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No Gender Difference in Willingness to Compete When Competing against Self[†]

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In *The Descent of Man*, Darwin described men as "rivals of other men" and as the sex that "delight[s] in competition" (Darwin 1888). Nearly 150 years later, economists have substantiated this narrative: men are more likely to enter competitive fields, pursue competitive promotions, and select into competitive payment schemes over piece rate schemes (for review, Niederle and Vesterlund 2011). The gender difference in willingness to compete has been documented in diverse societies, including isolated hunter-gatherers (Apicella and Dreber 2015), suggesting that differences in competitiveness between men and women is a relatively robust characteristic of humanity—though this does not imply that the difference is necessarily large, or present for all types of tasks. Additionally, it has been suggested that this difference in the willingness to compete may help to explain the persistent labor and economic disparities that exist between the sexes, such as the gender gap in earnings. Indeed, the predictive power of laboratory measures of competitiveness on career choices and labor market outcomes has been shown to be substantial (e.g., Buser, Niederle, and Oosterbeek 2014, Reuben, Sapienza, and Zingales 2015, Buser, Peter, and Wolter 2017).

Following the work of Niederle and Vesterlund (2007), economists have shifted their level of analysis from the descriptive to explanatory: *Why* is there a gender difference in willingness to compete and how can it be eliminated? Whereas earlier work claimed that there is a specific "preference for competitions" that is distinct from risk preferences and overconfidence, more recent work suggests that gender differences in these factors may actually explain all or most of the competitiveness gap (e.g., Gillen, Snowberg, and Yariv 2015, van Veldhuizen 2016). Other work has focused on implementing institutional changes to increase the number of women entering competitive environments. Such changes include: providing feedback about individual performance, instituting affirmative action policies, and assembling gender-specific competitions (for review, Niederle and Vesterlund 2011). Many of these policies however, are unfeasible and impractical from a firm's perspective. Moreover, restructuring firms to be "competition-free" can be suboptimal, as competition often enhances performance and productivity (e.g., Gneezy, Niederle, and Rustichini 2003, see also Shurchkov and van Geen 2016, on gender differences in choice of incentives for others).

To our knowledge, research on gender differences in willingness to compete has exclusively focused on competitions against others (*other-competition*). We consider a different type of competition: competition against one's own previous performance. This type of competition embodies notions of self-improvement, progress, and mastery, and the idea of such *self-competition* has previously been discussed in relation to sports performance and business related goal-setting (e.g., Locke 1968; Howe 2008; Brown, Cron, and Slocum 1998). We examine whether there is a gender difference

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in the willingness to self-compete, similar to the gender difference found when competing against others. We document that this is not so, and investigate why.

I. The Two Experiments[1]

A. *Laboratory Experiment*

The laboratory experiment, which follows the original Niederle and Vesterlund (2007) design closely, had two treatments: *Other* and *Self*. In the *Other* treatment, subjects performed a series of simple arithmetic problems in three rounds (each round lasting five minutes, with no feedback given between rounds and the incentives for each round outlined just before the start of that particular round). In the first round, subjects were paid a fixed amount for every correctly solved problem (piece rate). In the second round, subjects were anonymously matched in pairs and the subject with the highest score in the pair was paid double the piece rate for every correctly solved problem, whereas the other subject received nothing (tournament rate). Subjects were then given a choice about which payment scheme to apply in round three. If a subject chose the piece rate, she was paid the fixed amount for every problem she correctly solved in the third round. If she chose the tournament rate, her third round performance was compared to the second round performance of the matched participant, such that if she performed better than they did in the second round, she would earn double the piece rate for every correctly solved problem; otherwise she earned nothing. The *Self* treatment was identical with the following exceptions: (i) the subjects were not matched to another player; instead their scores in the second round tournament were compared to their own scores in the first round, (ii) when subjects chose whether to apply the piece rate or the tournament rate in the third round, a choice of tournament meant that their score in the third round would be compared to their own score in round two.

After the three rounds, all subjects filled out a questionnaire. Basic demographics, and self-reported risk aversion using a ten-point Likert scale, were collected. Subjects were also incentivized to correctly rank their own performance across the rounds, and to guess whether they outperformed their opponent in round two. These questions provided measures of confidence.[2] Subjects were paid in private for a randomly selected round before leaving the laboratory.

The experiment was programmed in z-Tree (Fischbacher 2007) and conducted at the ICES laboratory at George Mason University in October 2016. The 204 subjects (50.5 percent female) earned an average of $17.42 for their participation. Sessions lasted approximately 40 minutes.

