Competing for the benefit of offspring eliminates the gender gap in competitiveness

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Recent advances have highlighted the evolutionary significance of female competition, with the sexes pursuing different competitive strategies and women reserving their most intense competitive behaviors for the benefit of offspring. Influential economic experiments using cash incentives, however, have found evidence suggesting that women have a lower desire to compete than men. We hypothesize that the estimated gender differences critically depend on how we elicit them, especially on the incentives used. We test this hypothesis through an experiment with adults in China ($n = 358$). Data show that, once the incentives are switched from monetary to child-benefitting, gender differences disappear. This result suggests that female competition can be just as intense as male competition given the right goals, indicating important implications for policies designed to promote gender equality.

female competition | sexual selection | economic experiment | gender gap | affirmative action

Following pioneering works by Hrdy and Clutton-Brock, significant advances in evolutionary biology, psychology, and anthropology have produced an important body of knowledge on the occurrence and evolutionary significance of female competition (1–5). Despite Darwin's recognition of the importance of intrasexual competition, male–male and female–female competition for resources and sexual reproduction (6), most subsequent work has focused on the mechanisms and consequences of male competition. From an evolutionary perspective, variance in female reproductive outcomes [especially given the successful spread of monogamous marriage norms which reduces sex differences in the opportunity for sexual selection (4, 5, 7)] implies that men and women have been subject to similarly intense selection pressures (1, 8). If competitive traits derive from selection pressures, then men and women should each have evolved competitive traits. Recently, important studies have laid the foundation for understanding the difference in competitive strategies pursued by the sexes and, in particular, found that females reserve their most intense competitive behaviors for the benefit of offspring (3, 5, 8). The goal of this paper is to contribute new behavioral evidence to the study of the different modalities of women's competition.

Economists have long observed that sex differences in behavior exist and have consistently documented a gender gap in the desire to compete (9–13). In the standard experimental design on selection into competitive environments, men and women are given a series of computational tasks under different payment conditions and then asked to choose the preferred payment method for a subsequent task (9). Despite the lack of a gender difference in performance, when offered the choice to be paid on a tournament payment scheme or a noncompetitive piece-rate payment scheme, men usually choose tournament significantly more often than women. Controlling for confidence and risk aversion does not explain away the gender gap in choosing tournament. Numerous subsequent studies have replicated this finding, in the laboratory and in the field, and have explored possible ways to encourage women to choose tournament, such as affirmative action or varying the characteristics of the task or of the competition (10, 14–17). Adding to the more traditional explanations for gender differences in labor market outcomes [i.e., gender differences in human capital

accumulation (18) and gender discrimination (19)], this finding contributes a more direct behavioral explanation to the puzzle of why women are scarce in top-ranking professional positions: women simply do not select into competitive environments as much as men do because women are lacking in competitive behavioral traits. Despite how pervasive this idea has become, it has not found unequivocal support in labor market data (20). (In particular, the data show that the gender wage gap is smallest not in the least competitive jobs, but in the jobs with the most flexibility.) A better understanding of the mechanism behind gender differences in competitive behavior would allow for targeted policy in addressing labor market inequality.

In light of the evolutionary evidence, we hypothesize that the nature of the reward used in economic experiments can induce gender differences in behavior by turning on gender-specific tendencies to participate in a given sphere of competition, but these tendencies are not necessarily indicative of general competitiveness. We propose that women are not necessarily less competitive than men, especially in those spheres of competition that really matter to them. Despite cash being the standard reward medium in competitive environments [since it satisfies the three principles of nonsatiation, salience, and dominance (21)], this reward medium could interact with deep-seated gender differences in mating strategies and weaken women's tendency to compete and/or strengthen men's. Psychologists have shown that women find cues to resource acquisition such as earning capacity (here winning a large cash prize) more attractive in a prospective mate than men do (22). Traits related to ability to successfully compete over such resources do not appear to be

