Women Dislike Competing Against Men*

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Abstract

A prominent finding in the literature on gender competition is that women are less inclined to compete in comparison to men. In this paper, we conduct a laboratory experiment to examine the relevance of beliefs about the sex of potential competitors on men's and women's decision to enter competition. Specifically, we test whether women have a weaker preference to compete per se, or rather just shy away from competing against men. The results support the latter hypothesis. When given the possibility of choosing a competitor's sex, or when being in the lab surrounded only by female participants, the percentage of women entering competition is high and similar to the figures commonly reported for men. Moreover, only women are sensitive to the different cues we provide about the sex of potential competitors, and their competitiveness is largely driven by their beliefs about other women's competitive attitude. These findings have distinctive policy implications for the labor markets in which women are underrepresented. Above all, we argue that on-going interventions that highlight women's underrepresentation in job advertisements, which are intended to encourage women to apply, could be triggering the opposite effect. Instead, we advocate a *nudge* in the form of persuasive references to recent female applicants and/or existing female workers.

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1 Introduction

"Let me tell you about my trouble with girls... Three things happen when they are in the lab: You fall in love with them, they fall in love with you, and when you criticize them they cry".[1] These controversial remarks of the Nobel Laureate Tim Hunt anecdotally illustrate a pervasive phenomenon in the workplace; men often employ gender stereotypes to look-down-upon women. The concern over gender stereotypes is growing in recent years, as attested by the massive attention paid to sexism cases in major tech firms (e.g., Facebook and Twitter) and in academia. While the demand side of the market has already started to address gender problems in the workplace related to stereotypes (e.g., McKinsey's gender diversity program), and some research has explored its effects from a demand side perspective (e.g., Reuben, Sapienza, & Zingales, 2014), how gender stereotypes affect the supply side is unknown. In this paper, we study whether (and how) women's beliefs about the sex of potential competitors influence their decision to enter a competitive male-typed domain.[2]

The seminal work of Niederle and Vesterlund (2007) has catalyzed a host of studies investigating men's and women's self-selection into competitive environments (for a review of the literature, see Niederle & Vesterlund, 2011 and Niederle, 2016). The prevalent procedure to measure competitive preference across these studies is to ask participants to choose between a non-competitive and a competitive payment scheme for a subsequent performance of a real-effort task. The main finding is that men are significantly more inclined to choose the competitive payment. Accordingly, it has been suggested that a possible reason for the well-documented gender gap in wages and positions in the workplace as well as in educational choices is that men have a stronger preference to compete compared to women.[3] An open key question, however, is whether the accumulating evidence of women's lower willingness to compete is due to an aversion to competition per se, or because women dislike competing against men. The objective of this paper is to tackle this question by examining women's beliefs about the sex of potential competitors, a presumably important element influencing their entry into competition.

A common procedure in many studies that report women's lower willingness to choose the competitive option is to conduct mixed-sex laboratory sessions without referencing the gender composition of participants (e.g., Niederle & Vesterlund, 2007; Gneezy, Leonard, & List, 2009; Cason, Masters, & Sheremeta, 2010; Dohmen & Falk, 2011; Wozniak, Harbaugh, & Mayr, 2014; Almås, Cappelen, Salvanes, Sørensen, & Tungodden, 2016; Buser, Dreber, & Mollerstrom, 2017). Hence, if female participants perceive the gender composition in the lab and, accordingly, correctly anticipate potential male competitors, then the claim that women dislike competition per se might be compromised. If women dislike competing against men, the stylized fact that women shy away from competition might be a result of the mixed-sex composition in the lab rather than an intrinsic weaker preference for competition. Thus, for drawing accurate policy implications, elucidating the relationship between women's willingness to compete and their beliefs about the sex of potential competitors is of utmost importance.

[1] Remarks of Tim Hunt at the 2015 World Conference of Science Journalists.

[2] Throughout this paper, male-typed refers to domains/situations/contexts/environments/areas/fields in which men are stereotypically believed to be more skilled and/or overrepresented.

[3] For instance, although the percentage of women CEOs in the Fortune 500 companies is at an all-time high of 7.4% (May 2020), the figure is still dismal for women (source: fortune.com). For further evidence on gender unequal outcomes in the workplace see, e.g., Blau, Ferber, and Winkler (2013). For evidence on gender differences in educational choice and its correlation with competitiveness see Buser, Niederle, and Oosterbeek (2014).

Our study has two primary purposes. First, we conduct a controlled laboratory experiment to investigate whether women have a weaker preference to compete per se, or rather just shy away from competition against men. To this end, we measure men's and women's self-selection into competition across conditions entailing different cues for the gender composition of potential competitors. Specifically, we ask each participant to choose between a non-competitive and a competitive payment scheme for a subsequent performance of a mathematical task in three conditions: i. *No choice of sex condition* (benchmark): the gender composition of participants present in the lab is symmetric and, as standard in the literature, participants cannot choose the sex of the competitor; ii. *Choice of sex condition*: the gender composition of participants present in the lab is symmetric, but participants can choose the sex of the competitor while deciding to compete; iii. *All women condition*: the difference to the benchmark is that only female participants are present in the lab. Our conjecture is that women's beliefs about the sex of potential competitors influence their decision to enter competition. In particular, we hypothesize that women are not less competitive than men but, at least in male-typed domains, they dislike facing a male competitor. The second purpose of this paper is to assess if (and how) women's willingness to compete in the three conditions could help us to tailor policy intervention to encourage women to compete.

A central element of our experiment is that we do not inform participants about the gender composition in the lab before eliciting their choice of payment scheme, but rather rely on participants' perception of the gender composition, which we elicit at a later moment in the experiment. With this procedure, we aim not only to minimize the chance of participants realizing the goal of the experiment but also to better capture real-world decisions as, for instance, deciding whether to apply for a job. Moreover, the focus of this paper is on a male-typed domain because the most representative labor markets and educational programs in which the gender gap is a serious concern (i.e., high-level business positions, STEM fields) are stereotypically believed to be male-typed domains.[4] To create a male-typed environment in the lab, we choose a mathematical task because we expect female participants to be aware of the well-known stereotype that men are better at mathematics, and there is an empirical and theoretical basis to expect women to dislike competing against men in this situation.

Psychology research shows evidence that stereotype threat triggers women to feel apprehensive of the possibility of being judged based on negative stereotypes about their group in a (non-competitive) mixed-sex math context (e.g., Spencer, Steele, & Quinn, 1999). Stereotype threat is defined as a situational predicament where an individual is at risk of confirming a negative stereotype about their group. Performance impairment in situations where an individual's poor performance conforms to the stereotype is the effect mostly associated with stereotype threat (for a review of the literature, see Inzlicht & Schmader, 2012; Spencer, Logel, & Davies, 2016). Therefore, stereotype threat theory might explain the influential results of Gneezy, Niederle, and Rustichini (2003). While investigating exogenously generated competition within a male-typed domain, these authors show that men and women perform equally well in single-sex groups, but women perform worse when competing in mixed-sex groups.

A conceivable side effect of past repetitive exposure to math stereotype threats is for women to anticipate a poor math performance when on the verge of a mixed-sex competition. Accordingly, a reason for expecting women to shy away from competition against men in a math context could simply be a de-

[4] We could argue that it is interesting per se to investigate whether the stylized result that women shy away from competition also holds in a female-typed domain. In fact, because the seminal work of Niederle and Vesterlund (2007) as well as many of the follow-up studies that replicate their finding use a male-typed work task, some studies have already shown that the gender gap in competition entry is reduced when a female-typed work task is used instead (e.g., Kamas & Preston, 2010).

crease in their confidence level. Bordalo, Gennaioli, and Shleifer (2014) self-stereotyping model formally describes a confidence mechanism that predicts women's lower willingness to enter a math competition. Specifically, their model assumes that when a woman compares herself to men in a situation involving a math competition, she underestimates her probability to win because the stereotype that men are better at math amplifies believed differences in ability between the sexes. Therefore, the model predicts that women will enter competition less often when their confidence level is biased by negative self-stereotyping.

