mitigate the well-documented gender differences in competitiveness. We hypothesise that by reminding individuals the concept of competition may strengthen their willingness to compete more. We expect that priming will have a bigger impact on women, relying on previous research demonstrating that women's behavior is more sensitive to elements of the decision-making environment (e.g., Croson and Gneezy, 2009) and thus, priming competition may increase women's competitiveness.

To test our hypothesis, we adopt a unifying framework proposed by Niederle and Vesterlund (2007) allowing us to control for within-subject differences. We consider three treatments, all of which had subjects perform a real-effort task, consisting of adding four randomly generated two-digit numbers in a fixed period of time. Each treatment had three rounds. In the baseline (no priming) treatment, subjects were each paid £0.50 per correct addition in the first stage (piece-rate scheme). In the next stage, subjects participated in a tournament, in which the winner was paid £1 per correct addition and the loser received zero payment. The third stage had subjects select whether they would like to get paid based on piece rate or tournament incentives. Subjects' choices in the third stage provides us with a simple measure of their willingness to compete. To understand how priming affects individuals' willingness to compete, we consider two additional treatments. In the "Neutral priming" treatment, subjects were asked to unscramble sentences containing neutral primes; whereas, in the "Competitive priming" treatment, subjects unscrambled sentences with competitive primes. Our choice of priming task due to Rigdon and D'Esterre (2017) has been shown to significantly affect cheating behavior in tournaments. We adopt their priming technique and implement it in a novel setting measuring attitdes towards competition. The introduction of our priming intervention was done just before the beginning of stage 3 (see Section 2 for a more detailed description of our experimental design).

Our results can be summarised as follows. In the absence of priming, we replicate previous findings showing that women are less likely to compete compared to men (for an overview, see Niederle and Vesterlund, 2011). When priming is introduced, the well-documented gender gap in competitiveness closes. This is the case both when subjects

unscramble sentences with neutral and competitive primes, indicating that what matters is not the type of priming but its presence. Interestingly, the effects are stronger when subjects are facing neutral than competitive primes. We rule out that the difficulty of the priming task may play any role why neutral primes are more effective in closing the gender gap (as subjects' performance in the priming task is similar across treatments) and attribute this effect to the more negative sentiments triggered in the neutral comared to the competitive primng task. Specifically, by performing sentiment analysis, we find that neutral primes trigger more negative sentiments compared to competitive primes and thus, they have a stronger effect in closing the gender gap in competitiveness. This finding is in line with past research showing that negative emotions such as anger trigger more competitive behavior in different settings such as bidding in auctions (e.g., Riedl and Bosman, 2003). In addition, we test whether it is the presence of the priming task or the presence of a task that actually closes the gender gap. To do so, we conduct a follow-up experiment where, priot to making their choice about their preferred incentive scheme in stage 3, subjects were asked to read a newspaper article. The results from our follow-up experiment indicate that women compete less than men, providing evidence that it is the presence of the priming task that closes the gender gap, not having subjects perform a task, in general.

Our results broaden the existing literature by highlighting the key role that non-monetary incentives may play in influencing workplace behavior – namely, competitiveness. A growing literature has examined various factors that may shape the content of individuals' willingness to compete (e.g., Gneezy et al., 2003; Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007, 2010, 2011; Dargnies, 2012; Gneezy and Pietrasz, 2013; Dreber et al., 2014; Wozniak et al., 2014; Apicella and Dreber, 2015; Cornaglia et al., 2019). We propose an easy-to-implement intervention that has received less attention to the literature so far. Closer to our setting is a study by Balafoutas et al. (2018) who show that using *power* primes has positive effects in closing the gender gap in competitiveness. Our study complements theirs and offers new evidence about the broader role that priming interventions can play in affecting key aspects of economically relevant indicators such as competitiveness. This is particularly important taking into consideration recent concerns that have been raised about the replicability of results using priming methods in social psychology (see Chivers, 2019). While further research is needed to better understand the role of priming other concepts as well as the use of alternative priming techniques, the present evidence shows that priming can be a cost-effective mechanism that can produce consistent results in mitigating the gender differences in competitiveness.

The rest of our paper is organised as follows. Section 2 outlines the experimental design and procedures. Section 3 presents our main findings. Section 4 discusses our results and presents a follow-up experiment. Section 5 concludes.

2. Experimental framework and treatments

2.1 Framework

To analyze the impact of priming on competition choices, we adopted a framework that builds on the seminal work by Niederle and Vestrelund (2007). Subjects were matched in groups of two and matching remained constant during the experiment which consists of three different stages. In all stages, subjects had to perform an addition task. Specifically, subjects were asked to add four randomized two-digit numbers and to complete as many of these summations as possible in three minutes. Equations were presented to participants on a computer screen, where subjects typed in their answer and clicked a "Submit" button once they were ready. After each submission, subjects were shown the next equation to solve. Subjects were provided with a sheet of paper and a pen, but no other form of help was available to them. The difference in the structure of the three stages hinged on how subjects were getting paid in each stage. Below, a description of each of the stages is provided.

Stage 1 (Piece rate): Subjects are given three minutes to solve as many addition problems as they can. They receive £0.50 for each correct answer they provide. Note that in this task a subject's performance does not affect the earnings of the other subject in the pair, as each subject is compensated based on her or his own individual performance.

Stage 2 (Tournament): Subjects are given three minutes to solve as many addition problems as they can. The participant who solves the largest number of correct problems in her or his pair receives £1 for each correctly solved problem; the other subject in the group receives no payment. In the case of ties between the two subjects in the pair, the winner of the tournament is randomly chosen. Note that in this task a subject's performance affects the earnings of the other subject in the pair, as each subject is compensated in relation to the performance of the other member of the pair.

Stage 3 (Piece rate vs. tournament): Before performing the three-minute addition task, subjects are asked to decide whether they want to get paid according to a piece rate (as in Stage 1) or a tournament (as in Stage 2) compensation scheme. Each subject has to make a compensation choice. When subjects select the piece rate, they then get paid based on their own performance

in Stage 3 and receive £0.50 for each correctly answered addition problem. On the other hand, when subjects select the tournament, they receive £1 per correct answer if they correctly answer more questions than their partner did in Stage 2. If they correctly answer fewer questions than their partner in Stage 2, they receive no payment. In the case of ties, the subjects who selected the tournament in Stage 3 will receive the tournament winnings with a 50% chance and they will receive no payment with a 50% chance. Note that a subject's compensation choice (either piece rate or tournament) and performance during Stage 3 will not affect the earnings of the other person in the pair. As a result, the compensation choice in Stage 3 represents a measure of subjects' willingness to compete.

Ranking guess: At the end of the experiment, we also elicited beliefs about subjects' relative performance in Stage 1 (piece rate) and Stage 2 (tournament). Specifically, subjects indicated whether they ranked first or second relative to the other subjects' performance in their pair 1. The elicitation of relative ranking was incentivized: subjects could earn an extra £0.50 for accurate guesses (in each of the two questions). In our data analysis, we use responses to the ranking guess question in Stage 2 as a measure of subjects' confidence.