Significance

Despite Darwin's recognition of the importance of intrasexual competition, the topic of female competition has been largely ignored. Economists, looking for reasons why women are rarely found in top jobs, have accumulated experimental evidence pointing to women's lower desire to compete than men. Consistent with newer interdisciplinary hypotheses about female competition, our experimental results show that women can compete as much as men once we change the experimental reward medium to something more in line with women's goal: the benefit of one's children. Our results have important policy implications: a change in the workplace incentive structure could induce more women to enter workplace competitions. Such findings matter for a broader group of scientists including biologists, anthropologists, psychologists, economists, and sociologists.
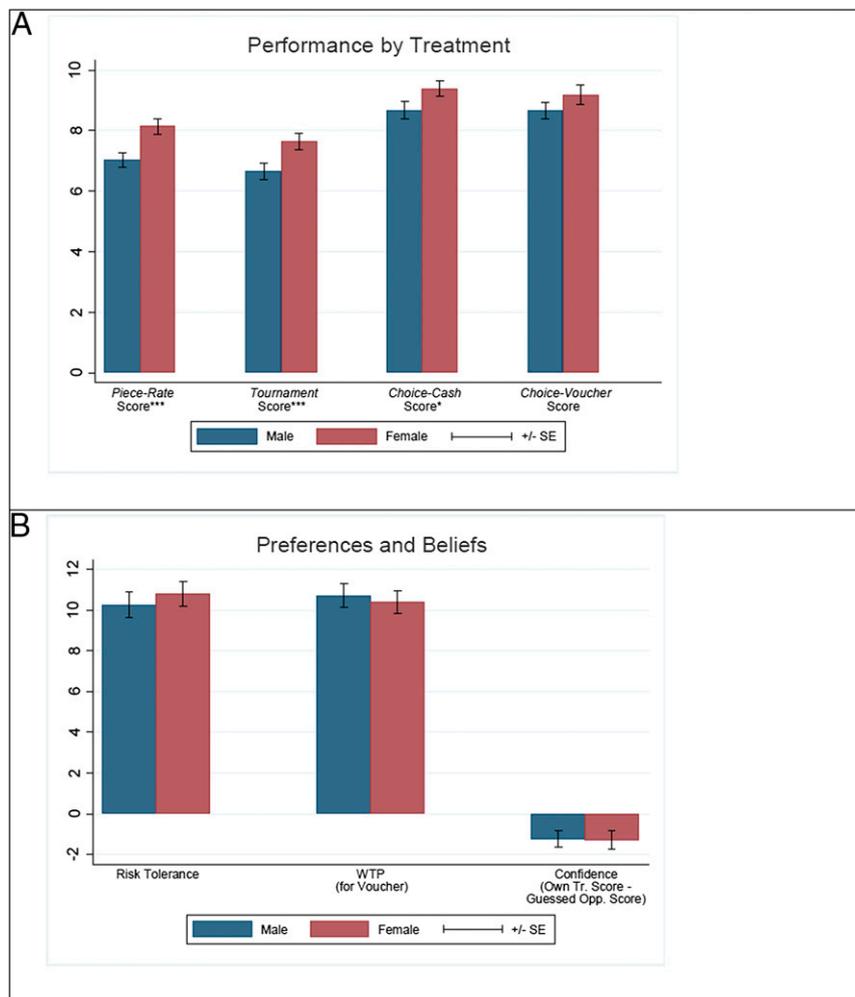
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Fig. 1. (*A*) Task performance. Bars represent the average number of correct problems solved by male (blue) and female (red) subjects by treatment. Error bars represent means ± SE. Women, on average, scored significantly higher than men in the two compulsory treatments (piece-rate and tournament), marginally higher in choice-cash, and not significantly higher in choice-voucher. (*B*) Preferences and beliefs. Bars represent, respectively, average choice in risk tolerance game, willingness to pay for the voucher, and confidence number by male (blue) and female (red) subjects. Error bars represent mean ± SE. No significant gender differences were found in preferences and beliefs.

highly ranked by men as desirable female characteristics, which could contribute to making men more competitive than women over these cash resources. On the contrary, given the different and more important role that mothers play in infant survival (23), and the high costs associated with violence (8), females reserve their most intense competitive behavior to ensure their reproductive success [i.e., the survival and thriving of their offspring (3, 5, 8)]. Therefore, we expect that women will be relatively more competitive for resources that directly benefit one's offspring than for a cash prize.

