Gender Beliefs and Cooperation in a Public Goods Game Experiment

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Abstract

We study the role of gender beliefs for cooperation in a public goods game experiment. Controlling for risk preferences and for subjects' unconditional willingness to cooperate, we find that gender beliefs affect behavior in homogenous groups where the group composition was announced.

JEL Classification: C72, C91

Key words: public good game, experiment, gender differences, gender beliefs

1 Introduction

Gender beliefs can be defined as different interpretations and expectations about the personality traits (how women and men are) and behavior (how women and men behave) of men and women. Moreover, gender beliefs are not only descriptive, but also prescriptive, stating how women and men should be and should behave (Heilman, 2001). Gender beliefs might affect behavior and lead to gender discrimination, positive or negative, via the impact these norms have on the agent's expectations.

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Previous experimental evidence on the economic impact of gender norms focused mainly on competitive environments. Men and women were found to react differently to payment schemes based on competition, and the differences can be at least partially attributed to the impact of expectations about the behavior of the other gender. Behavior in cooperative environments begs the same curiosity: does information of gender group composition add information that is taken as relevant by the interacting agents - and acted upon? For the purpose of this paper we rephrase this question more specific as: does information on group composition in terms of gender affect cooperation of groups in public goods games? The answer to this question is inconclusive so far, despite the bulk of literature, directly or indirectly related to it.

Contradictory observations can be found in the literature (Eckel and Grossman, 2000), indicating either that women are more cooperative than men , or that there is no gender difference, or that women are less cooperative than men. There seem to be at least one unifying theme identified on how gender matters in games where cooperation would affect the economic outcomes. Women seem to behave more prosocially - cooperatively - in games where no risk is at stake, i.e. in dictator games (Eckel and Grossman, 1998 and 2000). In these environments, the role of gender norms has been documents as well. Dana, Cain and Dawes (2005) ran dictator games in order to test for the influence of beliefs about fairness on the generosity of dictators in one shot games. They recognized both an influence of beliefs in fairness, leading to positive proposals, and of beliefs in standard economic rationality when students had received economic training, leading to zero proposals. They therefore concluded that "the interesting aspects of generosity demonstrated by our studies cannot be adequately formalized without somehow incorporating beliefs into the decision maker's utility function" (idem, p. 200). Another paper on the role of beliefs in dictator games focused on gender beliefs (Aguiar, Branas-Garza, Cobo-Reyes, Jimenez, and Miller, 2008). This experiment revealed that female receivers more often than male receivers prefer to play against a female dictator when offered the choice between a female and a male dictator: 80% of the women

chose for a female dictator whereas only 48% of the men opted for a female dictator. This result suggests that women have stronger gender beliefs about generosity/altruism than men. The authors, however, as in many other articles in experimental economics which find gender differences, do not provide any explanation for these differences. In a recent overview of gender differences in experimental economics, Croson and Gneezy (2009) argue that women's decisions are more context-specific than men's. For example, they conclude from studies on the ultimatum game and the prisoner's dilemma game that women's decisions vary more with the gender of their partner than men's decisions, indicating that also gender context is more influential for women as compared to men. But they offer no explanation why this would be the case.

In this paper, we focus on the role of gender in formulating beliefs about the (expected) behavior of others. The relevance of the group composition thus becomes central in our understanding of the rates of cooperation in the public goods game. We control for factors which might affect the players of both genders, and which have previously been linked to gender differences. These are risk preferences on one hand, and unconditional pro-social preferences on the other hand. Risk preferences may affect behavior in a social dilemma for conditional cooperators, who are uncertain about the behavior of others. Cooperation can be then seen as a gamble taken on the cooperativeness level of others. Will a cooperative behavior result in a sucker's position? Or will it result in a mutually profitable cooperation over long run? Moreover, we need to control for risk preferences as female subjects have been previously found more risk averse than male subjects in experimental studies (Eckel and Grossman, 2002).