Risk taking: we also asked subjects to indicate their willingness to take risks adopted from SOEP (see Dohmen et al. (2011)). Specifically, subjects answered the question "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?" on a scale from 0 ("risk averse") to 10 ("fully prepared to take risk").

2.2 Experimental treatments

Our experiment consists of three between-subjects treatments. Our priming intervention was introduced at the beginning of Stage 3 before subjects deciding about their preferred compensation scheme. The priming task involved a scrambled sentence task which asked participants to form a coherent and grammatically correct four-word sentence by dropping one word and rearranging the order for 15 sentences. The specific primes we used were adopted from a study due to Rigdon and D'Esterre (2017) which explored how priming competition affects cheating behavior in tournaments.

In our "Neutral priming" treatment, the scrambled sentence task consisted of neutral primes that are unrelated to competition. By contrast, in our "Competitive priming" treatment, primes included words like scored, outshined, defeated, won, prize, determined, competition, trophy,

[1] Recall that subjects at the end of each stage received feedback about the number of correct responses they provided but were not be aware of the performance of the other subject they are matched with.

goal. Appendix A provides the screenshots with the primes used in the "Neutral priming" and the "Competitive priming" treatments. Subjects were given six minutes to unscramble the sentences and were told that their performance in the priming tasks will not affect at all their payments from the experiment. As a baseline treatment, we also included a treatment where we included no priming task, enabling us to replicate previous literature showing significant gender differences in competitive choices in the absence of priming effects. We refer to our baseline treatment as the "No priming" treatment.

Procedures: In total, 19 sessions were conducted, and 350 subjects participated in our experiment. Specifically, 90 subjects took part in the "No priming" treatment, 142 subjects in the "Neutral priming" treatment and 118 subjects in the "Competitive priming" treatment. Subjects within the same "Priming" treatments were randomly allocated in the "Neutral priming" and "Competitive priming" conditions. Table 1 shows a breakdown of our observations across sessions and treatments. All subjects were recruited at the University of Birmingham, using the ORSEE software (Greiner, 2015). The vast majority of participants were undergraduate students from various academic fields. The experiment was conducted in the Birmingham Experimental Economics Laboratory (BEEL), and all treatments were computerized and programmed with the z-Tree software (Fischbacher, 2007). The full set of instructions used in the experiment is provided in Appendix B. Some of the instructions were also presented on the computer screen. Average earnings (including a show-up fee of £2.50) were £9.27 for sessions that lasted, on average, for 50 minutes.

Table 1. Overview of experimental design

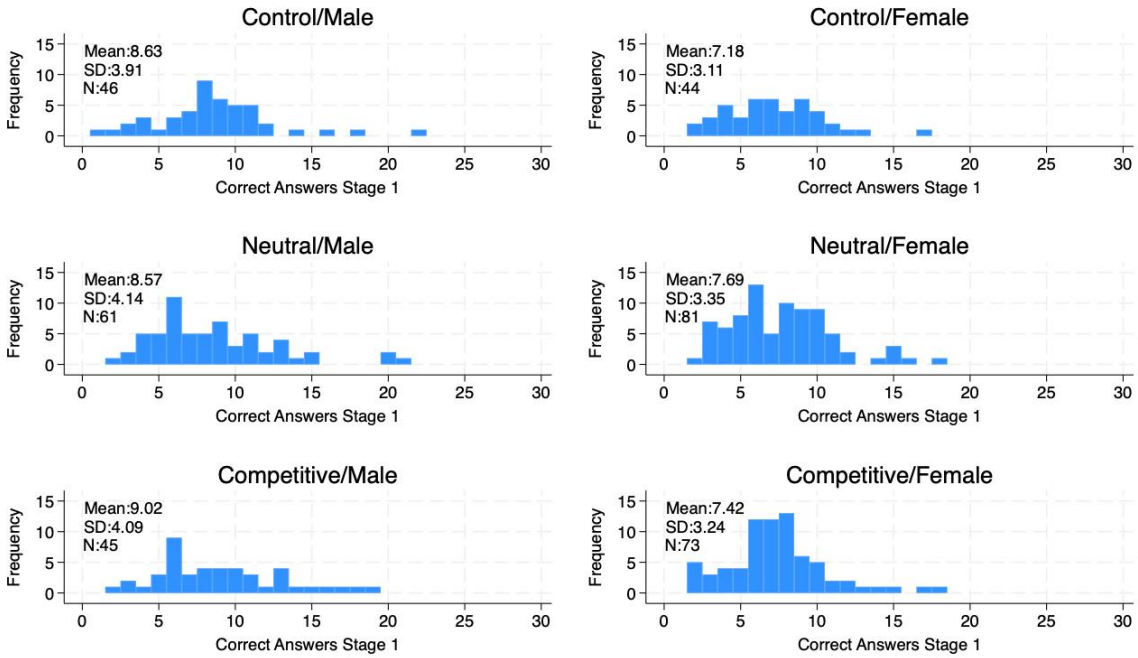
Treatments	Number of subjects per session			Total	Males	Females
No priming		S1: 20 S2: 18 S3: 20 S4: 16 S5: 15		90	46	44
Neutral priming	S1: 14 S2: 8 S3: 11 S4: 13 S5: 12	S6: 8 S7: 9 S8: 10 S9: 10 S10: 10	S11: 12 S12: 6 S13: 11 S14: 8	142	61	81
Competitive priming	S1: 6 S2: 10 S3: 9 S4: 7 S5: 6	S6: 10 S7: 8 S8: 10 S9: 8 S10: 6	S11: 8 S12: 12 S13: 7 S14: 10	118	45	73