From an economic perspective, women's lower competitive instincts over cash stakes, which could be used in turn to buy child-benefitting resources, would be consistent with a relaxation of the hypothesis of perfect rationality in favor of seemingly less rational yet still predictable behaviors rooted in social norms rather than market norms (24). For example, emerging evidence showing that tendencies to compete are reversed in matrilineal and matrilocal societies (25) and that girls in single-sex schools are as competitive as boys (26) suggests that nurture/culture plays an important role in contributing to the gender-specific competitive tendencies over cash stakes. Nature may play a role as well, because female competitiveness over cash seem to vary with hormone levels (27, 28) and

postmenopausal women are found to be more competitive than younger women.*

Experimental Procedures

To test our hypothesis, we designed an experiment in which subjects perform tasks and choose between piece-rate and tournament payment schemes (as in the standard protocol for eliciting competitive preferences) under two reward treatments: cash (the standard medium to incentivize participants in economic experiments); and a prize intended to benefit one's child (novel treatment)—a scholastic bookstore voucher with equal face value as the cash reward corresponding to performance in the experimental task.

The experimental design is within-subject. Each session consisted of six different rounds: the first four, administered in random order between sessions, were different treatments of a game designed to elicit a subject's desire to compete; the last two were a risk aversion elicitation task and a willingness-to-pay (WTP) elicitation task. The desire to compete elicitation task, with reward rules specific to each treatment, required subjects to add sets of five two-digit numbers, as many as possible in 3 min (such as 78 + 23 + 69 + 35 + 10 = ?). The number of correct solutions, our performance measure, was recorded as the subject's score. At the end of each round, the subjects were notified of their own performance but not what other

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*Flory J, Gneezy U, Leonard K, List J (2012) Gender, age, and competition: The disappearing gap. Unpublished manuscript.
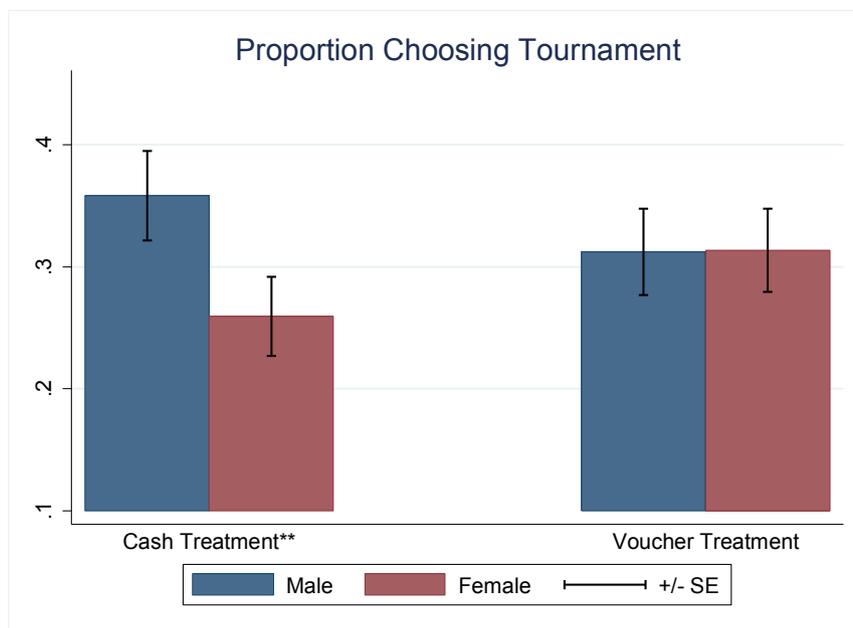
Proportion Choosing Tournament

Fig. 2. Tournament entry decision. Bars display the proportion of men (blue) and women (red) choosing to enter the tournament under choice-cash and choice-voucher. Error bars represent mean ± SE. Under choice-cash, the 10-percentage-point gender difference in tournament entry is significant (men: 0.36; women: 0.26; $P = 0.043$) but disappears under choice-voucher (men: 0.31; women: 0.31; $P = 0.978$).

subjects scored. At the end, subjects received a 25-renminbi (RMB) show-up fee plus additional payments depending on the performance score of the round randomly selected for payment, on average an additional 17.64RMB. The protocol has been approved by the Institutional Review Board for the Protection of Human Subjects (IRBPHS) of the University of San Francisco (IRBPHS no. 12-070) and by The Hong Kong University of Science and Technology Committee on Research Practices. Informed consent was obtained from all participants.

Rounds 1 and 2.
Piece-rate. To estimate a benchmark measure of gender difference in performance, and replicate standard protocol, we implemented a noncompetitive treatment: a piece-rate payment scheme in which every subject received 2RMB per correct answer. *Tournament.* Subjects were required to participate in a compulsory tournament in which the reward was 4RMB for each correct answer but only if the subject scored higher than a randomly matched anonymous opponent (another subject in the experiment, of unknown sex). With ties, winners shared the payment equally.