Conditional cooperation is pervasive and documented extensively in public goods games (see Fischbacher et al 2002). Cooperation of conditionally cooperative individuals depends on the beliefs about the cooperation of others. Gender norms might affect the type of beliefs subjects hold, depending on the gender composition of the interacting group members. We propose that gender beliefs might provide an escape route from the negative impact of uncertainty in the problem of cooperation faced by female individuals in a public goods

problem. This would take place as the information on the presence of female co-participants in an all-female public goods game group alleviates the uncertainty about the cooperation of others via gender norms.

This hypothesis we test experimentally, by first measuring risk-aversion and pro-social preferences of our participants, and then observing their behavior in a repeated public goods game in which we announced the group composition to the groups. We form either all-male or all-female groups, and moreover, we sort the groups by the risk preferences of their members. We form risk averse and risk neutral groups. Our gender belief hypothesis predicts that especially risk-averse female groups will succeed to cooperate better than their counter part risk-averse male groups, and that this is due to gender beliefs.

2 Hypothesis and experimental design

We hypothesize that gender beliefs affecting behavior in strategic situations by shaping the expectations of the interacting players will have an impact on the cooperation rates in the public goods games where the gender of homogenous groups is revealed to the subjects. Gender beliefs affect expectations and behavior depending on the composition of the group of interacting agents. As females are considered/expected to be more cooperative than males, receiving information on the homogenous group composition would shape differently the expectations in the all-male than in the all-female groups. Revealing group composition in the all-female groups in a public goods game decreases the strategic risk of cooperation, and hence lead to more cooperation than in the all-male groups:

Hypothesis: **(Gender norms and cooperation)** Female subjects are believed to be more cooperative (and in particular by other female subjects). Hence, information on group composition in homogeneous groups results, after controlling for risk-preferences and for pro-social preferences, in higher levels of cooperation in all-female groups than in all-male groups.

We test our hypothesis experimentally. Subjects of our experiment were 42 students of business and economics of Tilburg University (TU), The Netherlands[1]. We collected information on each subject on two occasions. Up to one week prior to the main experiment, each subject participated in a laboratory pre-experiment elicitation of risk preferences (using the Holt&Laury instrument) and an elicitation of unconditional social preferences (using the decomposed game technique, Messick, D. M. and McClintock, 1968; see also Offerman et al 1996), in this order. These experimEnts were conducted as single-person decision problems (although with payoff impact of an anonymously selected experiment participant in the part eliciting social preferences), and were conducted using the NetQ questionnaire facility. Each subject could login to the program at home, and complete the questionnaire. We recorded the duration of the experiment, in order to control for unduly short or long sessions. No feedback on the outcome of these auxiliary experiments was given to the subjects prior to finishing the main experiment, in order to avoid any spill-over effects. We then conducted two laboratory sessions, each consisting of 21 students, implementing our main experiment. The sessions lasted cca. 1 hour.

At the end of the laboratory session, subjects were paid for participating in the pre-experiment and for the main experiment; on average they earned 22.80 Euros.[2] The language used in the experiments was English, and they were partially computerized and conducted using z-Tree (Fischbacher, 2007).

One experimental design issue we have to address is the way we informed subjects about the gender. One possible point of concern is that this might lead to experimenter demand effect. Holm (2000) addressed this issue by comparing this explicit method of gender announcement with a more subtle one (first-name announcements). They found no qualitative differences in the data in the two treatments. We follow their conclusions and use the direct gender announcement in the experiment, avoiding possible anonymity issues among

[1] This paper reports data on the first batch of our experiments. Obviously, more data and replication is needed to check the robustness of our findings.

[2] Instructions for the experiment can be found at the following webpage: http://www.ru.nl/economie/contact_en/medewerkers/volledige_lijst_van/vyrastekova/.

the students participants due to announcing first names.