3. Results

3.1. Performance in piece rate (Stage 1) and tournament (Stage 2)

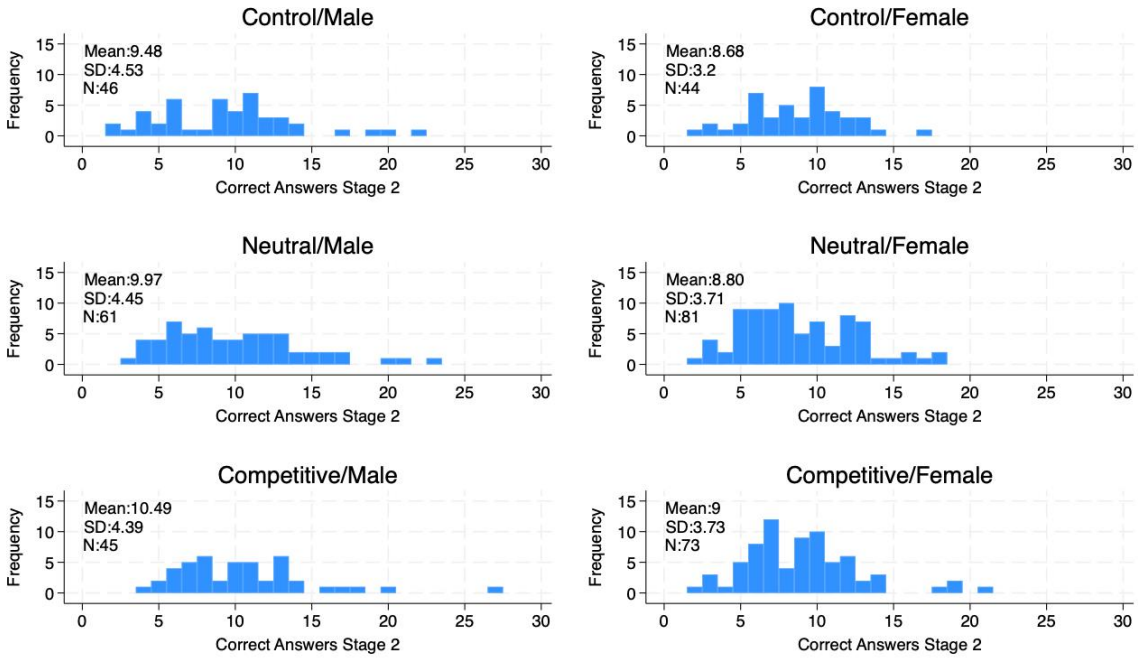
We start our analysis by exploring whether there are treatment differences in Stage 1 and Stage 2. Figure 1 shows the distribution of performance in piece rate stage (i.e. correct answers in Stage 1). We also report the averages, standard deviation, and number of observations, split by gender, across treatments. We observe that, in the "No priming" treatment, males solve, on average, 8.63 additions versus 7.18 additions solved by females (two-sided robust rank order test: $p=0.046$); in the "Neutral priming" treatment, males solve, on average, 8.57 additions versus 7.69 additions solved by females (two-sided robust rank order test: $p=0.294$) and in the "Competitive" treatment, males solve, on average, 9.02 additions versus 7.42 additions solved by females (two-sided robust rank order test: $p=0.060$).

Figure 1. Distribution of correct answers in piece rate (Stage 1)



We next turn to tournament (Stage 2) performance. Figure 2 shows the distribution of performance in the tournament stage (i.e. correct answers in Stage 2). We also report the averages, standard deviation, and number of observations, split by gender, across treatments. We observe that, in the "No priming" treatment, males solve, on average, 9.48 additions versus 8.68 additions solved by females (two-sided robust rank order test: p=0.501); in the "Neutral priming" treatment, males solve, on average, 9.97 additions versus 8.80 additions solved by females (two-sided robust rank order test: p=0.172) and in the "Competitive priming" treatment, males solve, on average, 10.49 additions versus 9 additions solved by females (two-sided robust rank order test: p=0.058).

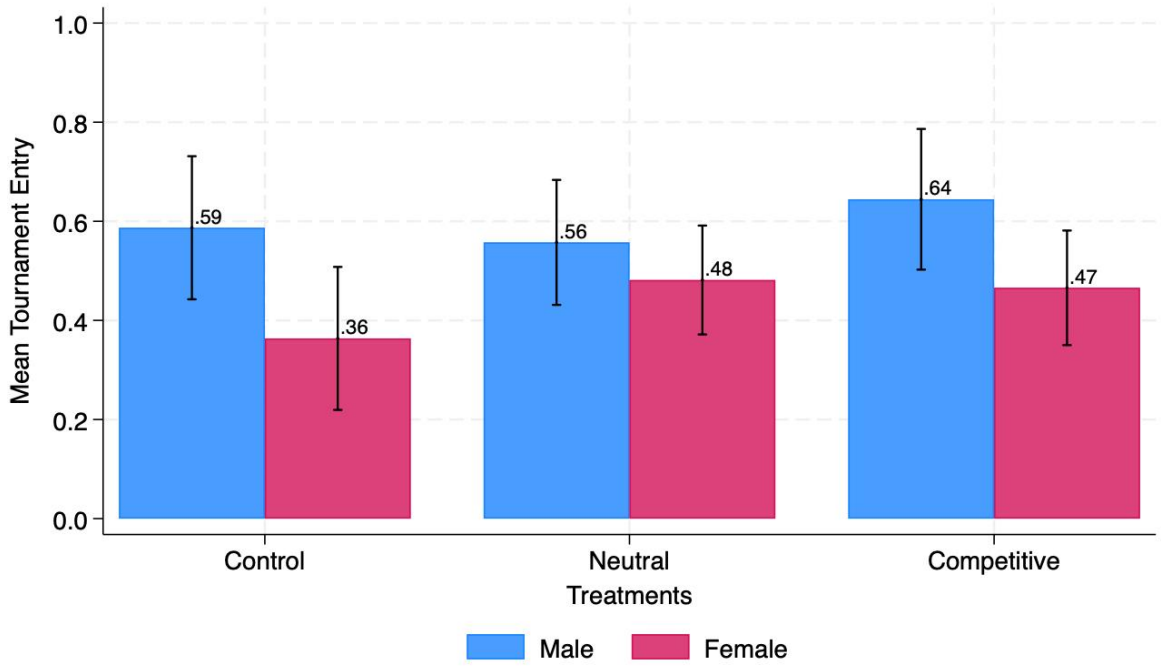
Figure 2. Distribution of correct answers in tournament (Stage 2)



3.2 Willingness to compete (Stage 3)

Our main research question concentrates on whether priming can close the gender gap in competitiveness as measured by observing subjects' selection of the tournament option in Stage 3. Figure 3 shows the percentages of males and females who chose to enter the tournament across treatments. In the "No Priming" treatment, 36% of females (16 out of 44) chose to enter the tournament, whereas the corresponding percentage for males is 59% (27 out of 46). A two-sided Fisher's test reveals significant gender differences (p=0.038) in the absence of priming – a result that has been replicated previously by many studies (see Niederle (2017)). In terms of the two priming treatments, we find that the gender gap closes. In particular, 48% of females (39 out of 81) and 56% of males (34 out of 61) enter the tournament in the "Neutral priming" treatment; whereas, 47% of females (16 out of 44) and 64% of males chose to enter the tournament in the "Competitive priming" treatment. The gender differences in competitiveness are statistically insignificant for the "Neutral priming" treatment (p=0.400) and becomes weakly significant in the "Competitive priming" treatment (p=0.087). However, our analysis so far does not control for factors that are likely to affect subjects' decision to enter the tournament such as performance in piece rate and tournament, their confidence and risk taking. We do so in Table 2.

Figure 3. Willingness to compete across treatments (split by gender)



Notes: Percentages of males and females choosing to enter the tournament in Stage 3 across treatments. Error bars, mean ± S.D.

Table 2 reports the results of six Probit regression models where the dependent variable is a binary variable equal to 1 if a subject chose to enter the tournament, and 0 otherwise. In column (1), our independent variables include the two treatment dummies "Neutral" (which equals 1 for the "Neutral priming" treatment and 0 otherwise) and "Competitive" (which equals 1 for the "Competitive priming" treatment and 0 otherwise), with the "No priming" treatment representing the omitted category. In addition, we control for gender effects including the dummy variable "Female" (which equals 1 if a subject is female and 0 otherwise), and for the interaction terms "Neutral x Female" and "Competitive x Female" capturing the impact of our priming intervention on the gender gap. Columns (2), (3), and (4) are augmented by controlling, respectively, for differences in performance between Stage 1 and Stage 2, confidence in Stage 2 and risk taking as separate regressors. Column (5) controls for all independent variable and Column (6) adds subjects' demographics as additional regressors.[2] Our results are reported in Table 2.