We consider a complementary reason for expecting women to shy away from competition against men in a math context. If women are prone to a math stereotype threat and they are chronically exposed to this threat, a logical reaction of women may be to develop a preference to avoid situations where their math ability can be compared to men's. Accordingly, women should be particularly susceptible to dislike situations involving a math competition against men because the mixed-sex competition should heighten women's awareness of gender, thus amplifying the situational predicament of stereotype threat.

The closest previous work to our study is scant. Gneezy et al. (2009) acknowledge the possible importance of female participants deducing the gender distribution of potential competitors[5], and Niederle, Segal, and Vesterlund (2013) recognize that quotas make the competition more sex-specific. To our knowledge, however, only two studies have attempted to manipulate the gender composition while investigating entry into competition. Using mixed- and single-sex groups, Booth and Nolen (2012) study boys and girls from either coeducational or single-sex schools. Their results suggest that girls are more willing to compete against other girls, but the figure is not segmented by the type of education. Gupta, Poulsen, and Villeval (2013) conduct balanced mixed-sex sessions in which they randomly match participants in mixed- and single-sex pairs. The authors find that women's choice of the competitive payment does not depend on the sex of their pair. However, in their setting, a participant is automatically the winner in case a participant is the only one to choose competition. Thus, the choice of payment scheme also depends on outguessing whether a participant's pair chickens out. Consequently, we cannot disentangle whether the result is mainly driven by women's competitive preference or outguessing. Hence, despite these two attempts[6], the connection between a woman's decision to enter competition and the sex of potential competitors remains unclear. Moreover, a key difference between these studies and our experiment is that they inform participants about the gender composition in the lab before participants choose a payment scheme, which likely induces experimenter demand effects (e.g., Zizzo, 2010).

Our paper also speaks to research investigating institutional mechanisms to promote women to compete more. Motivated by the debate about affirmative action policy, Balafoutas and Sutter (2012) and Niederle et al. (2013) find that instituting a competitive option more favorable to women in the form of quotas significantly increases women's entry into competition. As a result, the gender gap in competition entry decreases or even reverses. In addition, Balafoutas and Sutter (2012) show that preferential treatment for women in the form of a head start has a similar effect. However, they also find that preferential

[5]Using an elegant experiment, Gneezy et al. (2009) find that women of a matrilineal society in India (Khasi tribe) and men of a patriarchal society in Tanzania (Maasai tribe) enter competition similarly. However, as most Khasi participants in their experiment are women, the authors admit the possibility that Khasi female participants could have deduced the gender distribution of potential competitors. Accordingly, the authors acknowledge that their interpretation for the result [nurture] might be compromised if women are more likely to compete against women regardless of their society.

[6]In an interesting study about how men's and women's competitive preference evolve early in life, Sutter and Glätzle-Rützler (2015) also include mixed- and single-sex groups in their design to investigate boys and girls. However, the figure they report of girls' entry into competition is not broken down by single- and mixed-sex groups.

treatment in the form of a repetition of the competition in case a man wins—an institution that does not make the competition more sex-specific—does not significantly alter women's entry into competition.

Our study provides evidence that women are not less competitive than men, but rather dislike competing against men. In line with the literature, we find that women's willingness to compete is significantly lower than men's when male and female participants are present in the lab, and there is no possibility of choosing the sex of a competitor. In stark contrast, we find that women's percentage of competition entry is high and similar to that of men when male and female participants are present in the lab, but they can choose the sex of the competitor while deciding to compete. Likewise, women's entry into competition is high when there is no possibility of choosing the sex of a competitor, but only female participants are present in the lab. Since the competitive payment scheme we offer in each condition is the same, collectively these results indicate that the significant gender gap in the No choice of sex condition is not due to women shying away from competition per se, but rather women shying away from competition against men. Corroborating this interpretation, we observe that women who compete in the Choice of sex condition mostly choose a female competitor.[7]

The interpretation we give to women's behavior across conditions is substantiated by their beliefs about the sex of potential competitors. We show that in each condition women correctly perceive the actual gender composition of participants present in the lab. Moreover, in support of our hypothesis, we find in the No choice of sex condition that women are significantly less likely to enter competition the higher women believe is the proportion of male participants among the participants who choose competition. Regarding the confidence level, we find little support for negative self-stereotyping in our setting. Although we show that women hold the stereotype that men are better at mathematics, we find that differences in confidence between men and women do not explain much of the gender gap in the No choice of sex condition. Also, women's preference for a female competitor in the Choice of sex condition is not explained by a higher confidence to compete against women than against men either.

Our experiment allows us to distill distinctive policy intervention to encourage women to enter competitive male-typed domains. First and foremost, our findings on women's beliefs about the sex of potential competitors offer a new perspective on how to *nudge* (see, e.g., Thaler & Sunstein, 2008) women to compete. In light of our results, we prescribe that highlighting female role models can increase women's willingness to enter competitive male-typed domains. Namely, we propose that information in job advertisements that highlight women's underrepresentation—which is, for instance, a common practice in the economics academic job market[8]—should be replaced by references to recent female applicants and/or existing female workers. Second, our findings suggest that policy interventions that induce an increase in women's confidence can be effective, but not as plainly as we could expect. The evidence we present shows that women are not less confident than men while deciding to enter a mixed-sex competition. Rather, the gender difference we observe is that low-confident women are more reluctant to compete compared to low-confident men. This implies that policy interventions should particularly target low-confident women.

[7] Analysing data from the TV show "Miljoenenjacht" (the Dutch version of Deal or No Deal TV show), the contemporaneous study of van Dolder, van den Assem, and Buser (2020) provides external validity of our finding that women dislike competing against men

[8] Economics is a conspicuous male-typed domain because it is the least friendly science toward women among social sciences and the gender gap gets larger at each upper stage of the academic ladder. In 2019, only 30.3% of assistant professors, 25.8% of associate professors, and 14.5% of full professors were women (source: 2020 Report of the Committee on the Status of Women in the Economics Profession).

The remainder of the paper is organized as follows. In section 2, we describe the design of the experiment. In section 3, we present the results of the task performance and choice of payment scheme. In section 4, we analyze participant's confidence level. In section 5, we assess participants' beliefs about the sex of potential competitors. In section 6, we discuss the policy implications of the results. In Section 7, we conclude.

2 Design of the experiment

To investigate men's and women's self-selection into competition, we conduct a laboratory experiment with three conditions: the *No choice of sex* condition, the *Choice of sex* condition, and the *All women* condition.

2.1 Experimental procedure

The experiment is computerized using z-Tree software (Fischbacher, 2007) and conducted in the Behavioral and Experimental Economics Laboratory (BEElab) at Maastricht University. We recruit the participants via ORSEE software (Greiner, 2015) from the BEElab subject pool. In total, 204 subjects participate in the experiment (58, 90, and 56 in the No choice of sex condition, the Choice of sex condition, and the All women condition, respectively), and predominantly have a business and economics background.[9] By and large, participants also do not know each other at the session level.[10] The average age is 22. Each session lasts approximately 60 minutes on average. Average earnings are € 12.65. Participants' decisions and interactions are kept anonymous. Moreover, we do not inform participants about the gender composition in the lab before eliciting their preference to compete in any of the conditions. However, importantly for our purposes, before being invited to take a seat in a private computer cubicle, participants spend a few minutes in a welcome room where they could see each other.

2.2 Experimental conditions

2.2.1 No choice of sex condition

An equal number of men and women participate in each session of this condition.[11] We describe below the different steps of this condition in the order they happen.

- ***Practice round.*** The experiment starts with a practice round to familiarize each participant with the real-effort task. The task consists of consecutively solving five two-digit numbers addition

[9] 78% of the participants have a business and economics background. The remaining participants have a background in law, health sciences, psychology, neuroscience, arts and culture, European studies, or computer science.