2.1 Social preferences

Gender effects have been documented, mostly finding females to be more cooperative in nonstrategic environments. We control for this aspect of gender differences by measuring each subjects unconditional willingness to cooperate, using a decomposed game technique (Messick, D. M. and McClintock, 1968; see also Offerman et al 1996). This method consist of 24 pairs of payoffs, each of them affecting the payoff of the deciding subject and of one anonymous other subject in the experiment. These payoffs are obtained as equidistant coordinates on a circle, with a fixed diameter (corresponding to 150 cents in our case). Each payoff pair is a pair of two neighboring points on the circle. The choice between two payoffs represents on either the possibility to increase the payoff of the other person at a cost to the deciding player; or the possibility to decrease the payoff of the other person at a cost to the deciding player. By asking an individual to perform several such considerations, a robustness (or randomness) of such individual choice can be measured. Moreover, the sum of all individual payoff choices results in an average "inclination of a person, willingness to increase/decrease/or ignore the payoff consequences for the other person. Such inclination, indeed "type of prosocial orientation" can be then measured by the angle of this final payoff vector. Subjects with payoff vector with angle close to 0 (corresponding to the individually rational choice of keeping all money for oneself and neither increase nor decrease other's payoff) are categorized as the rational payoff maximizers. Subjects with a positive angle (above 5 degrees) are categorized as altruistic individuals, and subjects with a negative angle (below minus 5 degrees) are categorized as spiteful individuals.

2.2 Risk preferences

We measured risk preferences using a standard tool developed by Holt and Laury (2002). Each subject had to choose one of two lotteries (alternatives) offered in eight decision Situations, see Figure 1. These choices allow us to

Situation 1:	Alternative A: 1/10 cards with prize 200 cents and 9/10 cards with prize 160 cents Alternative B: 1/10 cards with prize 385 cents and 9/10 cards with prize 10 cents
Situation 2:	Alternative A: 2/10 cards with prize 200 cents and 8/10 cards with prize 160 cents Alternative B: 2/10 cards with prize 385 cents and 8/10 cards with prize 10 cents
Situation 3:	Alternative A: 3/10 cards with prize 200 cents and 7/10 cards with prize 160 cents Alternative B: 3/10 cards with prize 385 cents and 7/10 cards with prize 10 cents
Situation 4:	Alternative A: 4/10 cards with prize 200 cents and 6/10 cards with prize 160 cents Alternative B: 4/10 cards with prize 385 cents and 6/10 cards with prize 10 cents
Situation 5:	Alternative A: 5/10 cards with prize 200 cents and 5/10 cards with prize 160 cents Alternative B: 5/10 cards with prize 385 cents and 5/10 cards with prize 10 cents
Situation 6:	Alternative A: 6/10 cards with prize 200 cents and 4/10 cards with prize 160 cents Alternative B: 6/10 cards with prize 385 cents and 4/10 cards with prize 10 cents
Situation 7:	Alternative A: 7/10 cards with prize 200 cents and 3/10 cards with prize 160 cents Alternative B: 7/10 cards with prize 385 cents and 3/10 cards with prize 10 cents
Situation 8:	Alternative A: 8/10 cards with prize 200 cents and 2/10 cards with prize 160 cents Alternative B: 8/10 cards with prize 385 cents and 2/10 cards with prize 10 cents
Situation 9:	Alternative A: 9/10 cards with prize 200 cents and 1/10 cards with prize 160 cents Alternative B: 9/10 cards with prize 385 cents and 1/10 cards with prize 10 cents
Situation 10:	Alternative A: 10/10 cards with prize 200 cents Alternative B: 10/10 cards with prize 385 cents

Figure 1: Lotteries List Eliciting Risk Preferences (Holt and Laury, 2002).

categorize subjects' risk preferences. Starting from Situation 1, alternative B would be chosen only by an individual willing to accept a considerable risk. A risk-neutral person would prefer alternative A over alternative B in Situations 1 to 4, after that, however, she would switch to alternative B. The later an individual switches to choosing Alternative B after Situation 4, the stronger is the aversion to risk she reveals. Eventually, in situation 10, all rational and payoff incentivized individuals should switch to B. We therefore characterize a subject by the number of times he/she chooses alternative A before switching to alternative B. We exclude from categorization the individuals who switch between alternative A and choosing alternative B several times. Table 1 contains the number of individuals in each category, per gender.