[2] Demographic variables includes subjects' age; being an economics student (using a dummy variable that equals 1 if a subject is registered for an Economics degree, and 0 otherwise); being religious (using a dummy variable that equals 1 if a subject indicates that they are religious, and 0 otherwise); and their political orientation (using an ordinal variable, where political orientation is measured on a 10-point Likert Scale ("1"= extreme left, …, "9"=extreme right)).

Table 2. Tournament entry across treatments – Regression results

	Dependent variable: Tournament entry					
	(1)	(2)	(3)	(4)	(5)	(6)
Neutral	-0.075	-0.127	-0.167	-0.174	-0.305	-0.269
	(0.771)	(0.636)	(0.487)	(0.536)	(0.250)	(0.332)
Competitive	0.150	0.088	0.045	0.112	-0.020	-0.010
	(0.566)	(0.750)	(0.867)	(0.667)	(0.940)	(0.971)
Female	-0.568**	-0.642***	-0.656***	-0.569**	-0.681***	-0.639***
	(0.024)	(0.009)	(0.006)	(0.021)	(0.001)	(0.004)
Neutral x Female	0.377	0.469	0.759**	0.488	0.918**	0.879**
	(0.293)	(0.204)	(0.045)	(0.198)	(0.016)	(0.026)
Competitive x Female	0.112	0.171	0.472	0.164	0.543	0.540
	(0.754)	(0.639)	(0.219)	(0.636)	(0.133)	(0.148)
Difference in correct answers		-0.091***			-0.033	-0.035
between Stage 1 and Stage 2		(0.002)			(0.269)	(0.336)
Confidence			1.309***		1.248***	1.288***
			(0.000)		(0.000)	(0.000)
Risk taking				0.208***	0.208***	0.205***
				(0.000)	(0.000)	(0.000)
Constant	0.219	0.151	1.309***	-0.936***	-1.897***	-2.490***
	(0.170)	(0.398)	(0.000)	(0.000)	(0.000)	(0.000)
Controls?	No	No	No	No	No	Yes
Obs.	350	350	350	350	350	350
"Female + Neutral x Female"	0.457	0.515	0.731	0.776	0.458	0.450
"Female + Competitive x Female"	0.073	0.079	0.549	0.096	0.648	0.758

*Notes: Probit estimates. All models use clustered standard errors at the session level (reported in parentheses). * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.*

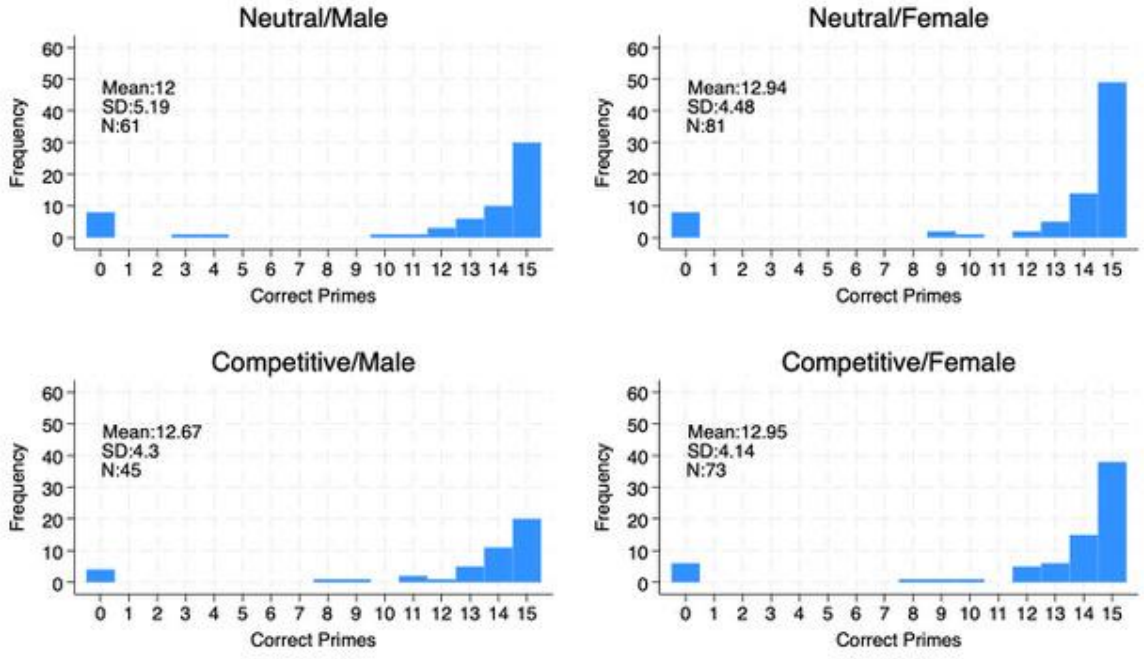
Three main observations stand out from our regression analysis. First, when there is no priming, we find that females are less likely to enter the tournament (as indicated by the coefficient of the variable "Female"). This effect is robust and statistically significant across all our regression models. Second, when we explore the role of priming, we find that the observed gender differences disappear. This is captured by the adding the coefficients of the variables "Female" and the interaction term "Neutral x Female" for the impact of neutral priming on tournament entry and by the adding the coefficients of the variables "Female" and the interaction term "Competitive x Female" for the impact of competitive priming on tournament entry. The respective p-values are indicated in the last two rows of each regression model in Table 2. We find that the p-values for the joint coefficient "Female + Neutral x

Female" is statistically insignificant in all regression models ($p>0.450$). In terms of the joint coefficient "Female + Competitive x Female", we find some weak differences in columns (1)-(4), but these differences disappear when considering the most comprehensive regression models reported in columns (5) and (6). Taken together, our analysis shows that the presence of either neutral or competitive primes closes the gender gap in competitiveness. Third, and in line with previous literature, we find that the coefficients of the variables "Difference in correct answers between Stage 1 and Stage 2" "Confidence" and "Risk taking" are statistically significant and their signs are in the expected direction.

4. Discussion and follow-up experiment

The main finding from our analysis is that both of our priming interventions – using neutral or competitive primes – close the gender gap in competitiveness. We also find that neutral primes have a stronger effect in closing the gender gap compared to competitive primes. We next explore possible reasons why this is the case. One possibility may relate to subjects' performance in the priming task. It might be that subjects in the "Neutral" treatment find the priming task more difficult and work harder to unscramble sentences which might lead them to be more competitive (especially for males). To test for this, we next look at the average number of correct sentences that males and females provide across the two priming treatments. Figure 4 shows the distribution of correct sentences in the two priming treatments, along with averages and the corresponding standard deviations.