[10] Using the debriefing question: "How many of the participants in this experimental session do you consider as a person you know?", we find that participants know, on average, 0.81, 0.71, and 0.64 persons in the No choice of sex, Choice of sex, and All women conditions, respectively.

[11] We conduct two sessions in this condition. The procedure to ensure an equal number of male and female participants per session is described in the Web Appendix.

problems (e.g., 84 + 94 + 17 + 19 + 39). Previous results indicate no significant gender difference in productivity to perform this addition task (e.g., Niederle & Vesterlund, 2007). In this round, each participant practices the addition task for 2 minutes and receives no payment.[12]

- ☐ ***Round 1: Baseline Performance.*** Each participant performs the addition task for 5 minutes under a piece-rate payment scheme, earning € 0.50 per correct answer. This step serves to elicit the addition task productivity of each participant.

- ☐ ***Choice of payment scheme for a subsequent performance of the addition task.*** Each participant chooses between a non-competitive and a competitive payment scheme for a subsequent performance of the addition task. If a participant chooses the non-competitive alternative, the participant is paired with a randomly chosen participant among the participants who have also chosen the non-competitive alternative. By the end of the experiment, one of the two is chosen with a 50% probability for actual payment.[13] The chosen participant earns € 1 per correct answer. The other participant earns nothing regardless of their number of correct answers. If a participant chooses the competitive alternative, the participant subsequently competes under a winner-take-all tournament against a randomly chosen participant among the participants who have also chosen to compete.[14] In this pairwise competition, the participant who correctly solves more problems earns € 1 per correct answer, and the other earns zero. In case of a tie, one of the two is chosen as the winner with a 50% probability.

- ☐ ***Winning belief.*** Elicitation of each participant belief in winning the subsequent competition (we describe this elicitation in detail in section 4).

- ☐ ***Round 2: Performance under the chosen payment scheme.*** Each participant performs the addition task for 5 minutes under the chosen compensation scheme.

- ☐ ***Perception of the gender composition.*** Elicitation of each participant's perception of the gender composition of participants present in the lab (we describe this elicitation in detail in section 5).

- ☐ ***Beliefs about the willingness of each sex to enter competition.*** Elicitation of each participant's beliefs about the likelihood of each sex to enter competition (we describe this elicitation in detail in section 5).

- ☐ ***Stereotype-based beliefs.*** Elicitation of each participant's beliefs about men's and women's performance in Round 1, in which all participants perform under a piece-rate payment scheme (we describe this elicitation in detail in section 4).

[12] During the practice round as well as during subsequent performance rounds, the following holds while participants perform the addition task: i. After an answer is provided, we immediately inform whether the answer is correct and a new problem is instantaneously displayed on the screen; ii. The total number of correct answers is permanently displayed on-screen; iii. We do not provide feedback on other participants' performance.

[13] In case an odd number of participants choose the non-competitive payment, the unmatched participant is still paid with a 50% probability, but this participant being paid does not imply that another participant is not paid.

[14] In case an odd number of participants choose competition, a randomly chosen performance among the matched participants who have chosen competition is used a second time to determine the earnings of the unmatched participant. If only one participant chooses competition (something that did not happen), the competition is not implemented and the participant is paid according to the non-competitive payment.

- ☐ ***Risk attitude.*** Each participant answers the question: "How do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, in which the value 0 means: 'not at all willing to take risks' and the value 10 means: 'very willing to take risks' ".[15]

- ☐ ***Questionnaires.*** Each participant answers demographics and debriefing questions.

We inform participants beforehand that one of the two monetarily incentivized performance rounds is randomly chosen with equal probability at the end of the experiment for actual payment. A participant's total payment in the experiment equals the sum of the earnings for the randomly chosen round, the earnings associated with monetarily incentivized belief elicitation questions plus a € 3 show up fee. Participants only learn of their earnings after completing the questionnaires.

Our measure for competitiveness builds on the existing literature. However, the non-competitive alternative we offer is different. The standard in the literature is to offer a plain piece-rate as a non-competitive payment alternative. A possible reason to observe choice differences between a plain piece-rate and a competitive payment scheme is differences in risk attitude because the latter incentive makes payment uncertain. Therefore, to mitigate the influence of risk attitude on the choice of payment scheme, we offer instead a non-competitive payment alternative that also makes payment uncertain, although not dependent on the performance of other participants.

Another noteworthy aspect of the design is the implementation of a real-time competition.[16] This competition setting allows us to inform each participant that choosing the competitive alternative means to subsequently compete against another participant who has also chosen to compete. As we argue in later sections, this competition setting is essential to elicit the proper confidence level of each participant as well as the beliefs of each participant about the sex of potential competitors.

2.2.2 Choice of sex condition

An equal number of men and women participate in each session of this condition.[17] The only important difference compared to the No choice of sex condition is when participants choose a payment scheme for a subsequent performance of the addition task. In this step, each participant is rather asked to choose between three payment alternatives for a subsequent performance of the addition task. The first alternative is the same non-competitive payment scheme offered in the No choice of sex condition. The other two alternatives offer a competitive payment scheme. A participant who chooses the second alternative subsequently competes under a winner-take-all tournament against a randomly chosen *man* among the men who have also chosen to compete. A participant who chooses the third alternative subsequently competes under a winner-take-all tournament against a randomly chosen *woman* among the women

[15] In a field experiment, Dohmen et al. (2011) show that responses to this general risk question reliably predict incentivized lottery choices.

[16] The procedure routinely used in the literature to determine the earnings of a participant who chooses competition is to compare a participant's subsequent competitive performance to a past exogenously elicited competitive performance of other participants in the experiment. Yet, we are not the first to implement real-time competition (see Dohmen & Falk, 2011).

[17] We conduct three sessions in this condition. The procedure to ensure an equal number of male and female participants per session is described in the Web Appendix.

who have also chosen to compete.[18] The only difference between the two competitive alternatives is the sex of the competitor. We should emphasize that the competitive payment scheme is the same; it is a winner-take-all tournament.

2.2.3 All women condition

We use the same design as in the No choice of sex condition. The distinctive element is that only women participate in this condition.[19]

3 Basic experimental results[20]

3.1 Piece-rate baseline performance

Table 1. Piece-rate baseline performance (in average number of correct answers)

	No choice of sex	Choice of Sex	All Women
Men	10.31	10.29	n.a.
	(4.05)	(5.07)	
Women	10.28	10.38	10.45
	(3.50)	(3.76)	(4.78)
p-value	0.919	0.418	n.a.

Note: p-values derived from Mann-Whitney tests of equality of distributions between men and women. Standard deviation in parentheses.

We start by verifying that there is no significant gender difference in productivity for the addition task. In Table 1, we document the participants' piece-rate baseline performance. We observe that men's and women's performance is similar in the No choice of sex and the Choice of sex conditions, respectively. Moreover, we reach the same conclusion after comparing the distribution of women's performance in the All women condition to the distribution of men's performance in the other two conditions (Mann-Whitney tests yield a p-value ≥ 0.542 for both comparisons). Therefore, the participants' baseline performance data do not corroborate the stereotype about women's lower ability in mathematics.[21]

[18] Participants who choose competition are matched to participants with equivalent choices (e.g., a man who chooses a female competitor is matched to a woman who chooses a male competitor). For unmatched participants, we use a similar procedure to the one described in footnote 14 (see Web Appendix for the details of the procedure that we use in the Choice of sex condition). For the cases in which the competition cannot be implemented (something that did not happen), the participant is paid according to the non-competitive payment.

[19] We conduct two sessions in this condition.

[20] All tests we report throughout the paper are two-sided.

[21] Participants' Round 2 performance data do not corroborate the stereotype either. The average number of correct answers in that round is 11.45 and 11.41 for men and women in the No choice of sex condition, respectively; 11.51 and 11.58 for men and women in the Choice of sex condition, respectively; 11.80 for women in the All women condition.

3.2 Choice of payment scheme

Table 2. Choice of a winner-take-all tournament (in percentage)

	No choice of sex	Choice of sex	All women
Men	69%	76%	n.a.
Women	38%	67%	71%
p-value	0.034	0.486	n.a.