Number of "A " choices (risk type)	# Male	# Female
3 (RN)	1	3
4 (RN)	8	6
5 (RA)	3	5
6 (RA)	6	6
7 (RA)	1	0
8 (RA)	0	1
9 (RA)	1	0
Not categorized	1	0

Table 1: Risk Preference Types by Gender.

2.3 Public goods game with information on gender composition

We used a standard linear public goods game in order to model the cooperation in social dilemma. Three subjects were matched into a group and received and endowment of 15 tokens each, to choose to invest into the joint project (public good) with return of 0.6 points per token in the joint project, or keep for oneself, with return of 1 point per token in the private project. One point was worth 5 cents. Subjects participated in 11 rounds of interaction. In round 1, we elicited their contributions schedule - a complete strategy for the public goods game. We did not provide any feedback on decisions made in round 1, until the end of the experiment. In rounds 2-11, subjects participated in the repeated public goods game. In round 2, we additionally provided the information about the gender group composition. One sentence on the screen informed subjects that "all subjects in the group are of the same gender", either female or male, as appropriate for the relevant groups. Besides using gender pairing as a treatment variable, we also sorted our groups by risk-aversion, as measured in the pre-experiments. Sum of the individual risk-aversion measures as determined by the number of A choices in the risk elicitation tool did not exceed 12 in groups denoted as RN, i.e. groups were composed only of risk neutral or risk taking individuals. Groups composed of risk averse individuals, with the sum exceeding 12, are the groups denoted by RA. We sorted groups in such a way that the individual groups members did not differ from each other in terms of

the risk-aversion measure too much (at most by 1 step, whenever possible). We hypothesized that the information on gender composition would, due to gender beliefs, remove strategic risk in the all-female groups. Consequently, we expect that the impact of gender beliefs would be higher in groups where individuals are more risk-averse than in groups with lower risk-aversion.

3 Data analysis

Figure 2 presents the individual average contributions, by gender and by the group aversion type assigned to the group. Here, group aversion type is either RN or RA where RN stands for risk-neutral/risk taking and RA stands for risk averse. Groups with the type RA consist of individuals who switched to the more volatile alternative B at a later stage than a risk-neutral individual would (i.e. in later than in Situation 4). Remaining groups are of type RN. Although the group differences are not extremely large, it is the case that the risk-averse type female groups achieve the highest cooperation rates in the long run, in the last round of the experiment.

We estimated the individual contributions strategy in the following way[3]. A variable to be explained is the individual's change in own contribution between rounds t-1 and t. As explanatory variables, we used the two preferences characteristics of the subject: the social preference type (being either spiteful, with value -1, individualistic, with value 0, or cooperative, with value 1) and risk-preference type (being either risk taking or neutral, with value -1, or, being risk averse, with value 1). We also include a freerider indicator, equal to 1 if the subjects contributed less than others on average in the previous round t-1, and equal to 0 otherwise.

We estimated a random effects Tobit model, censored at the maximal and minimal possible adjustment of individual contributions, see Table 2. The ad-

[3] When we abuse the reality of repeated interaction, and consider an individual contribution per round as an independent observation, then we find that risk-taking females take more "risk ", i.e. cooperate more, than male groups composed of risk-taking individuals, (MWU, p=0.087 one-sided; Kolmogorov Smirnov test p=0.055), while risk-averse men and women contribute on average the same amounts (MWU, p=0.121 one-sided; Kolmogorov Smirnov test, p=0.099).