Figure 4. Correct number of priming sentences across treatments (split by gender)



Overall, we observe that subjects provide similar number of correct sentences across treatments and regardless of gender. A two-sided Kruskal-Wallis test reveals insignificant differences in the number of correct priming sentences across gender and treatment groups ($\chi^2(3) = 3.254, p = 0.354$). Pairwise comparisons also show no gender differences within each treatment condition (for "Neutral priming", two-sided robust rank order test: p=0.188; and for "Competitive priming": p=0.519). When we compare treatment differences in the average number of correct sentences, for a given gender, we again document insignificant differences (for males, two-sided robust rank order test: p=0.979; and for females: p=0.409). Taken together, our analysis shows that both priming tasks were perceived of similar difficulty and subjects' performance was not different across gender and treatments. This rules out the explanation that the difficulty of the task can explain the reasons why neutral primes are more effective than competitive primes in closing the gender gap.

Next, we look at the possible differing emotional effects that the two priming tasks might have generated which in turn might explain why the effects of the neutral primes are stronger. To do so, we ask ChatGPT to rate the sentiment of each of the correctly unscrambled sentences that each subject provided on a scale from "-1" to "1" (where 0 represents neutral sentiment). [3] This allows us to obtain an average sentiment score for each subject, which we

[3] In this analysis, we consider only subjects who actually engaged with the priming task. This has resulted in analyzing a slightly lower number of observations (N=130 in the "Neutral" treatment and N=108 in the

regress on our main treatment dummies: "Neutral" which equals 1 for the "Neutral" treatment and 0 for the "Competitive" treatment; and "Female" which equals 1 for females and 0 otherwise. Our regression results are shown in Table 3 which includes regression models without and with demographics (Models 1 and 2, respectively).

Table 3. Sentiment score of primes across treatments – Regression results

	Dependent variable: Average sentiment score	
	(1)	(2)
Neutral	-0.392***	-0.393***
	(0.029)	(0.029)
Female	-0.024**	-0.024**
	(0.011)	(0.010)
Constant	0.593***	0.630***
	(0.020)	(0.044)
Controls?	No	Yes
Obs	237	237

*Notes: OLS estimates. All models use clustered standard errors at the session level (reported in parentheses). * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.*

Our analysis reveals that the coefficient of the dummy variable "Neutral" is negative and statistically significant in both models, implying that subjects' sentiments are more negative in the "Neutral" than the "Competitive" treatment. The same holds when we look at the coefficient of "Females": females' sentiments are more negative in the "Neutral" than the "Competitive" treatment. Overall, these results point to the direction that subjects in the "Neutral" treatment have been primed with negative sentiments which are likely to explain why neutral primes are more effective in closing the gender gap compared to the "Competitive" treatment. This result ties with previous evidence showing that negative emotions such as anger trigger more competitive behavior in different settings such as bidding in auctions (e.g., Riedl and Bosman, 2003).

As our final point, we conduct a follow up experiment (N=86; 41 males and 45 females) in order to test whether it is actually priming that closes the gender gap or having subjects engage in a task, more generally. To disentangle these two possibilities, we employ an identical design to the one outlined in Section 2, with only one difference: subjects were asked to undertake an irrelevant task before they decide on their preferred compensation choice. Specifically, this task involved subjects reading a BBC article called "The crab invading the

"Competitive" treatment). Importantly, our main results as reported in Section 3 remain the same when we exclude those subjects who did not try the priming task (see Figure A.3 and Table A.1 in Appendix B).

Mediterranean Sea".[4] Subjects were given six minutes to read the article (the same time as the duration of the priming tasks) and after this, they were asked to select their preferred compensation scheme (piece rate vs. tournament). We refer to the follow-up experiment as the "Irrelevant task" experiment, allowing to separate the effects of priming from the effects of performing an irrelevant neutral task on gender differences in competitiveness. If females are less likely to enter the tournament in the "Irrelevant task" experiment (like they did in the "No Priming" treatment), we can conclude that it is actually the presence of priming – rather than the presence of a task – that closes the gender gap. If, instead, we find that females and males are equally likely to enter the tournament in the "Irrelevant task" experiment (like they did both in the "Neutral priming" and the "Competitive priming" treatments), we can conclude that it is the presence of a task that matters in closing the gender gap in competitiveness.

We test our hypothesis by perform regression analysis as reported in Table 4. The dependent variable is equal to 1 if a subject chooses to enter the tournament and 0 otherwise and captures a subject's willingness to compete. The interpretation of the independent variables is the same to the ones included in the regressions of Table 2.

Table 4. Tournament entry in the "Irrelevant task" experiment – Regression results

	Dependent variable: Tournament entry					
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.836***	-0.842***	-0.812***	-0.638**	-0.621**	-0.565**
	(0.227)	(0.245)	(0.236)	(0.284)	(0.314)	(0.271)
Difference in correct answers between Stage 1 and Stage 2		-0.019			0.015	-0.012
		(0.044)			(0.060)	(0.070)
Confidence			0.482***		0.449	0.474
			(0.176)		(0.307)	(0.297)
Risk taking				0.144***	0.139***	0.158***
				(0.048)	(0.041)	(0.043)
Constant	0.343*	0.307**	-0.016	-0.544***	-0.826***	-0.210
	(0.177)	(0.131)	(0.198)	(0.081)	(0.136)	(1.193)
Controls?	No	No	No	No	No	Yes
Obs.	86	86	86	86	86	86

*Notes: Probit estimates. All models use clustered standard errors at the session level (reported in parentheses). * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.*

[4] The article can be accessed here: https://www.bbc.com/future/article/20220809-how-the-mediterranean-became-the-worlds-most-invaded-sea.

Our regression analysis shows that the coefficient of the variable "Female" is negative and statistically significant across all our model specifications. This indicates that females are less likely to enter the tournament than males in the "Irrelevant task" experiment, a result that replicates our observation from the "No priming" treatment. We thus offer evidence that it is the presence of priming that closes the gender gap in competitiveness rather than having subjects perform an irrelevant task. However, the type of priming task does not matter as subjects perform equally well in unscrambling neutral and competitive words.

5. Conclusions

We report on an experiment specifically designed to test for the causal impact of priming in closing the gender gap in competitiveness. Our main framework extends Niederle-Vesterlund (2007) by having subjects perform a scrambled sentence task in which they were asked to form a coherent and grammatically correct four-word sentence including either neutral or competitive words. In the absence of any priming effects, we replicate previous results in the literature showing that females compete less than males. We find that the inclusion of a priming task reduces gender disparities and closes the gender gap in competitiveness. However, the effect of neutral primes is stronger than that generated by competitive primes. We explore several mechanisms for this effect. While the difficulty of the priming task across treatments and gender is similar, our sentiment analysis shows that subjects in the "Neutral" treatment have more negative sentiments compared to those in "Competitive" treatments, with the effects being stronger for females than males. We additionally test whether it is the presence of a priming task that matters in a follow-up experiment. We thus ask subjects to perform an irrelevant task and provide evidence that it is indeed the presence of a priming task that closes the gender gap. Our results highlight that costless and simple interventions may bring about significant changes in organizational behavior by reducing well-documented gender inequalities in the workplace.