Note: p-values derived from Fisher's exact tests of contingency between men and women.

In Table 2, we summarize men's and women's self-selection into competition. In the No choice of sex condition, 69% of men choose to compete whereas only 38% of women do so. This observed gender gap in competition entry is substantial and in line with the literature. In regression (1) of Table 3, we show that this result is robust when controlling for individual baseline performance and risk score. Specifically, women have a significant 32 percentage point lower probability than men of choosing the competitive payment scheme, ceteris paribus.

Table 3. Probit models of payment choice

Dependent variable: *1 if payment choice is a winner-take-all tournament*			
	No choice of sex	Choice of sex	All women
	(1)	(2)	(3)
1 if female	-0.32^{***}	-0.11	n.a.
	[0.123]	[0.089]	
Baseline performance	0.05^{***}	0.04^{***}	0.04^{***}
	[0.016]	[0.010]	[0.010]
Risk score	-0.007	0.016	0.022
	[0.028]	[0.017]	[0.025]
Observations	58	90	56
Pseudo R^2	0.164	0.120	0.133

Note: The table reports marginal effects. *** significant at 1 %. Robust standard errors in brackets.

In the Choice of sex condition, 76% of men and 67% of women select the competition. This gender gap in competition entry is not significant and robust when controlling for individual productivity and risk attitude (see regression (2) of Table 3). Recall that the two competitive alternatives in this condition involve a winner-take-all tournament, which is the same payment incentive that we offer as a competitive alternative in the No choice of sex condition. Hence, if women had a weaker preference to compete per se, we would have also observed a low percentage of competition entry among the women in the Choice of sex condition. Instead, we observe a striking 76% increase in the percentage of women who choose competition in the Choice of sex condition compared to the No choice of sex condition. In fact, the narrowing of the gender gap in entering competition in the Choice of sex condition is due to a significant increase of women who choose to compete (38% vs. 67%, p = 0.018, Fisher's exact test) since the competition entry of

men is only insignificantly higher in the Choice of sex condition (69% vs. 76%, p = 0.597, Fisher's exact test).

As for the choice of the competitor's sex, we show in Table 4 that both men and women reveal preference for a female competitor, but this inclination is not significant for men. In addition, regression analysis shows that both men's and women's choice of the competitor's sex is not driven by their baseline performance and risk attitude (see Web Appendix).

Table 4. Choice of the competitor's sex (in percentage)

	Male competitor	Female competitor	p-value
Men	35%	65%	0.121
Women	23%	77%	0.005

Note: p-values derived from binomial tests for the null hypothesis that the choice of a male or a female competitor is equally likely to occur.

These results are consistent with our conjecture that the sex of potential competitors influences a woman's decision to enter competition. To further investigate women's behavior, we subsequently conduct the All women condition, in which the setting is the same as in the No choice of sex condition, but only female participants are present in the lab. In this condition, we find that 71% of women enter competition. This represents a striking 87% increase in the percentage of women who compete compared to the No choice of sex condition (38% vs. 71%, p = 0.005, Fisher's exact test).[22] Thus, women's significantly higher percentage of competition entry in the All women condition is also consistent with our hypothesis.

Finally, a remark on risk attitude is in order. In regressions (1) – (3) of Table 3 the risk score predictor is statistically insignificant in each condition, which indicates that participants' choice of payment scheme is not determined by their risk attitude.[23] This is likely due to the design of our experiment in which payment is risky under both the competitive and non-competitive payment schemes.

4 Stereotypes, confidence, and the "irrational" competitors

In this section, we investigate whether there is evidence to establish a connection between the stereotype that men are better at mathematics and the choice for competition. Specifically, we investigate whether we can discriminate between two possible explanations grounded in stereotype threat: confidence to compete vs. preference to compete. A common element to both explanations is that each assumes that individuals of the targeted group hold the stereotype that men are better at mathematics. Therefore, we start by verifying that participants do indeed hold the stereotype.

[22] Compared to the Choice of sex condition, the increase in the percentage of competing women is not significant (67% vs. 71%, p = 0.667, Fisher's exact test).

[23] The risk score remains insignificant when we regress specification (1) and (2) of Table 3 separately for men and women.

4.1 Stereotype-based beliefs

To verify that participants hold the stereotype, we elicit participants' estimation of the performance of male and female participants in the 5 minutes Round 1 piece-rate performance. Specifically, each participant answers two questions: i. "How many addition problems did male participants correctly solve, on average, in the 5 minutes Round 1 piece-rate performance (excluding yourself if you are a man)?"; ii. The same question, but with reference to female participants. These questions are monetarily incentivized using a scoring rule that yields a higher reward the more accurate the estimate is (see Web Appendix for the full instructions, which provide the details of the monetary incentive scheme).[24]

In the first row of Table 5, we report the average of men's estimate of the gender gap in performance per condition. In the second row of Table 5, we report the corresponding figures for women. We find that participants hold the stereotype in each condition. That is, participants do believe that men have, on average, a significant advantage to perform the addition task compared to women. Most importantly, the participants of the targeted group—women—hold the stereotype.

Table 5. Participants' estimate of the gender gap in performance (in number of correct answers)

	No choice of sex	Choice of sex	All women
Men	1.1^{***}	0.8^{***}	n.a.
	(2.70)	(2.37)	
Women	2.1^{***}	1.7^{***}	1.6^{***}
	(2.52)	(2.22)	(3.06)

Note: A participant's estimate of the gender gap equals a participant's estimate of the performance for men minus a participant's estimate of the performance for women. *** significant at 1% derived from Wilcoxon signed-rank tests. Standard deviation in parentheses.

Hence, women's competition entry behavior across conditions accommodates a preference-based explanation grounded in stereotype threat. As we discussed in the introduction, if women are chronically exposed to a math stereotype threat relatively to men, a logical reaction of women is to develop a preference to avoid situations where their math ability can be compared to men. Moreover, women's dislike with being compared to men is amplified in our setting because we include a competitive dimension. In light of this explanation, women's entry into competition should be low in the No choice of sex condition, and they should prefer a female competitor in the Choice of sex condition. In the All women condition, there is no stereotype threat (assuming women perceive that men are not present). As a result, women's entry into competition should be high.

However, as the stereotype pertains to women's lower ability in mathematics, an alternative mechanism could be that women's exposure to a situation evoking the stereotype triggers negative self-stereotyping, which undermines women's confidence to compete against men. Accordingly, women's belief in winning the competition should be considerably lower in the No choice of sex condition because women cannot avoid the possibility of a mixed-sex competition when they choose competition. In contrast, women's

[24] In the All women condition, we ask participants the same two questions, but about male and female participants of a previous session of the experiment so that we avoid deception.

belief in winning the competition is not biased downwards in the Choice of sex condition because negative self-stereotyping bias women's confidence against men, but not against other women. In the All women condition, negative self-stereotyping does not come to mind at all (assuming women perceive the absence of male participants). Therefore, according to the self-stereotyping model, the lower percentage of competition entry among women in the No choice of sex condition is a rational response of women as payoff maximizers to their belief in a lower probability of winning the competition.

To test self-stereotyping, the stereotype-based beliefs that we report above are not appropriate, though. The stereotype-based beliefs surely indicate how a female participant compares the addition task performance of other female participants relative to male participants. However, these beliefs do not necessarily indicate how a female participant believes in her *own* performance of the addition task relative to the *other participants who choose to compete*, which is in our view the proper measure of a participant's confidence level at the moment they choose a payment scheme.

4.2 Winning belief: the impact of confidence on the choice of payment scheme

To sort out the impact of possible differences in confidence level on the choice of payment scheme, we elicit participants' belief in winning the competition.

