

CESifo Venice Summer Institute

19 - 24 July 2010



“BEHAVIOURAL WELFARE ECONOMICS”

to be held on **21 - 22 July 2010**
on the island of San Servolo in the Bay of Venice, Italy

Competition for Trophies Triggers Male Generosity

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Altruistic cooperation is indispensable in human societies, and much progress has been made towards developing institutions to promote pro-social decisions. Economists have focused on punishment and rewards, but often find that incentives can crowd out intrinsic motives for cooperation and detrimentally impact efficiency^{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}. At the same time, evolutionary biologists have long recognized that cooperation, especially food sharing, is typically efficiently organized in groups living on wild foods even absent formal economic incentives^{13, 14, 15, 16, 17, 18}. Despite its evident importance, the source of this voluntary compliance remains controversial. Drawing on evolutionary psychology, we hypothesize that such cooperation relies on male preferences for unique and displayable rewards (trophies) out of competition. Here we show with a controlled lab experiment that cooperation flourishes in a generosity competition with trophy rewards while cooperation breaks down in the same environment with equally valuable but non-unique and non-displayable rewards. Further, we find that males' competition for trophy rewards is the driving force behind such differences. In contrast, we find no evidence that female competitiveness is modulated by trophies. Our results suggest new paths for promoting cooperation in human groups without sacrificing efficiency. They could have important impact in any domains where voluntary compliance matters --- including relations between spouses, employers and employees⁹⁻¹¹, market transactions and conformity to legal standards^{8, 12}.

How to promote the behavior of altruists and depress that of egoists is vital for cooperation^{19, 20}. The axiom of self-interested behavior suggests that the only remedy for the norm compliance problem is to provide sufficient incentives^{2, 7}. Unfortunately, the remedies, especially small pecuniary incentives, enforce compliance by sacrificing intrinsic altruistic motives as well as reduced economic efficiency¹⁻¹².

Alternative solutions to the norm-compliance problem seem to exist. For example, evolutionary biologists have long tried to explain why human males provided food for a group even absent direct food reciprocity¹³⁻¹⁸. They argue that food contributions

became a status-bearing display for those who won hunting competitions^{17, 18}. In particular, winners were awarded status from food recipients, so that emerged as a currency of reciprocity^{8-11, 21}. An implication is that males may have an evolved preference for unique displays out of competition. If so, unique and displayable rewards (trophies, with their evolutionary connection to status), may modulate male generosity in contemporary competitive social environments.

We examined whether and how a competition for unique trophy rewards affects male generosity in ‘public goods’ game with real money stakes. A total of 152 subjects (30.8% female) participated in our experiment under three conditions: the *Mug* treatment (unique mug rewards with an ICES logo); the *Ice-cream* treatment (Haagen-Dazs ice-cream bar rewards) and the *Baseline* (absent competition for rewards).

Clearly, systematic differences in the way males and females value mug and ice-cream rewards, can confound inferences regarding the source of behaviour in our treatments. To address this issue we conducted a standard WTP elicitation²² (see Methods), and we were unable to find evidence of systematic differences in subjective values either between males and females or between mug and ice-cream (Fig. 1; unless otherwise noted, all p-values reported in this paper refer to two-tailed Mann-Whitney test).

In light of our goal of informing the role of displayed rewards, our *Ice-cream* treatment constitutes a powerful control for the effects of trophies on male behavior. In particular, the *Ice-cream* is identical to *Mug* except that the Ice-cream reward is neither unique nor displayable. The comparison between *Mug* and *Baseline* or *Ice-cream* provides rigorous evidence on how competition for displayable rewards affects cooperation. Moreover, because subjects know the rewards will be distributed privately, our design enables an investigation of how rewards modulate subjects’ intrinsic desire^{23,24} to compete (see Methods Summary).