References

Apicella, C. L., and Dreber, A. (2015). Sex differences in competitiveness: Hunter-gatherer women and girls compete less in gender-neutral and male-centric tasks. Adaptive Human Behavior and Physiology, 1:247-269.

Balafoutas, L., and Sutter, M. (2012). Affirmative action policies promote women and do not harm efficiency in the laboratory. Science 335:579–582.

Balafoutas, L., Fornwagner, H., and Sutter, M. (2018) Closing the gender gap in competitiveness through priming. Nature Communications, 9:4359.

Bargh, J.A. (2006). What have we been priming all these years? On the development, mechanisms, and ecology of nonconscious social behavior. European Journal of Social Psychology, 36:147-168.

Buser, T., Niederle, M. and Oosterbeek, H. (2014). Gender, competitiveness, and career choices. Quarterly Journal of Economics, 129:1409–1447.

Cassar, A., and Rigdon, M.L. (2021). Option to cooperate increases women's competitiveness and closes the gender gap. Evolution and Human Behaviour, 42:556-572.

Cassar, A., Wordofa, F. and Zhang, Y. J. (2016). Competing for the benefit of offspring eliminates the gender gap in competitiveness. Proceedings of National Academy Science 113: 5201–5205.

Cassar, L., and Meier, S. (2018). Nonmonetary Incentives and the Implications of Work as a Source of Meaning. Journal of Economic Perspectives, 32:215-38.

Chivers, T. (2019). What's next for psychology's embattled field of social priming. Accessed at: https://www.nature.com/articles/d41586-019-03755-2

Cohn, A., and Marechal, M. (2016). Priming in economics. Current Opinion in Psychology, 12:17-21.

Cornaglia F., Drouvelis M., and Masella P. (2019). Competition and the role of group identity, Journal of Economic Behavior & Organization, 162:136-145.

Croson, R., and Gneezy, U. (2009). Gender Differences in Preferences. Journal of Economic Literature, 47:448-474.

Dargnies, M-P., (2012), Men Too Sometimes Shy Away from Competition: The Case of Team Competition. Management Science, 58:1982-2000.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. Journal of Personality and Social Psychology 18:105-115.

Dohmen, T.J., Falk, A., Huffman, D., Sunde, U., Schupp, J. and Wagner, G.G. (2011). Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences. Journal of the European Economic Association, 9:522–550.

Dreber, A., von Essen, E. and Ranehill, E. (2014). Gender and Competition in Adolescence: Tasks Matter. Experimental Economics, 17:154-172.

Fischbacher, U. (2007), z-Tree: Zurich toolbox for ready-made economic experiments. Experimental Economics, 10:171–178.

Gallus, J. (2016). Fostering Public Good Contributions with Symbolic Awards: A Large-Scale Natural Field Experiment at Wikipedia. Management Science, 63:3999–4015.

Gneezy, U., and Pietrasz, A. (2013), When Half of the Men Are More Competitive than All Women, Working paper.

Gneezy, U., and Rustichini, A. (2000). Pay enough or don't pay at all. Quarterly Journal of Economics, 115:791–810.

Gneezy, U., and Rustichini, A. (2004), Gender and Competition at a Young Age. American Economic Review Papers and Proceedings, 94:377-381.

Gneezy, U., Meier, S., and Rey-Biel, P. (2011). When and why incentives (don't) work to modify behavior. Journal of Economic Perspectives, 25:191–210.

Gneezy, U., Niederle, M. and Rustichini, A. (2003). Performance in Competitive Environments: Gender Differences. Quarterly Journal of Economics, 118:1049-1074.

Graf, C., Merz, E. M., Suanet, B., and Wiepking, P. (2021). Social norms offer explanation for inconsistent effects of incentives on prosocial behavior. Working paper.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. Journal of the Economic Science Association, 1:114-125.

Harbring, C., and B. Irlenbusch. (2003). An experimental study on tournament design. Labour Economics, 10: 443-464.

Hertel, G., and Fiedler. K. (1998). Fair and dependent versus egoistic and free: effects of semantic and evaluative priming on the 'Ring Measure of Social Values'. European Journal of Social Psychology, 28:49-70.

Kosfeld, M., and Neckermann, S. (2011). Getting More Work for Nothing? Symbolic Awards and Worker Performance. American Economic Journal: Microeconomics, 3:86–99.

Kosfeld, M., Neckermann, S. and Yang, X. (2017). The Effects of Financial and Recognition Incentives across Work Contexts: The Role of Meaning. Economic Inquiry, 55: 237–47.

Lazear, E. P. (2000). Performance pay and productivity. American Economic Review 90: 1346–1361.

Mellsröm, C., and Johannesson, M. (2008). Crowding out in blood donation: Was Titmuss right? Journal of the European Economic Association, 6:845–863.

Morgeson, F. P., and Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and Validating a Comprehensive Measure for Assessing Job Design and the Nature of Work. Journal of Applied Psychology 91(6): 1321–39.

Niederle, M., and Vesterlund, L. (2007). Do women shy away from competition? Do men compete too much? Quarterly Journal Economics, 122:1067–1101.

Niederle, M., and Vesterlund, L. (2010), Explaining the Gender Gap in Math Test Scores: The Role of Competition. Journal of Economic Perspectives, 24:129-144.

Niederle, M., and Vesterlund, L. (2011), Gender and Competition. Annual Review in Economics, 3:601–30.

Niederle, M., Segal, C., and Vesterlund, L. (2013). How costly is diversity? Affirmative action in light of gender differences in competitiveness. Management Science, 59:1-16.

Prendergast, C. (1999). The provision of incentives in firms. Journal of Economic Literature, 37:763.

Reuben, E., Sapienza, P., and Zingales, L. (2015), Taste for competition and the gender gap among young business professionals, Technical report, National Bureau of Economic Research.

Riedl, A. M. and Bosman, R. (2003). Emotions and Economic Shocks in a First-Price Auction: An Experimental Study. Tinbergen Institute Discussion Paper No. 2003-056.

Rigdon, M.L., and D'Esterre, A. (2017). Sabotaging Another: Priming Competition Increases Cheating Behavior in Tournaments, Southern Economic Journal, 84:456-473.

Tonin, M., Vlassopoulos, M. (2015). Corporate philanthropy and productivity: evidence from an online real effort experiment. Management Science, 61, 1795-1811.

Villeval, M. C. (2012). Ready, steady, compete. Science 335, 544–545.

Wozniak, D., Harbaugh, W. T., and Mayr, U. (2014), The Menstrual Cycle and Performance Feedback Alter Gender Differences in Competitive Choices. Journal of Labor Economics, 32:161-198.