Rounds 3 and 4.
Choice-cash. Subjects had to choose under which payment scheme their next performance should be compensated: piece-rate (2RMB per correct answer) or tournament (4RMB per correct answer if score higher than the opponent, nothing otherwise).[†] The three treatments described above are identical to the standard protocol in the literature.
Choice-voucher. Similar to choice-cash, the choice-voucher treatment also required subjects to choose between the two types of compensation schemes. The only difference, giving us our comparison of interest, was that the compensation reward was not cash but a bookstore voucher of equal face value.

Although rounds 3 and 4 always followed rounds 1 and 2, the treatment order within the two blocks was randomly assigned to sessions; thus, the four treatment order combinations were pr-tr-cc-cv, tr-pr-cc-cv, pr-tr-cv-cc, and tr-pr-cv-cc, where pr indicates piece-rate, tr indicates tournament, cc indicates choice-cash, and cv indicates choice-voucher. See *SI Appendix*, Table S2 for a balance check of the counter-balanced design and characteristics of the participants facing each order combination.

After the first four rounds, subjects were asked to guess their opponent's score in the compulsory tournament. The difference between their own score and their guess of their opponent's score is used to proxy for their confidence in winning the tournament.

Rounds 5 and 6.
Risk tolerance. To estimate a subject's risk attitude, we administered the Multiple Price List (MPL) elicitation method with real payoffs (reported in *SI Appendix, 5. Experimental Instructions*).
WTP. To estimate how much each individual valued the voucher, we used a procedure similar to the previous MPL (reported in *SI Appendix, 5. Experimental Instructions*).

Survey Instruments. At the end, subjects were asked to answer demographic and socio-economic questions, as well as a series of questions about their beliefs (see *SI Appendix, 6. Survey Instruments*).

The sample pool is comprised of 358 parents (173 fathers, 185 mothers) of middle and high school students recruited through seven educational institutions throughout Shanghai, China, between June and August of 2012, who participated in 18 experimental sessions lasting 45–60 min each. In addition to written instructions, to ensure consistency and prevent framing and other uncontrolled biases, instructions were voice recorded in Mandarin and played back. Solutions were recorded on paper by the participants and immediately graded by research assistants. *SI Appendix*, Table S1 displays the participants' summary characteristics.

The importance placed by Chinese culture on education made it highly likely that parents would use the scholastic voucher to purchase something for the child, as we intended. In China, educational textbooks and "learning aids" make up an unusually high market share of the publishing industry, accounting for 65% of all turnover.[‡] We further substantiate our claim by interviewing teachers and parents. Shanghai teachers in focus groups were unanimous in their belief that parents would only use the vouchers to buy educational books for their children, in particular, test preparation books. Parents agreed with the teachers: we conducted a study with a convenience sample of 72 parents of high school students around Shanghai (with no overlap with the experimental sample) in which we handed out 20RMB bookstore vouchers identical to those used in the experiment. When asked how they would use the voucher, 85% of respondents indicated they would use it for their child. There was no gender difference (mothers: 83%, $n = 42$; fathers: 87%, $n = 30$; $P = 0.703$).

[†]As in ref. 4, if a subject chooses Tournament, her score was compared with the score of her opponent in the compulsory tournament round, rather than her opponent's score in choice-cash, to ensure that participants choosing the Tournament option are competing against the scores of others also performing under the Tournament condition, so to rule out reasons for choosing the Piece-Rate scheme, such as not wanting to impose negative externality on others or strategic response to beliefs about other participants' choices.

[‡]See Buchinformtaionszentrum's 2014 report (29), funded by the German Federal Foreign Office. The report further finds that of the top 10 Chinese book publishers, 7 are in the education sector, including the top 4 publishers.

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Table 1. Tournament entry decision by treatment

Independent variables	Choice-cash		Choice-voucher		
	(1)	(2)	(3)	(4)	(5)
Female	−0.099** (0.049)	−0.122** (0.049)	0.001 (0.049)	−0.019 (0.050)	−0.015 (0.050)
Score		0.014 (0.009)		0.020** (0.008)	0.020** (0.008)
Risk tolerance		0.007** (0.003)		0.005* (0.003)	0.003 (0.003)
Confidence		0.015** (0.006)		0.007 (0.005)	0.007 (0.005)
WTP					0.008** (0.003)
Observations	358	357	358	357	357
Log likelihood	−218.8	−205.7	−222.4	−212.4	−209.8
Mean dependent variable	0.307	0.308	0.313	0.314	0.314

Dependent variable: tournament entry. Probit regression: dependent variable is 1 if the subject chooses to enter the competition; the variable is 0 otherwise. Score is no. of correct answers in the compulsory tournament. Marginal effects are reported. Robust SEs are in parentheses. WTP, willingness to pay for the voucher. *$P < 0.10$; **$P < 0.05$.