We elicit this belief immediately after participants make their choice of payment scheme. In the No choice of sex and All women conditions, we ask participants the following question: "Consider only the other participants who have just chosen to compete in the subsequent performance round. How many of these participants (in percentage terms) did correctly solve less addition problems than you in the 5 minutes Round 1 piece-rate performance?". In the Choice of sex condition, we ask participants two versions of this question. In one version, we ask the question with reference to the male participants who have chosen to compete; in the other version, we ask the question with reference to the female participants who have chosen to compete. The questions are monetarily incentivized using a scoring rule that yields a higher reward the more accurate the estimate is (see Web Appendix for the full instructions, which provide the details of the monetary incentive scheme).

Ideally, the winning belief should incorporate two elements: i. Elicit a participant's belief about their *own* performance relatively to *only* the *other participants who have chosen to compete*; ii. A participant's estimate is about their expected relative performance in the *subsequent competition*. We only incorporate the former element because incorporating the latter element poses a serious incentive problem.[25] As a proxy for the second element, we use a participant's estimate of their relative performance in the piece-rate round. That is, we rely on the assumption that a participant's belief about their relative performance among the participants who choose competition is similar in both rounds. Spearman's rank correlations are consistent with this assumption [No choice of sex condition: piece-rate performance (PR) vs. competitive performance (COM), $\rho = 0.731$. Choice of sex condition: PR Men vs. COM Men, $\rho = 0.749$ | PR Women vs. COM Women, $\rho = 0.775$. All women condition: ρ = PR vs. COM, = 0.847].

[25] If the question were instead "Consider only the other participants who have just chosen to compete in the subsequent performance round. How many of these participants (in percentage terms) do you expect to correctly solve less addition problems than you in the subsequent performance round?", a too salient hedging opportunity would arise because we monetarily incentivize the question using a scoring rule that makes a participant's earnings higher the more accurate a participant's estimate is. The scoring rule would, therefore, give an incentive for a participant to report an estimate of zero and subsequently solve no problem to ensure the maximum payment.

In Table 6, we document the winning beliefs. If the self-stereotyping hypothesis were correct, the women's belief in winning in the No choice of sex condition—in which they cannot avoid the possibility of competing against men—should be substantially lower not only than men's belief in winning but also than women's belief in winning in both the Choice of sex and All women conditions. However, none of these comparisons leads to significant differences (41.5% vs. 44.5%, p = 0.791, Mann-Whitney test; 41.5% vs. 44.9%, p = 0.527, Mann-Whitney test; 41.5% vs. 44.6%, p = 0.556, Mann-Whitney test). Although women in the No choice of sex condition are directionally less confident, the difference in confidence level is not significant. In other words, we do not find evidence for negative self-stereotyping.

Table 6. Winning belief (in average percentage)

	No choice of sex	Choice of sex	All women
Men	44.5%	44%	n.a.
	(24.9)	(25.6)	
Women	41.5%	44.9%	44.6%
	(24.4)	(25.7)	(24.7)

Note: In the Choice of sex condition, a participant's winning belief equals max {winning belief against a man, winning belief against a woman}. Standard deviation in parentheses.

Regression analysis corroborates this finding. Comparing regressions (1) and (4) of Table 7, we see that after adding the winning belief as a predictor, the gender gap in the probability of entering competition (which is measured by the female predictor) in the No choice of sex condition only slightly decreases. In addition, comparing regressions (2) and (5) of Table 7, we see that the gender gap in competition entry in the Choice of sex condition remains insignificant after including the winning belief as a predictor. In short, although regressions (4) – (6) of Table 7 show that the winning belief helps to predict entry into competition in each condition, differences in men's and women's confidence level do not explain much of the observed gender difference in entry into competition in the No choice of sex condition.[26]

Nonetheless, we find an interesting difference related to the confidence level. In Table 8, we break down the entry into competition by participants with a winning belief lower than 50%—who we denominate as low-confident—and participants with a winning belief higher than 50%—who we denominate as high-confident. In the No choice of sex condition, we observe a considerably lower entry into competition among low-confident women compared to low-confident men. The same is observed when comparing low-confident women in the No choice of sex condition to low-confident women in the other two conditions. High-confident women, on the other hand, similarly enter competition across the three conditions. Collectively, these findings show that the lower willingness of women to enter competition in the No choice of sex condition is driven by the low-confident women.

[26]In stark contrast to the winning beliefs, we find no significant effect of the stereotype-based beliefs when we add them as a covariate in the regressions of Table 7 (as well as in the remaining regression analyses that we present in the paper). Thus, we dismiss this variable in the regression analyses that we present for the sake of relevance.

Table 7. Probit models of payment choice II

Dependent variable:	*1 if payment choice is a winner-take-all tournament*					
	Panel A			Panel B		
	No choice of sex	Choice of sex	All women	No choice of sex	Choice of sex	All women
	(1)	(2)	(3)	(4)	(5)	(6)
1 if female	-0.32^{***}	-0.11	n.a.	-0.28^{***}	-0.11	n.a.
	[0.123]	[0.089]		[0.106]	[0.084]	
Baseline performance	0.05^{***}	0.04^{***}	0.04^{***}	0.03^{**}	0.02^{*}	0.02
	[0.016]	[0.010]	[0.010]	[0.017]	[0.012]	[0.013]
Risk score	-0.007	0.016	0.022	-0.004	0.017	0.024
	[0.028]	[0.017]	[0.025]	[0.023]	[0.017]	[0.023]
Winning belief				0.009^{***}	0.006^{***}	0.005^{**}
				[0.002]	[0.002]	[0.002]
Observations	58	90	56	58	90	56
Pseudo R^2	0.169	0.120	0.133	0.388	0.197	0.190

Note: The table reports marginal effects. In Panel A, we again report the results of Table 3 for ease of comparison. *Winning belief* is a variable that ranges from 0-100. ***, **, and * significant at 1%, 5%, and 10%, respectively. Robust standard errors in brackets.

Table 8. Choice of a winner-take-all tournament split by low- and high-confident participants

	No choice of sex		Choice of sex		All women	
	$bwin < 50$	$bwin > 50$	$bwin < 50$	$bwin > 50$	$bwin < 50$	$bwin > 50$
Men	56%	91%	62%	95%	n.a.	n.a.
Women	17%	88%	56%	84%	61%	82%
p-value	0.035	1.000	0.779	0.603	n.a	n.a

Note: bwin refers to participants' winning belief. p-values derived from Fisher's exact tests of contingency between men and women. The choices of the participants with a winning belief equal to 50% are: in the No choice of sex condition, one woman competes and two women do not compete; in the Choice of sex condition, one woman and one man compete, and one woman does not compete; in the All women condition, three women compete.

4.3 Confidence and the choice of sex

The results so far show that women shy away from competition only when they cannot avoid the possibility of competing against men. Since this behavior is not explained by women's lower confidence level relatively to men, we understand the results as evidence of women's dislike of competition against men. However, women's aversion to competition in the No choice of sex condition seems to hold only for low-confident women. As a robustness check for whether women's dislike of competition against men is specific to low-confident women, we examine the impact of confidence level on women's choice of the competitor's sex.

In Table 9, we show that both low- and high-confident women overwhelmingly, and equally, prefer to compete against a woman. Moreover, regression analysis shows that women's choice of the competitor's sex is not driven by a higher confidence level to compete against a woman (see Web Appendix for details). Looking at men, we observe that both low- and high-confident men's choice of the competitor's sex is not significantly different from a random choice.

Table 9. Choice of the competitor's sex split by low- and high-confident participants

		Male competitor	Female competitor	p-value
Men	$bwin > 50$	35%	65%	0.332
	$bwin < 50$	38%	63%	0.454
Women	$bwin > 50$	20%	80%	0.035
	$bwin < 50$	21%	79%	0.057

Note: bwin refers to participants' winning belief. p-values derived from binomial tests for the null hypothesis that the choice of a male or a female competitor is equally likely to occur.

Our conclusion is that women dislike competing against men independently of their confidence level. However, if women cannot avoid the possibility of competing against men when women enter competition (as is the case in the No choice of sex condition), high-confident women still enter competition because their belief in a high probability of winning the competition more than compensates their dislike of competition against men.