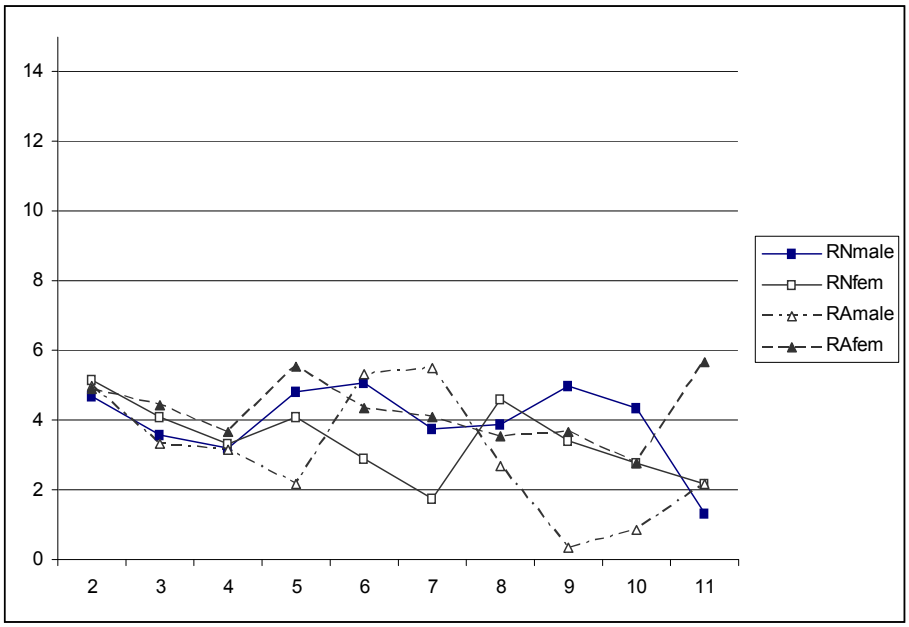

Figure 2: Individual Average Contributions in Female (fem) and Male (male) Groups, and in Risk Averse Groups (RA) and Risk Neutral/Risk Taking Groups (RN).

social type	2.875***
	(1.010)
social type*gender	-2.498**
	(1.225)
risk preference type	-2.509
	(1.544)
risk preference type*gender	3.608*
	(2.088)
gender	0.909
	(0.909)
others contribution in t-1	-0.095
	(0.041)
being freerider in t-1	4.985***
	(0.071)
constant	-4.770***
	(0.972)
N	0.336
Log Likelihood	-479.50352

Table 2: Explaining Change in Individual i's Contribution Between Period $t-1$ and Period t by a Censored Tobit model with Individual Random Effects.

justment of own contribution to the public good between period t-1 and t depends in an expected way on the individual preference characteristics: cooperative types increase contributions more and risk-averse types increase less than their counterparts. Interactions with gender are supporting our hypothesis. Interacting risk-preferences with gender, we find that risk-averse female types increase their contributors more than risk-averse male types. Consequently, the information on the group gender composition mitigates the risk-aversion of females towards being more cooperative, and this effect is stronger than when males are informed about the homogenous the gender composition. This observation is in line with our gender belief hypothesis formulated above.

4 Discussion and conclusions

Our experiments have accounted for social preferences and risk aversion in order to assess whether gender differences in cooperative behavior in a repeated public goods game should be entirely attributed to gender differences in these

individual preference measures, or whether cooperative behavior is also affected at the social level, namely by gender beliefs. By forming purely male and female groups in the experiments, and by revealing the group composition to the participants, we have shown that there seems indeed to be an influence of gender beliefs on strategic behavior in the public goods game. Female subjects react more cooperatively than men in our experiments, and this impact is particularly relevant in groups composed of risk-averse female subjects. We have hypothesized this impact of announcing the group gender composition, by supposing that informing females on homogenous female groups amounts to removing the uncertainty with respect to the unconditional prosocial preferences of the co-players. This decreased risk, due to the information on gender composition, is then reflected in a higher level of cooperativeness of female rather than male subjects - when accounting for their risk preferences.