Results

With respect to performance (i.e., the number of correct answers), women on average scored significantly higher than men in the compulsory treatments of the first two rounds (8.14, 7.03, $P = 0.003$ in Piece-Rate; 7.64, 6.66, $P = 0.009$ in tournament), marginally higher in choice-cash (9.39, 8.67, $P = 0.069$), and higher, but not significantly so, in choice-voucher (9.18, 8.65, $P = 0.199$) (Fig. 1*A*). Within gender, improvements in scores from the first two rounds to the next two were statistically significant ($P = 0.000$ male; $P = 0.000$ female), consistent with learning effects. There were no statistically significant gender differences in risk tolerance (10.82, 10.26, $P = 0.528$) or in willingness to pay for the voucher (10.39, 10.72, $P = 0.682$). Men and women were equally under-confident, guessing that their opponents would answer one more question correctly than they themselves did (−1.30, −1.25, $P = 0.933$) (Fig. 1*B*).

Our preliminary results are displayed in Fig. 2. Under choice-cash (cash treatment), in the voluntary tournament with cash as the prize, the gender difference in choosing the tournament payment scheme is statistically significant at the 5% level (tournament entry rate among women and men, respectively: 0.26, 0.36, $P = 0.043$), with men 9.89 percentage points more likely to enter the tournament, despite scoring lower than women in the compulsory cash tournament. Under choice-voucher (voucher treatment), in the voluntary tournament with the bookstore voucher as the prize, there were no gender differences in the tournament entry rate (0.31, 0.31, $P = 0.978$). Compared with the cash treatment, men reduced their willingness to compete from 0.36 to 0.31 ($P = 0.131$), about the same amount for which

women increased their willingness to compete (from 0.26 to 0.31, $P = 0.105$, marginally significant).

Next, we test for gender differences using separate probit regressions for the cash and voucher treatments, controlling for a set of explanatory variables highlighted in the literature as possible causes of the gender gap in tournament entry: risk tolerance, confidence, and probability of winning the tournament, as proxied by performance in the compulsory tournament (Table 1). The voucher treatment regressors also include the willingness to pay for the voucher, to control for the stakes size variation induced by heterogeneity in individual valuations. In all models, the coefficient on female is the one of interest and can be interpreted as the residual gender difference in willingness to compete after controlling for these explanatory variables. In the cash treatment, a woman is about 12 percentage points (SE, 0.049) less likely to enter the competition than a man with the same compulsory tournament score, risk tolerance, and confidence. This result is consistent with existing literature. Once the tournament prize is changed to the child-benefiting voucher, the gender coefficient becomes insignificant and close to zero in all specifications.

Our main results, shown in Table 2, pool the data from the cash and voucher treatment to formally test for the significance of the gender–treatment interaction. We take advantage of the power of our within-subject design by including individual fixed effects, which allows us to measure the rate by which women, relative to men, are more likely to compete in the voucher treatment compared with the cash treatment, controlling for all individual heterogeneity that is constant across treatments, such as performance in the compulsory tournament, risk tolerance, confidence, as well as unobserved treatment–constant individual differences. (The results can be

Table 2. Tournament entry decision regressions specified as panel with treatment interactions

Independent variables	(1)	(2)
Voucher treatment	−0.046 (0.030)	−0.050 (0.067)
Female × voucher treatment	0.100** (0.045)	0.101** (0.046)
WTP × voucher treatment		0.001 (0.003)
Score × voucher treatment		0.003 (0.007)
Risk tolerance × voucher treatment		−0.003 (0.003)
Confidence × voucher treatment		−0.003 (0.004)
Constant	0.307*** (0.011)	0.308*** (0.011)
Control for subject fixed effects	Yes	Yes
Observations	716	714
No. of subjects	358	357