4.4 The "irrational" competitors

In this section, we examine whether a participant's choice of payment scheme is a rational response to a participant's winning belief in terms of expected payoff maximization.

Under reasonable assumptions, we can predict the choice of payment scheme that is consistent with expected payoff maximization solely based on a participant's winning belief (see the Web Appendix for the detailed theoretical analysis). In a nutshell, assuming a participant is risk neutral or risk averse[27], a participant who believes to have a higher (lower) than 50% chance of winning the competition should choose the winner-take-all tournament (non-competitive payment).

[27] It is reasonable to assume that participants are either risk neutral or risk averse since economics experiments eliciting risk attitude do not find support for risk loving preferences (see Croson & Gneezy, 2009).

In the following analysis, we compare each participant actual choice of payment scheme to the choice predicted once considering their winning belief. Logically, a participant has a rational response if a participant's actual choice of payment scheme coincides with the predicted choice.

In column (3) of Table 10, we report the percentage of participants whose actual choice coincides with the predicted choice. We observe that 86% of women in the No choice of sex condition have a rational response to their winning belief. The percentage of rational responses in the other four cases—men in the No choice of sex condition, men and women in the Choice of sex condition, and women in the All women condition—is significantly lower compared to women in the No choice of sex condition (Fisher's exact tests of contingency yield p-value ≤ 0.07 for any of the four comparisons). The lower percentage of rational responses in these four cases seems to be due to an excessive entry into competition. If all participants had a rational response, then only 38% of men in the No choice of sex condition, 41% of men and 42% of women in the Choice of sex condition, and 42% of women in the All women condition would have chosen competition (see column (1) in Table 10).

Table 10. Rational responses in terms of expected payoff maximization

		Predicted Choice	Actual Choice	Rational Response
		(1)	(2)	(3)
No choice of sex	Men	38%	69%	62%
	Women	33%	38%	86%
Choice of sex	Men	41%	76%	62%
	Women	42%	67%	62%
All women	Women	42%	71%	59%

Note: Predicted Choice refers to the predicted percentage of competitive choices given participants' winning belief; Rational Response refers to the percentage of participants whose actual choice coincides with the predicted choice. In column (1), we treat the few participants who estimate a probability of winning equal to 50 % as equally likely to choose between the two payment alternatives. We again report the percentage of actual competitive choices for ease of comparison.

To examine excess entry, we analyze the choices of the participants who do not have a rational response. There are two possible types of "irrational" response in our setting: i. The *"irrational" competitor*, i.e., a participant who chooses competition, but whose expected payoff maximization choice corresponding to their winning belief is the non-competitive payment; ii. The *"irrational" non-competitor*, i.e., a participant who chooses not to compete, but whose expected payoff maximization choice corresponding to their winning belief is competition.

The results in Table 11 show that the occurrence of both types of "irrational" response is sparse among women in the No choice of sex condition. In the other four cases, however, we observe that the percentage of "irrational" competitors is considerable and clearly higher than the percentage of "irrational" non-competitors. McNemar tests for the significance of changes validate these observations. The occurrence of both responses is not significantly different for women in the No choice of sex condition whereas in each of the other four cases the "irrational" competitor response occurs significantly more often (McNemar

tests yield p-value = 0.625 for women in the No choice of sex condition and p-value ≤ 0.013 for any of the other four cases).[28]

In short, we observe that in all cases, except for women in the No choice of sex condition, the percentage of "irrational" competitors is substantial. We regard an "irrational" competitor response as stronger evidence of a participant's preference to compete than if a participant's choice to compete is in accordance with expected payoff maximization.[29] Hence, we argue that the observed low percentage of "irrational" competitors only among women in the No choice of sex condition is evidence that women dislike competing against men.

Table 11. "Irrational" competitors and "irrational" non-competitors

	No choice of sex		Choice of sex		All women	
	"Irrational" competitors	"Irrational" non-competitors	"Irrational" competitors	"Irrational" non-competitors	"Irrational" competitors	"Irrational" non-competitors
Men	35%	3%	36%	2%	n.a.	n.a.
Women	10%	3%	31%	7%	34%	7%

Note: "Irrational" competitors (non-competitors) refers to the participants who choose competition (no competition), but whose choice consistent with expected payoff maximization would be the non-competitive payment (competitive payment).

5 Uncovering the beliefs about the sex of potential competitors

We conclude our analysis by examining participants' beliefs about the sex of potential competitors. Since participants are not informed about the gender composition of participants present in the lab, we first examine if (and how) each participant perceives the gender composition of participants present in the lab. Second, we elicit participants' beliefs about the likelihood of each sex to enter competition. Finally, we analyze whether the beliefs about the sex of potential competitors influence participants' decision to enter competition.

5.1 Perception of the gender composition

To assess if (and how) participants perceive the gender composition of participants present in the lab we ask each participant the following question: "How do you perceive the gender composition of participants in this experimental session?". The response options available are "I did not notice the gender composition of participants"; "Only female participants"; "Mainly female participants"; "Balanced composition"; "Mainly male participants"; and "Only male participants". This elicitation is not monetarily incentivized with a scoring rule because rewarding an accurate perception would have incentivized the participants who did not notice on the gender composition to guess it.

[28] The McNemar test analyzes whether the two possible types of "irrational" responses happen with the same frequency. The null hypothesis for each of the 5 cases we test is that the proportion of "irrational" competitors and "irrational" non-competitors is the same. This test is not sensitive to the number of rational competitors and rational non-competitors.

[29] Reuben, Wiswall, and Zafar (2017) share a similar view.

Table 12. Unawareness of the gender composition (in percentage)

	No choice of sex	Choice of sex	All women
Men	45%	53%	n.a.
Women	14%	13%	16%

Note: The percentage refers to the men (women) who chose the alternative "I did not notice the gender composition of participants".

The results in Table 12 indicate that the overwhelming majority of women reveal that they did notice the gender composition whereas this aspect has not distinctively attracted the attention of men. Hence, we proceed the analysis considering only women for the sake of relevance and brevity (see Web Appendix for the corresponding analysis for men).

In Table 13, we report the specific gender composition of participants present in the lab that was perceived by the women who reveal to have noticed the gender composition. We see that in each condition almost every woman correctly perceives the actual gender composition of participants present in the lab. This finding supports that the beliefs we present in the following section, which are elicited based on the actual gender composition of participants present in the lab, capture the true beliefs of women at the moment they are asked to choose a payment scheme.

Table 13. Women's perception of the gender composition (in percentage)

	Only female	Mainly female	Balanced composition	Mainly male	Only male
No choice of sex	0%	4%	88%	8%	0%
Choice of sex	0%	8%	90%	2%	0%
All women	87%	11%	0%	2%	0%

Note: In each condition, the percentages are computed relatively to the women who reveal to have noticed the gender composition.

5.2 Beliefs about the likelihood of each sex to enter competition

To elicit participants' beliefs about the sex of potential competitors, we ask participants the following two questions (presented on the same screen): i. "For your information, there are 15 male participants in this experimental session. How many male participants do you think have chosen to compete (excluding yourself if you are a male participant and chose competition)?"; ii. The same question, but with reference to female participants. The questions are monetarily incentivized using a scoring rule that yields a higher reward the more accurate the estimate is (see Web Appendix for the full instructions, which provide the details of the monetary incentive scheme). In the All women condition, we only ask the second question, which we adjust for the higher number of female participants present in the lab.