Our explanation of these gender differences that we found in our public goods experiment is based on the literature in sociology, gender studies, and social psychology on gender beliefs. The differences in gender beliefs about men and women can be summarized around achievement-oriented traits for men – agentic traits – and service-oriented traits for women – communal traits (idem). This leads to the prescriptive gender belief about women "that women should be nurturing and service-oriented (communal), but not tough and achievement-oriented (agentic)" (idem, p. 667). Both descriptive and prescriptive dimensions of gender beliefs contribute to individual self-definitions as masculine or feminine, and operate at the interpersonal level. "In the broader social psychological context, gender beliefs contribute to individuals' definitions of their self-schemas, social identities, and self-evaluations. Gender beliefs also operate in the interpersonal domain, defining the behaviours that are appropriate to various social contexts, influencing individuals' expectations for and interpretations of others' behavior, and guiding the manner in which people interact with members of their own and the other gender" (Whitley and Ægisdóttir, 2000: 962).

The empirical literature on gender beliefs has widely demonstrated that both

men and women hold gender beliefs. In particular, they both believe that men are more agentic and should behave more agentic than women, and that women are more communal and should behave more communal than men (Heilman, 2001). This is also confirmed for specific roles and behaviours, such as leadership: both men and women characterize leadership in general as masculine, whereas when they are asked to characterize particular elements of leadership, they both tend to identify structure as a masculine trait of leadership and consideration as a feminine trait of leadership (Johanson, 2008). Most empirical studies find that men hold stronger gender beliefs than women, and that beliefs about masculinity tend to be stronger than those about femininity (Baber and Jenkins Tucker, 2006; Smiler and Gelman, 2008). However, studies on specific contexts do not always confirm this general result, for example in the case of leadership: men and women tend to hold equally strong gender beliefs about leadership (Johanson, 2008). The general finding that men hold stronger gender beliefs and that the gender beliefs about masculinity tend to be stronger than those on femininity suggest that masculinity is more narrowly defined than femininity ad that men tend to be more essentializing than women (Smiler and Gelman, 2008). This gender difference in gender beliefs has been explained by social dominance theory and expectation states theory, which argue that because men tend to have on average a higher socio-economic status than women and they want to preserve that advantaged position, it is in their interest to hold on more strongly to traditional stereotypes about gender roles and traits compared to women (Whitley and Ægisdóttir, 2000; Ridgeway, 2001; Gerber, 2009). Cecilia Ridgeway has pointed out how status beliefs interact with gender beliefs so that even when individuals do not endorse dominant status beliefs, their recognition that these beliefs are widely shared will lead them to assume that others will treat them according to those beliefs, which will in turn affect their own behavior in a stereotype way.

Gender beliefs are rather essentialist of character, in the sense that they change only very slowly and are often reproduced in new contexts, for example becoming attached to newly emerging jobs in the labour market. This resilience