B. *Online Experiment*

We used the labor market Amazon Mechanical Turk to ensure that the results from the laboratory replicate. The online experiment also entailed additional treatments to further investigate the mechanisms underlying the findings. Specifically, we implemented two additional versions of the *Other* treatment. In *Other*, *Same Gender* we matched participants of the same gender in the competition, and in *Other*, *Same Ability* participants who did the same number of tasks correctly in the first round were matched. Ahead of the second round, subjects were informed about these aspects of the matching. We use these treatments in order to mirror certain features of self-competition—the fact that the person knows their own gender and also has additional information about her own ability to perform in the task, respectively—and to investigate whether these alone cause the gender difference in competitiveness to diminish. The online experimental design also differed from the laboratory design in two other ways: (i) math tasks were replaced with a Captcha-style counting task to prevent cheating, and (ii) the rounds were shortened to 90 seconds.

994 subjects (49.9 percent female) took part in the online experiment conducted in November 2016. On average, participants earned $1.20 for an approximately twelve-minute-long session.

[1] Further details about the experiments, including all instructions, are available in the online Appendix.

[2] Our main confidence variable is a dummy equal to 1 for subjects who believe that they improved their performance between rounds 2 and 3 ("Self") or that they performed better than the person they were matched to in the second round (the three "Other" treatments). The results are robust to using other specifications.

Table 1—Percentage Choosing Tournament Rate, by Treatment and Gender

Treatment	Women	Men	Total
Panel A. Laboratory experiment			
Other	37.5	57.7	48.0
	(7.1)	(6.9)	(5.0)
Self	41.8	55.1	48.1
	(6.7)	(7.2)	(4.9)
Total	39.8	56.4	48.0
	(4.8)	(5.0)	(3.5)
Panel B. Online experiment			
Other	27.8	40.0	34.3
	(4.2)	(4.3)	(3.0)
Other, same gender	21.9	34.1	28.0
	(3.7)	(4.2)	(2.8)
Other, same ability	30.6	33.3	32.0
	(4.2)	(4.3)	(3.0)
Self	35.7	31.1	33.5
	(4.2)	(4.3)	(3.0)
Total	29.0	34.7	31.9
	(2.0)	(2.1)	(1.5)

Note: Standard errors in parentheses.

II. Results[3]

A. *Laboratory Results: No Gender Difference in the Willingness to Self-Compete*

Panel A of Table 1 reports the percentage of subjects choosing the tournament rate by gender and treatment. We replicate the oft-documented finding that women are less willing than men to other-compete: In the *Other* treatment 57.7 percent of men chose to compete in the third round, compared to merely 37.5 percent of women. This results in a gender gap of 20 percentage points ($p = 0.044$).[4] When the competition is against the participant's own previous score, the size of the gender gap is reduced by a third and is no longer statistically significant ($p = 0.176$). The difference in difference is, however, not significant ($p = 0.612$) in the laboratory data alone.[5]

Panel A of Table 2 outlines the regression analysis for the lab experiment. A comparison of columns 1 and 2 in panel A indicates that risk preferences and confidence explain parts of the gender difference in the willingness to other-compete. Risk preferences are related also to the willingness to self-compete, but here the coefficient on Female is not significant (columns 3 and 4).

B. *Online Results: Replication and Investigating Mechanisms*

Panel B of Table 1 shows that the gender gap in the willingness to compete is 12 percentage points in the *Other* treatment in the online experiment ($p = 0.045$). In the *Self* treatment the sign of the gap reverses and it is no longer significant ($p = 0.446$). Further, a difference-in-difference estimation reveals that the gender gaps in the two treatments differ marginally significantly from each other ($p = 0.052$). The analysis of the *Self* and *Other* treatments in the online experiment (specifications 5–8 in Table 2, panel B) also gives similar results to the regression analysis for the laboratory experiment.

Considering the two additional versions of the *Other* treatment, we note that there is still a significant gender difference in competitiveness in the *Other*, *Same Gender* but not in the *Other*, *Same Ability* treatment (panel B of Table 1 and panel C of Table 2). The latter result indicates that receiving a signal that the matched opponent has an ability akin to one's own (similar to what happens in self-competition), is enough to eliminate the gender difference.

That women are more risk averse (e.g., Croson and Gneezy 2009) and less overconfident (Niederle and Vesterlund 2007) than men has been documented previously. We largely replicated these findings (see the online Appendix). As these factors have been shown to be important mechanisms underlying the gender difference in the willingness to other-compete, we investigate if the roles of risk and confidence are different in self-competition, which could be one reason that we find no gender gap in that type of competition. We confirm this by regressing a dummy indicating the choice to compete in the third round on either risk or confidence, a dummy that takes the value 1 if the treatment is *Other* and 0 if it is *Self*, and the interaction between the two (controlling for ability with round 1 score as in

[3] Summary statistics for both experiments as well as additional analysis and robustness checks are available in the online Appendix.