Supplementary Material (intended only for online publication)

Appendix A. Screenshots

Figure A.1. Screenshot with the primes used in the "Neutral priming" treatment

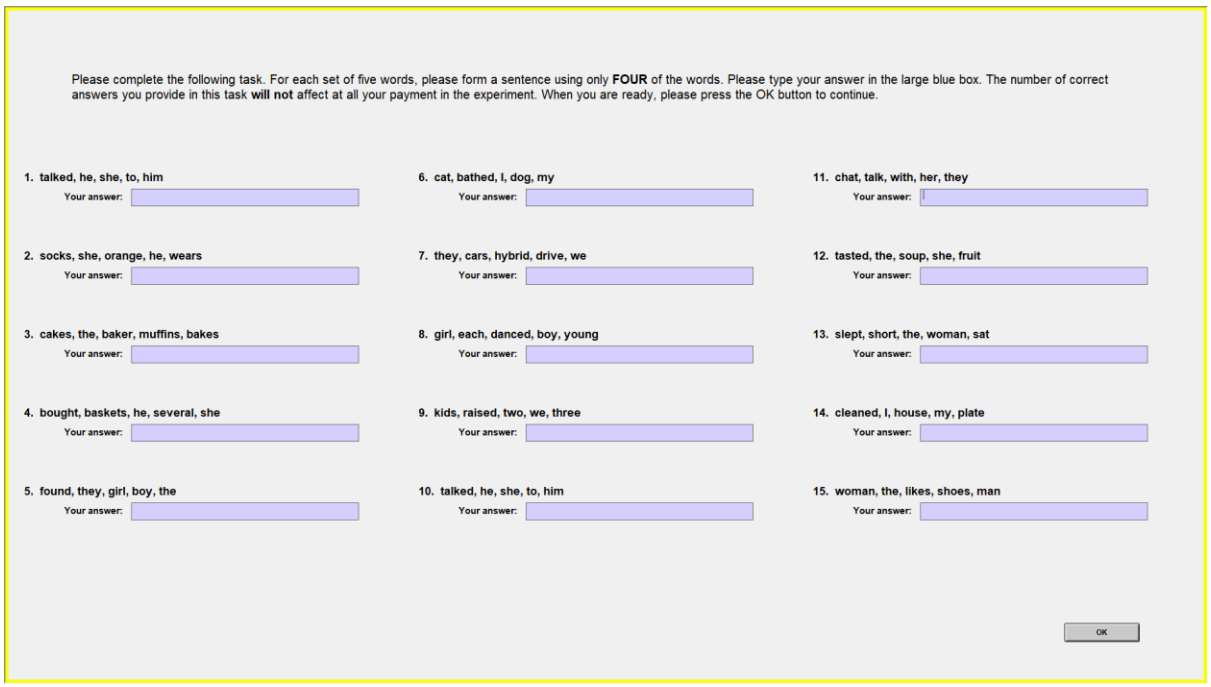


Figure A.2. Screenshot with the primes in the "Competitive priming" treatment

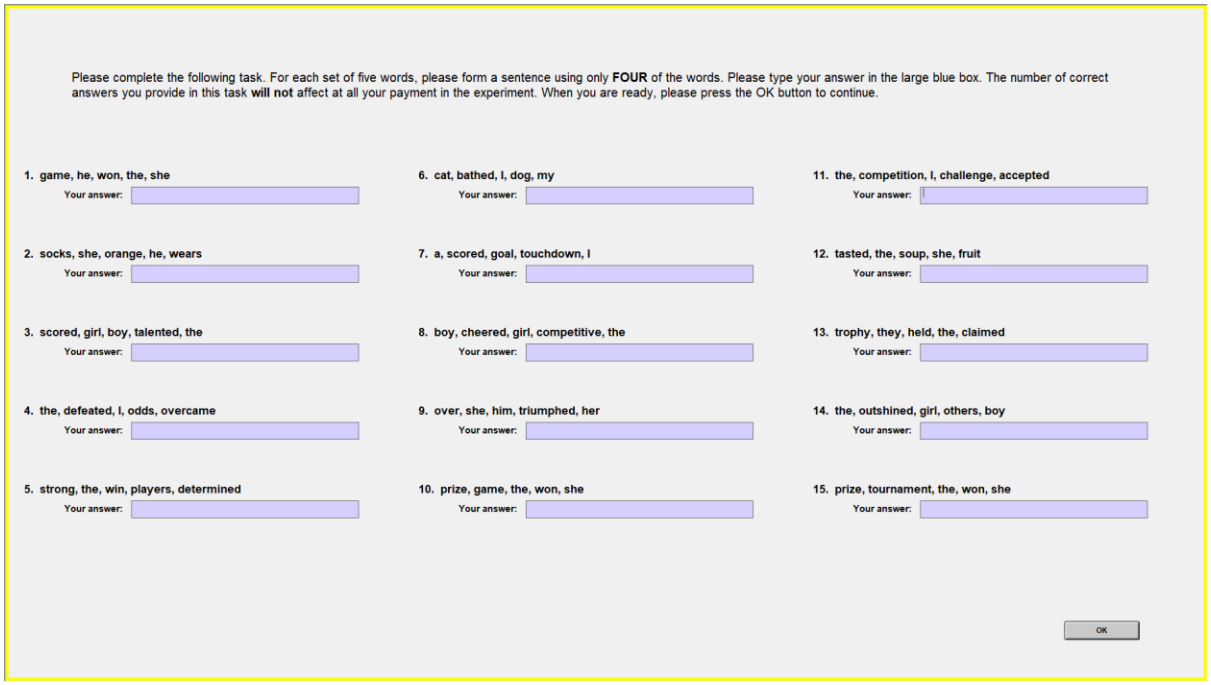
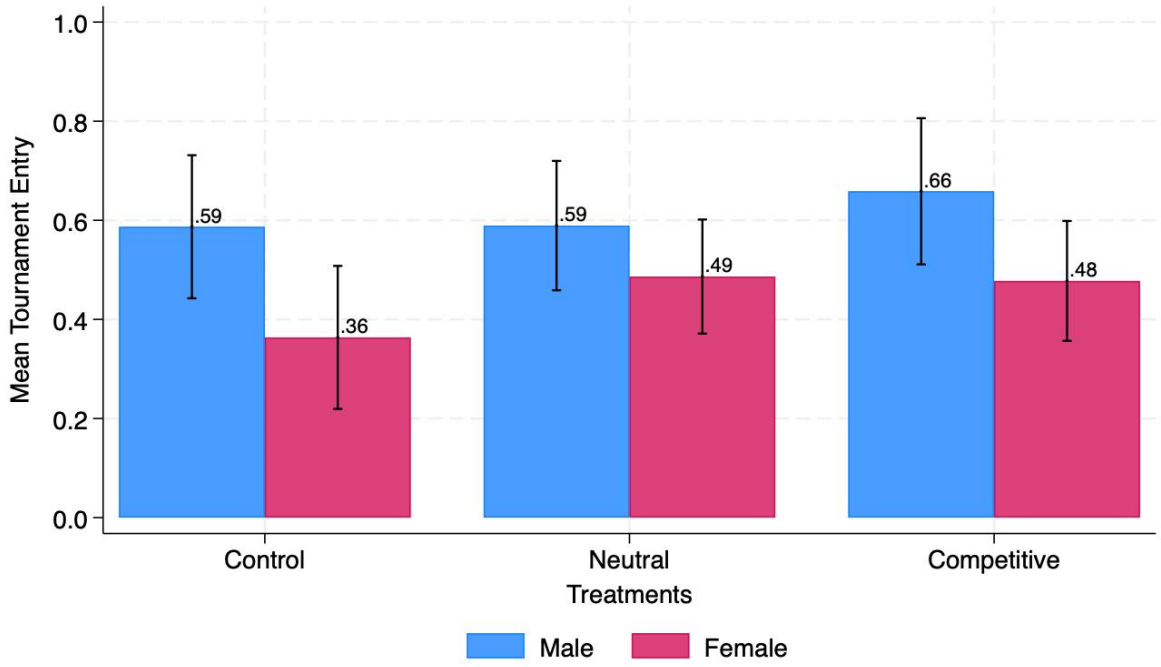


Figure A.3. Willingness to compete across treatments (split by gender) – only subjects who tried the priming task



Notes: Percentages of males and females choosing to enter the tournament in Stage 3 across treatments. Error bars, mean ± S.D.