of gender beliefs may signal an evolutionary origin. The dominant evolutionary explanation is through sex selection theory, which holds that men are by nature more competitive because, having many sperm, they want to maximize their number of offspring, whereas women, having only a few eggs, are more cooperative so they seek to maximize the quality of their offspring. This would explain why males exhibit more dominance behavior than females, both among animals and among humans, according to Browne (1998), and they compete with each other for access to females. Recently, however, sex selection theory has received serious criticisms, within biology, psychology and the social sciences. For example, Adovasio, Soffer and Page (2007) have shown in an historical anthropological study that the idea of men as the proactive providers and women as the passive reproductive machinery of society is not confirmed by recent evidence on women's roles in prehistorical times. Artifacts such as baskets, sculptures, and tools as well as features of agriculture suggest that women were just as active, innovative and productive as men in prehistory and they argue that there is no evidence that men and women behaved in consistently different ways when it comes to cooperation. An internal critique, from biology, comes from Joan Roughgarden (2004) who shows internal inconsistencies in Darwin's sexual selection theory and the adaptation of this theory in evolutionary psychology. She proposes instead social selection theory based on the need for both males and females to cooperate in order to ensure that offspring will be raised. In a recent article, Roughgarden, Oishi, and Akçay (2006) present social selection theory through a cooperative bargaining game framework, showing that animals cooperate to rear (and not only produce) the largest number of offspring possible, because offspring are investments held in common between males and females. A third critique on a sexual selection explanation of gender beliefs is provided by Shelly Taylor (2001) who, like Roughgarden, argues that sex differences originate from the need for cooperation, while recognizing that among primates this seems to be a stronger characteristic among females than males. She explains this difference, however, not through biology but through socialization of women into closer friendships and networks around

food provisioning, childcare and defence against roaming young males, and the socialization of men into hierarchical groups which function best for tasks such as defence, attack and hunting. Therefore, Taylor argues, women tend to prefer to befriend other women and female friends have closer ties than male friends. Men's groups therefore are more often threatened by power plays around dominance and control, Taylor argues, and one of the consequences of these power plays is the exclusion of young aggressive males from groups, who then start roaming around. This explanation of the origins of gender beliefs around agentic and communal traits leads us to a social constructivist perspective, which holds that gender beliefs are produced in social and historical contexts rather than inherent to individuals' sex. The social constructivist perspective includes various gender theories, of which the gender role theory and social domination theory are the best known.

Our experiment does not allow us to distinguish between nature and nurture as explanations for gender beliefs. But the literature and our findings suggest that social context rather than biology seems to be a more convincing explanation. As indicated by Ridgeway (2001), the interaction between status beliefs and gender beliefs through expectation status theory is especially likely in cooperative, goals-oriented contexts in which group status beliefs become salient. Moreover, she states, "... the theory argues that gender status beliefs become effectively salient (i.e., sufficiently salient to measurably affect task behavior and evaluation) when gender either distinguishes between actors in a situation ... or is linked by cultural beliefs to the task or goals they face" (Ridgeway, 2001: 643). A public goods game centres around cooperation, a typical feminine trait according to commonly held gender beliefs, as we have reviewed above. Hence, the task in our experiment was not gender-neutral but positively linked to a feminine gender belief, which allowed for the expression of behavior in relation to the intrapersonal level of gender beliefs: one's own behavior independently of others. The other social context provided in our experiment was information about the sex of one's partners, which allowed for the expression of behavior in relation to the interpersonal level of gender beliefs: one's behavior in relation

to one's expectation of the behavior of others. So, in our experiment we had a cooperative context (task), which is in line with a feminine gender belief, and a gender context provided as treatment variable (information that the other players are female or male). This experimental setting allows us to explain the results in terms of interpersonal gender beliefs and intrapersonal gender beliefs. First, we find that the female subjects in our experiment behaved more cooperatively than men, when corrected for differences in risk aversion. This is explained by interpersonal gender beliefs: female players believe that they are more cooperative than men, and hence they act more cooperatively than male players who believe that they are less cooperative than women. Second, we find that women who are given the information that the other players are also female cooperate more than women and men who do not receive information about the sex of their partners. This, then, is explained by interpersonal gender beliefs: female players will cooperate more when they are given the information that their partners are also female, because they are socialised into cooperation with other women. At the same time, we found that male players do not cooperate so much more when being informed that their partners are male. This can be explained on the one hand through socialisation: men have less personal experience with men's cooperativeness compared to women with women's cooperativeness. On the other hand we can explain this by referring to the interaction of gender beliefs and status beliefs, which lead men to reassert their higher status by not adopting stereotype feminine behaviour in interactions with other men, but to reassert their masculinity through continuing with more competitive behaviour rather than cooperative behaviour.

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