[4] All tests, unless otherwise noted, are two-sided *t*-tests of proportions. Our results are robust to using the nonparametric Fisher Exact test instead, see the online Appendix.

[5] In addition to the analysis of the online data below, we also perform the analysis on the pooled data. Here the difference in difference is significant, see the online Appendix.

TABLE 2—REGRESSION ANALYSIS

	(Other) (1)	(Other) (2)	(Self) (3)	(Self) (4)
Panel A. Lab experiment				
Female	−0.195	−0.114	−0.132	−0.029
	(0.10)	(0.10)	(0.10)	(0.10)
Confidence		0.246		−0.013
		(0.11)		(0.10)
Risk		0.039		0.091
		(0.02)		(0.02)
Constant	0.177	−0.212	0.503	−0.008
	(0.14)	(0.22)	(0.16)	(0.20)
Observations	100	100	104	104
R^2	0.116	0.180	0.019	0.140
	(Other) (5)	(Other) (6)	(Self) (7)	(Self) (8)
Panel B. Online experiment				
Female	−0.126	−0.090	0.052	0.083
	(0.06)	(0.06)	(0.06)	(0.06)
Confidence		0.246		0.128
		(0.06)		(0.06)
Risk		0.045		0.032
		(0.01)		(0.01)
Constant	0.297	−0.114	0.371	0.120
	(0.07)	(0.10)	(0.08)	(0.12)
Observations	245	245	248	248
R^2	0.028	0.172	0.006	0.042
	(Other, same gender) (9)	(Other, same gender) (10)	(Other, same ability) (11)	(Other, same ability) (12)
Panel C. Online experiment, ctd				
Female	−0.122	−0.094	−0.028	0.030
	(0.06)	(0.05)	(0.06)	(0.06)
Confidence		0.269		0.287
		(0.06)		(0.05)
Risk		0.027		0.042
		(0.01)		(0.01)
Constant	0.349	0.063	0.307	−0.117
	(0.07)	(0.09)	(0.07)	(0.11)
Observations	257	257	244	244
R^2	0.019	0.158	0.002	0.158

Notes: Dependent variable is a dummy indicating choice of competition in the third round. Robust standard errors in parentheses. All regressions control for task ability measured as the score in task 1. Risk is a 1–10 self-assessed index of willingness to take risk with 1 = "Not at all willing to take risks" and 10 = "Very willing to take risk." Confidence is a dummy that takes on the value 1 for subjects who believed that they improved their performance between the second and the third round ("Self" treatment) or that they performed better than the person they were matched to in the second round (the three "Other" treatments). All results are robust to using probit instead of OLS.

all regressions). The results, which are outlined in more detail in the online Appendix, indicate that especially confidence ($p = 0.014$), and to some extent risk aversion ($p = 0.095$), have a larger impact on the choice of whether or not to compete in the *Other* treatment than in the *Self* treatment.[6] Additionally, we document in the online Appendix that whereas men report to be less risk averse than women overall, the gender difference in confidence is significant for other-competition but not for self-competition.

C. *Self-Competition is No Worse than Other-Competition for Performance Boosting*

Previous literature (e.g., Gneezy, Niederle, and Rustichini 2003) has documented that competitions can boost performance. With our design we cannot distinguish competition boosting effects from learning effects, as the order of the piece rate and the tournament rate is not randomized. We do however investigate if the performance improvement between rounds 1 and 2 is significantly different in the two treatments and find that it is not. In our laboratory experiment we document an average score improvement of 23.9 percent in the *Other* treatment and 18.2 percent in the *Self* treatment ($p = 0.444$ for t-test of difference). In the online experiment the improvement between the first and the second round is 18.0 percent in the *Self* treatment and 22.2 percent in the three *Other* treatments ($p = 0.456$).

III. Conclusions

While women are less willing than equally able men to compete against other people, we find no gender difference in the willingness to compete against one's own, previous score. For those worried about the inequalities resulting from women shying away from competitive settings, our results provide an alternative to simply removing competitive features from the environment—features which are partly employed to boost performance. Instead, we suggest that a restructuring of institutions, such that competitive pressure primarily concerning comparisons

[6] Using the laboratory data, the same analysis yields $p = 0.068$ for confidence and $p = 0.469$ for risk. See the online Appendix.

with oneself is enhanced, could be tried to reduce gender disparities in economic and labor market outcomes. This will be especially appropriate when ratchet-effects are not a concern, and when the competition is mainly used for motivation and remuneration rather than for selection. The fact that self-competition leads to a boost in performance similar to other-competition, suggests that firms would not have to sacrifice these properties of the competitive environment.

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