Table A.1 Tournament entry across treatments (only subjects who tried the priming task) – Regression results

	Dependent variable: tournament entry					
	(1)	(2)	(3)	(4)	(5)	(6)
Neutral	0.005	-0.045	-0.079	-0.084	-0.207	-0.159
	(0.262)	(0.275)	(0.247)	(0.291)	(0.279)	(0.284)
Competitve	0.189	0.125	0.112	0.166	0.0801	0.0993
	(0.260)	(0.278)	(0.267)	(0.256)	(0.276)	(0.265)
Female	-0.568**	-0.633**	-0.656**	-0.572**	-0.671**	-0.630**
	(0.252)	(0.246)	(0.236)	(0.248)	(0.210)	(0.218)
Neutral x Female	0.309	0.391	0.665*	0.389	0.787*	0.753*
	(0.369)	(0.378)	(0.397)	(0.399)	(0.411)	(0.414)
Competitive x Female	0.104	0.167	0.430	0.145	0.484	0.488
	(0.337)	(0.347)	(0.367)	(0.314)	(0.331)	(0.335)
Difference in correct answers between Stage 1 and Stage 2		-0.080**			-0.013	-0.013
		(0.030)			(0.039)	(0.039)
Confidence			1.309***		1.287***	1.314***
			(0.181)		(0.220)	(0.230)
Risk				0.233***	0.234***	0.228***
				(0.033)	(0.040)	(0.041)
Constant	0.220	0.159	-0.772***	-1.072***	-2.056***	-2.686***
	(0.160)	(0.178)	(0.215)	(0.181)	(0.313)	(0.675)
Controls?	No	No	No	No	No	Yes
Obs	328	328	328	328	328	328
"Female + Neutral x Female"	0.337	0.385	0.979	0.555	0.748	0.725
"Female + Competitive x Female"	0.038	0.057	0.425	0.026	0.482	0.613

*Notes: Probit estimates. All models use clustered standard errors at the session level (reported in parentheses). * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.*

Appendix B. Experimental instructions

INSTRUCTIONS

General Instructions

Welcome! You are about to take part in a decision-making experiment. This experiment has been financed by various research institutions. Just for showing up you have already earned £2.50. You can earn additional money depending on the decisions made by you and other participants. It is therefore very important that you read these instructions with care.

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. You may use the provided scrap paper but no phones, calculators, or other devices. If you use a device, talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your following of these rules.

We would like to stress that any choices you make in this experiment are entirely anonymous. Please do not touch the computer or its mouse until you are instructed to do so. If you have any questions at any point, please raise your hand and one of us will come to your desk to answer your question. Please do not ask any question out loud. Thank you.

During the experiment, participants will be divided into groups of two. You will therefore be in a group with one other participant. **You will remain paired with the same participant until the end of the experiment.** At no point during the experiment, nor afterwards will you be informed about the identity of the other participant in your group and the other participant will never be informed about your identity.

Detailed Information about the Experiment

You will be given 3 minutes to perform the following task during three separate rounds. The task consists of calculating the sum of four randomly chosen two-digit numbers like the following examples:

21 + 35 + 48 + 29 = 133. 10 + 72 + 15 + 44 = 141.

You cannot use a calculator to determine these sums; however, you can make use of the provided paper in your desk in order to do the necessary calculations. You must submit your answer by pressing the 'Submit' button. As soon as you have submitted your answer, a new set of two-digit numbers will be provided. You can choose not to answer a question by clicking the 'Submit' button without typing anything as an answer. In this case, you will be moved to

the next problem. To help with time management, there will be a clock counting down the seconds for the 3-minute duration.

Payment

The method we use to determine your earnings will vary across rounds. Before each round we will describe in detail how your payment will be determined. Only one of the three rounds will determine your payment for the experiment and it will be randomly chosen at the end. Each round is equally likely to be selected. At the end of the experiment, you will be paid in private and in cash depending on the outcomes of the randomly selected round.

Onscreen instructions

Round 1 – Piece rate

If Round 1 is the one randomly selected for payment, then you get £0.50 for each correct answer you provide in this round during the 3-minute time limit. We refer to this payment as the piece rate payment .

At the end of the 3 minutes you will see a screen showing how many correct answers you provided during this round.

Please do not talk or try to communicate with other participants during the experiment. If you have any questions, please raise your hand. Once everyone has completed Round 1, you will receive new instructions for Round 2.

Round 2 – Tournament

For Round 2, you will be placed in a tournament and compete against the other person in your pair in this task. The person with the highest score ("the winner") in this Round will receive £1.00 for each correct answer provided. The other person of the pair will receive zero payment. If there are ties, the winner will be randomly determined: with a 50% chance you will receive the tournament winnings and with a 50% chance the person you are paired with will receive the tournament winnings.

At the end of the 3 minutes you will see a screen showing how many correct answers you provided.

Please do not talk or try to communicate with other participants during the experiment. If you have any questions, please raise your hand. Once everyone has completed Round 2, you will receive new instructions for Round 3.

[Note: In "Neutral priming" and "Competitive priming" treatments, subjects received information about the priming task (as shown in the screenshots of Appendix A) before subjects making their choice – piece-rate or tournament – in Round 3.]

Round 3 – Piece rate vs. Tournament

For Round 3, you will be given the opportunity to decide how you would like to be paid for your performance. You can either choose the individual piece rate pay or enter in a tournament. If Round 3 is the one randomly selected for payment, then your earnings for this round are determined as follows.

If you choose the piece rate, you receive £0.50 for each correct answer you provided in this Round.

If you choose the tournament, the number of correct answers will be compared to the number of correct answers the other person in your pair provided in Round 2. If you provide more correct answers in Round 3 than the number of correct answers the other person in your pair provided in Round 2, then you receive £1.00 per correct answer. You will receive zero payment in this Round if you choose the tournament and do not provide more correct answers now, than the other person in your pair did in Round 2. If there are ties, the winner will be randomly determined: with a 50% chance you will receive the tournament winnings and with a 50% chance you will receive zero payment.

At the end of the 3 minutes you will see a screen showing how many correct answers you provided.

Please do not talk or try to communicate with other participants during the experiment. If you have any questions, please raise your hand.

Are there any questions before we begin?