In the subsequent analysis, we include all the female participants. The results are qualitatively the same if we exclude the few female participants who reveal not to have noticed the gender composition. In Table 14, we report women's beliefs about the likelihood of each sex to enter competition. We observe that women's belief about men's likelihood to enter competition is essentially the same in the No choice of

Table 14. Women's beliefs about the likelihood of each sex to enter competition

	No choice of sex	Choice of sex	All women
Belief probability men enter	70.6% (15.1)	72% (15.9)	n.a.
Belief probability women enter	51.5% (18.0)	51.5% (15.9)	65.4% (16.2)

Note: Belief probability men enter equals: (estimate of male participants who enter competition/total male participants in the session)*100; Belief probability women enter equals: [estimate of female participants who enter competition/(total female participants in the session-1)]*100. We report the average of these variables. Standard deviation in parentheses.

sex and the Choice of sex condition (70.6% vs. 72%, p = 0.806, Mann-Whitney test). Women's belief about other women's likelihood to enter competition is similar in the Choice of sex and All women conditions (64.4% vs. 65.4%, p = 0.897, Mann-Whitney test), but significantly lower in the No choice of sex condition (51.5% vs. 64.4%, p < 0.01, Mann-Whitney test; 51.5% vs. 65.4%, p < 0.01, Mann-Whitney test). In other words, in the condition in which women cannot avoid the possibility of facing a male opponent when they compete, women's belief about other women's willingness to compete is, on average, substantially lower.

5.3 Women's beliefs about the sex of potential competitors and competition entry

In regressions (1) and (2) of Table 15, we observe that women's belief about the percentage of men among the participants who choose competition significantly predicts women's choice for competition in the No choice of sex condition, but not in the Choice of sex condition. The insignificance of this predictor in the Choice of sex condition is logical because the proportion of men among the participants who choose competition does not affect the chance of facing a male competitor when a participant chooses to compete. In contrast, this predictor captures women's belief in the probability of facing a male competitor in the No choice of sex condition. Therefore, the significance of this predictor in the No choice of sex condition corroborates the finding that women dislike competing against men. More specifically, regression (1) of Table 15 indicates that women who believe in a higher probability of facing a male competitor are significantly less likely to choose competition, when controlling for performance, risk score, and winning belief.

Less intuitive is the more detailed result we present in regression (4) of Table 16, in which we separately report the impact of women's beliefs about men's and other women's likelihood to enter competition. We see that women's lower willingness to compete in the No choice of sex condition is not driven by women's belief about men's likelihood to compete, but rather by women's belief about other women's likelihood to enter competition. Moreover, regressions (5) and (6) of Table 16 show that in the Choice of sex and All women conditions the more a woman believes other women enter competition, the more likely a woman enters competition herself. Finally, relevant for the policy implications that we draw in the next section, comparisons of regressions (4) – (6) with regressions (1) – (3) in Table 16 further show that the women's belief about the likelihood of other women to enter competition and the women's winning belief predictors are orthogonal.

Table 15. Probit models of payment choice III (only women)

Dependent variable: *1 if payment choice is a winner-take-all tournament*		
	No choice of sex	Choice of sex
	(1)	(2)
Baseline performance	0.03	0.02
	[0.040]	[0.021]
Risk score	-0.02	0.01
	[0.043]	[0.026]
Winning belief	0.010***	0.005**
	[0.002]	[0.002]
Belief percentage men among competitors	−0.024**	-0.014
	[0.012]	[0.009]
Observations	29	45
Pseudo R^2	0.468	0.191

Note: The table reports marginal effects. *Belief percentage men among competitors* indicates the women's belief about the proportion of men among the participants who choose competition, i.e., it equals: [estimate of male participants who enter competition/(estimate of male participants who enter competition + estimate of female participants who enter competition)]*100. *Winning belief* is a variable that ranges from 0-100. *** and ** significant at 1% and 5%, respectively. Robust standard errors in brackets.

Table 16. Probit models of payment choice IV (only women)

Dependent variable:	*1 if payment choice is a winner-take-all tournament*					
	Panel A			Panel B		
	No choice of sex	Choice of sex	All women	No choice of sex	Choice of sex	All women
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline performance	0.03	0.03	0.02	0.03	0.03	0.01
	[0.033]	[0.021]	[0.013]	[0.038]	[0.016]	[0.011]
Risk score	0.01	0.01	0.02	-0.01	-0.03	0.01
	[0.035]	[0.026]	[0.023]	[0.041]	[0.025]	[0.024]
Winning belief	0.010***	0.005**	0.005**	0.010***	0.005**	0.005**
	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
Belief probability men enter				-0.008	0.005	n.a.
				[0.007]	[0.004]	
Belief probability women enter				0.011**	0.014**	0.010***
				[0.005]	[0.003]	[0.003]
Observations	29	45	56	29	45	56
Pseudo R^2	0.340	0.166	0.190	0.492	0.336	0.322

Note: The table reports marginal effects. *Winning belief*, *Belief probability men enter*, and *Belief probability women enter* are variables that range from 0-100. *** and ** significant at 1% and 5%, respectively. Robust standard errors in brackets.

In sum, in each condition, women's willingness to compete is higher the more they believe other women do compete. However, women's belief about other women's likelihood to enter competition in the No choice of sex condition is, on average, significantly lower. Put together, these findings indicate that women compete less in the No choice of sex condition because they believe fewer women compete.

The specification we present in Table 17, in which we pool the three conditions, clearly demonstrates the latter connection. Comparing regressions (1) – (3) of Table 17, we observe that adding women's belief about the likelihood of other women to enter competition as a predictor to the set of controls makes the difference in self-selection into competition between women in the No choice of sex condition and women in the Choice of sex condition statistically insignificant. Moreover, we obtain the same conclusion when we regress specifications (1) – (3) of Table 17 using either women in the All women condition as the base group or women in the Choice of sex and All women conditions pooled as the base group. Put simply, differences in women's belief about other women willingness to compete largely explain the observed lower inclination of women to enter competition in the No choice of sex condition compared to women in the Choice of sex and All women conditions.

Table 17. Probit models of payment choice V (only women, pooling the three conditions)

Dependent variable: *1 if payment choice is a winner-take-all tournament*			
	(1)	(2)	(3)
No choice of sex	−0.25***	−0.23***	-0.10
	[0.092]	[0.086]	[0.084]
All women	0.05	0.04	0.02
	[0.088]	[0.085]	[0.075]
Baseline performance	0.04***	0.02*	0.02*
	[0.008]	[0.010]	[0.009]
Risk score	0.01	0.01	-0.01
	[0.017]	[0.016]	[0.014]
Winning belief		0.006***	0.006***
		[0.002]	[0.001]
Belief probability women enter			0.010***
			[0.002]
Observations	130	130	130
Pseudo R^2	0.163	0.242	0.360

Note: The table reports marginal effects. Women in the Choice of sex condition are the base group. *Winning belief* and *Belief probability women enter* are variables that range from 0-100. *** and * significant at 1% and 10%, respectively. Robust standard errors in brackets.

6 Discussion of policy implications

Our results indicate that implementing single-sex competition, or allowing women to choose the sex of their competitors promotes women to compete more. Such institutional changes, however, are usually out of the question.[30] Nevertheless, understanding the competitive behavior of women in the single-sex and the choice of sex contexts provides insight into interventions to encourage women to compete in the more realistic context in which they cannot avoid the possibility of competing against men.

6.1 Increase women's willingness to compete via female role models

The evidence we present shows a systematic inclination of women to enter competition the more they believe other women may enter. This finding reveals women's preference for a more sex-specific competition. One intervention in mixed-sex competitions that likely induces women to perceive the competition more sex-specific is affirmative action. Implementing a competition in mixed-sex groups with two possible winners, Niederle et al. (2013) find that women increase their competition entry from 31% to 83% when they introduce a quota ensuring that the better performing woman is among the winners. However, this quota intervention also illustrates the likely side effect that would emerge if such a policy were implemented outside the lab; men decrease their competition entry from 74% to 45% when the female quota is introduced.[31]

Behavioral economics research shows that choices are influenced by (according to standard rational choice theory) irrelevant features of the choice environment such as framing (e.g., Kahneman & Tversky, 2000). Moreover, the ongoing *nudge* movement (see, e.g., Thaler & Sunstein, 2008) advocates we can *nudge* better decisions without constraining freedom of choice if we properly design the choice environment.[32] Without wanting to suggest that the use of a quota system cannot be justified in any circumstance, we propose an alternative intervention to promote women's entry into male-typed domains: drawing women's attention to female workers in male-typed domains is likely an effective intervention to persuade women to enter these domains.