Dependent variable: tournament entry. Linear regression: dependent variable is 1 if the subject chooses to enter the competition; the variable is 0 otherwise. Score is no. of correct answers in the compulsory tournament. WTP, willingness to pay for the voucher. Note that in column (1), the main effect of female is absorbed by the subject fixed effects. Note that in column (2), the main effects of female, willingness to pay, score, risk tolerance, and confidence are absorbed by the subject fixed effects. Column (2) also controls for the interactions of multiple switching behavior in both the willingness to pay and the risk tolerance instruments with treatment. Robust SEs are in parentheses. **$P < 0.05$; ***$P < 0.01$.

equivalently displayed using a first-difference model, as shown in *SI Appendix*, Table S4.) The results in column (1) of Table 2 show that mothers, compared with fathers, are 10 percentage points (SE, 0.045) more likely to compete when the prize is a voucher for their child, relative to their choices in the cash treatment. Column (2) of Table 2 shows a nearly identical coefficient on the gender–treatment interaction when controlling for the interactions of treatment with willingness to pay for the voucher, score in the compulsory tournament, risk tolerance, and confidence. In fact, these interactions terms are all insignificant, implying that, unlike gender, the effects of these variables on the choice to compete do not differ across treatments.

The effect of greater female participation in the competition is that women went from being underrepresented among winners of the cash tournament (45%) to being slightly overrepresented among winners of the voucher tournament (53%), with proportionate representation implying that 52% of the winners would be women. [Women make up 55% of the winners in the compulsory tournament (tournament).] The voucher treatment eliminated the gender gap in winning the competition. Robustness analysis reported in *SI Appendix, 3. Supplementary Analysis* rules out alternative interpretations based on mother and father differential selection into the experiment, the treatment order, or a higher valuation of vouchers by women.

Unlike an intervention such as affirmative action (16), the voucher treatment does not change the probability of winning for either men or women conditional on entering the tournament, which prevents a more qualified man from being passed over in favor of a woman. Further analysis on the efficiency of child-benefitting incentives (here vouchers) is described in *SI Appendix, Table S6* and finds that the voucher treatment positively selects for high ability people, male and female, and increases earnings for both males and females. High-ability women, in particular, increased their likelihood of tournament entry by 10 percentage points under the voucher treatment ($P = 0.026$) and saw their earnings increase by 8.5% ($P = 0.086$). Men and low-ability women are not affected in a statistically significant way. We conclude that the voucher treatment increases equity without loss of efficiency.

Discussion

In conclusion, consistent with recent evolutionary theories of female competition (1), the experimental results indicate that a child-benefitting reward can trigger an increased desire in mothers to compete, compared with fathers, above their desire to compete for cash.[§] These findings suggest that policy interventions, other than affirmative action, may be effective in reducing inequality in the labor market: for instance, rewarding professional achievement with high quality on-site daycare, school vouchers, after school enrichment programs, tutor allowances, or more flexibility to reduce hours worked, which has been shown to correlate with lower gender gaps in earnings (20). As policy tools, child-benefitting rewards could induce high-ability women to enter more labor market competitions and earn more, without negative impacts on men and low-ability women. Other desirable properties of such policy tools are discussed in *SI Appendix, 4. Efficiency Considerations*. Importantly, the voucher treatment does not change the probability of winning in favor of one sex, conditional on entering the competition. This is a persistent source of concern with affirmative action interventions, which could be seen as unfair even if there are no ex post adverse efficiency consequences (16). An intervention that preserves the conditional probability of winning may find more broad based support (32).

[§]Our findings are consistent with the results emerging from the negotiation literature in psychology, according to which gender differences in negotiated outcomes are not attributable to internal traits (lower negotiation capacity or lower motivation) but to women negotiating economic outcomes simultaneously with seeking social approval and behaving strategically depending on the potential for backlash occurring in different contexts (30). According to these studies, women are fully aware of the potential for backlash when their assertive behavior could be viewed as incongruent with the prevailing gender norms and stereotypes. In contexts in which backlash is likely to occur (as in self-advocacy situations where negotiation is for oneself), women are shown to behave less assertively than in contexts in which there does not exist a violation of prevailing gender stereotypes (as in other-advocacy contexts where negotiations are on behalf of others). When negotiating on behalf of others, women are found to negotiate more assertively (as much as men) and achieve better outcomes, because they do not expect incongruity evaluations. Similar results have been found through incentivized economic experiments where competing in teams leads to a substantial reduction in the male–female competition gap (31).

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