To illustrate this idea, consider the academic job market in economics. In this male-typed domain, job advertisements commonly highlight women's underrepresentation as a form to encourage women. According to our results, however, this practice should be absolutely avoided. Rather than highlighting that women are a minority, job advertisements should instead include positive references to recent female applicants and/or existing female workers. For instance, we suggest that a framing such as "The organization # wants to increase its proportion of female staff in areas where women are underrepresented. Women are therefore explicitly encouraged to apply" (source: `https://econjobmarket.org/`) should be replaced by a statement along the lines of "The recent considerable increase of our female

[30] Notable exceptions exist, though. In chess, for instance, women may choose to compete in mixed-sex or only-women tournaments.

[31] From an efficiency perspective, we could argue that discouraging men is good if it drives out the less productive men. Yet, we leave aside that perspective in our analysis. Our experimental setting is not appropriate to quantify the cost/gain associated to participants' entry into competition based on participants' work task productivity because we purposely align the payoffs of the payment alternatives that we offer.

[32] Policy makers are increasingly open to the idea of nudging people as evident, for instance, from the establishment of the *Behavioural Insights Team* by the British government.

employees has been contributing to our aim to promote a balanced representation of men and women among our staff. Therefore, we strongly encourage women to keep applying.".[33]

In brief, we assert that including information that highlights female role models rather than on-going interventions that highlight women's underrepresentation is the appropriate way to boost the participation of women in male-typed domains. Moreover, the *nudge* that we advocate could be an excellent alternative to controversial policies such as affirmative action in the form of quotas because the intervention that we propose would be unlikely to affect the behavior of men.

6.2 Increase women's willingness to compete via confidence level

In our experimental setting, we observe that higher confidence significantly predicts more entry of women into competition in every condition. Moreover, the predictive magnitude of women's confidence level is stronger in the No choice of sex condition.[34]

Our results may thus explain why a less invasive intervention, such as advice for women, is ineffective (see Brandts, Groenert, & Rott, 2015)[35], but a strong intervention, such as preferential treatment for women in the form of a head start, boosts women's competition entry in a mixed-sex context (see Balafoutas & Sutter, 2012). However, the results of Balafoutas and Sutter (2012) also illustrate the likely side effect that would emerge if such a policy were implemented outside the lab; when comparing Balafoutas and Sutter (2012) major head start treatment to their treatment without intervention, women's competition entry increases from 31% to 69%, but men's competition entry decreases from 64% to 50%.[36]

In general, there is room to intervene via women's confidence level. Our results particularly suggest that boosting the confidence of low-confident women is critical to making women compete more in a mixed-sex context. However, more research is needed to test specific interventions that could encourage women to compete without discouraging men. Last but not least, our results also show that confidence level positively influences women's willingness to compete independently of their belief about other women's willingness to compete, which indicates that the two types of intervention we discussed are complementary.

[33]The author has been invited to pitch this specific intervention to the corporation side at a SODI convening. The intervention proposal raised considerable interest due to its "low-cost + high-speed" potential. As a follow-up, the author is assisting a unit to conduct interventions on job adverts. (note: The SODI is a recently created organization at the University of Chicago that aims for tighter collaboration between researchers and practitioners to promote diversity and inclusion in the workplace.)

[34]The significance of women's winning belief as well as the explanatory power of the specification after adding the winning belief as a predictor is stronger in the No choice of sex condition. Regressing Panel A models of Table 15 without the winning belief predictor yield a pseudo R2 of 0.105, 0.116 and 0.133 in the No choice of sex, Choice of sex, and All women conditions, respectively.

[35]Concerned with the reverse discrimination costs that affirmative action policy could entail, Brandts et al. (2015) investigate whether advice by more experienced individuals could be an alternative to promote women to compete more. They find that this intervention does not significantly increase women's competition entry.

[36]In unreported regressions, in which we run the models (1) and (2) of Table 15 for men, we find that higher confidence significantly predicts more entry into competition. Thus, lower confidence may explain men's lower entry into competition when there is a head start for women.

7 Concluding remarks

The present study was designed to determine whether different cues to the sex of potential competitors alter women's willingness to compete in a male-typed domain. To the best of our knowledge, our study represents the first attempt at explicitly testing in the lab the connection between women's beliefs about the sex of potential competitors and their decision to enter competition. Our hypothesis was that women do not have a weaker preference to compete per se, but rather dislike competing against men.

Our findings shed new light on the literature on gender competition. Our results demonstrate that women dislike competing against men in a male-typed domain. Specifically, we find that women's unwillingness to enter a potential mixed-sex competition is significantly driven by women's belief in a higher proportion of men among potential competitors. In contrast, if women can avoid the possibility of a mixed-sex competition when they enter competition, women compete as much as men do.

Moreover, we find the intriguing result that women's lower willingness to enter a mixed-sex competition in a male-typed domain is not driven by their belief about men's likelihood to enter competition, but rather by women's belief that other women are less inclined to enter competition. It is the latter belief that in turn increases women's belief in facing a male competitor. Perhaps women behave according to what they believe other women do just because they are a woman themselves. This would be consistent with the psychology literature on gender typing (e.g. Bem, 1981) and the sociology literature on homophily (e.g., McPherson, Smith-Lovin, & Cook, 2001), which is the tendency of people to interact with individuals who resemble them. Future research will have to test the relevance of these motives.

We confirm previous findings that women's confidence level predicts their willingness to enter competition. However, we find little support for negative self-stereotyping (Bordalo et al., 2014), which in our setting would imply a lower confidence level of women when they cannot avoid the possibility of a mixed-sex competition. In this situation, we instead observe a remarkable lower willingness to enter competition of low-confident women compared to low-confident men.

Our results have important policy implications. A growing literature that investigates institutional mechanisms to promote women to compete more (e.g., Balafoutas & Sutter, 2012; Niederle et al., 2013) shows that preferential treatment in the form of quotas or a head start for women boosts women's competition entry (but also decreases men's competition entry). Our findings suggest an alternative course of action to nudge women to compete that is unlikely to affect men's willingness to compete and, consequently, to be less controversial. While attempting to nudge women to enter competitive male-type domains, we should make reference to women who do enter or seek to enter these domains, rather than highlighting women's underrepresentation. Namely, including information in job advertisements about women who recently applied and/or got hired in male-typed domains deserves consideration as a promising intervention to explore.

In closing, some words of caution are in order. First, our study only considers the supply-side. Even if supply-oriented interventions are effective in increasing women's willingness to enter male-typed domains, this would be insufficient when employers have a strong bias to favor men in the hiring process of male-typed domains (see, e.g., Reuben et al., 2014). Therefore, parallel interventions in the demand-side that make the hiring process as much gender blind as possible are certainly desirable (see, e.g., Goldin

& Rouse, 2000).[37] Second, some studies quantify the cost/gain associated with participants' entry into competition based on participants' productivity of a real-effort task (see, e.g., Balafoutas & Sutter, 2012, Niederle et al., 2013). Our setting, though, is unsuitable to perform such kind of analysis because we purposely align the payoffs of the payment alternatives we offer. Finally, our analysis and discussion sections were directed to understand how to promote women to compete more in a mixed-sex context. However, there are circumstances in which being competitive might not be desirable like, for example, participating in joint work in a mixed-sex team. From this perspective, our results reveal that men compete too much, not that women compete too little. Hence, for mixed-sex contexts in which cooperation is the most desirable attribute, the relevant question to be studied seems to be how can we persuade men to be less competitive rather than persuading women to be more competitive.

Supplementary material

The Web Appendix contains the supplementary material of this article.

[37] Gender bias seems to be present not only in the hiring process but also in the promotion process. Leading organizations like McKinsey, BCG, Goldman Sachs, and Catalyst are increasingly searching for mechanisms to tackle this problem.

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