All interactions in the experiment took place anonymously. In all conditions, fixed groups of four subjects played following game they knew would last ten periods. Each

member received an endowment of 20 E\$ and decided how much to invest into a group project. The E\$s not contributed to the project were transferred to the subject's private account. For every 1E\$ invested in the project, all group members, including those who invested little or nothing, earned 0.4 E\$. Thus, ignoring any value subjects placed on competitive rewards (see SI Note 1 for details), it was always in one's material self-interest to invest 0 E\$ regardless of how much the other three members invested. Yet, if every group member chose to keep his or her endowment privately, then there is nothing to be shared, whereas if all invest their 20 E\$ then every member earns a return of $0.4 \times 80 = 32$ E\$.

Subjects made their investment decisions simultaneously and once they finished they were shown how many E\$s each member of their group had invested. Next, subjects were also able to register approval ratings for their group members' decisions. All approval decisions were made simultaneously and subjects were not allowed to assign points to themselves. At the end of each period in *Mug* and *Ice-cream* treatments, subjects who were assigned the most approval points (tying allowed) by their groups won an electronic gold star only displayed to the winners. As tying is allowed, each subject can receive up to ten stars over ten periods, with each star increasing by 10 percentage points the chance of receiving the final reward (see Methods Summary).

Despite similarities in determinants of approval points received across treatments (see SI, Table 1), we find that overall cooperation is significantly higher in *Mug* than in either *Ice-cream* or *Baseline* treatments (Fig. 2a). Moreover, the frequency of full contributions in groups is highest when mugs are the rewards for competition (Fig. 2b) From period 6 to 10, 48.2% subjects in *Mug* contributed their whole endowment, while only 29.2% did so in *Baseline* and 18.8% in *Ice-cream*.

Higher cooperation in *Mug* is associated with increased male competitiveness in relation to *Ice-cream*. We find significantly more males in *Mug* (N=40) won at least one star over ten periods than did males in *Ice-cream* (N=27, $z=2.116$, $P = 0.034$); while females display no difference between *Mug* (N=16) and *Ice-cream* (N=21) ($z=-0.813$, $P=0.16$).

Also, males are significantly more competitive than females only in *Mug*. More males (95%) than females (75%) won at least one star (Fig. 3a, $z=2.166$, $P = 0.030$) in *Mug*. Also, more males (55%) than females (25%) won at least five stars ($z=-2.015$, $P=0.044$). In contrast, we find no evidence of differences between males ($N=27$) and females ($N=21$) in *Ice-cream* either for those who have won at least one star ($z=0.692$, $P=0.489$), or those who won five stars or more ($z=0.000$, $P=1.000$, see Fig. 3b).

Convergent evidence supporting these gender differences and male competitive generosity in *Mug* is provided by a random (individual) effect GLS regression analysis (with robust standard errors clustered by group, see SI, Table 2). We examined how contributions of subject i in the current period varied with i 's gender, previous period's approval points received and average contribution of one's group members, as well as period dummies. The regression coefficient of male in *Mug* is 5.657 ($z=2.76$, $P=0.006$), significantly higher than the coefficient of female in *Mug* 1.369 ($\chi^2(1) = 4.41$, $P=0.036$), male in *Baseline* 0.943 ($\chi^2(1) = 3.78$, $P=0.052$) and male in *Ice-cream* 1.175 ($\chi^2(1) = 2.95$, $P=0.086$). This indicates that, after controlling for other factors, males in *Mug* voluntarily contribute significantly more than males or females in any other treatment. A random effect Tobit analysis yields similar results (see SI, Table 2).

What mechanisms might be involved in generating the effect of trophies on male generosity? One possibility could be that trophies modulate male beliefs regarding altruistic acts¹⁹. That is, males might have expected other males to contribute more in order to compete for the mug reward. This possibility is supported by higher first-period contributions in *Mug* than *Ice-cream* by males but not females. We find males' first period contributions in *Mug* ($N=40$) are significantly higher than in *Ice-cream* ($N=27$, $z=3.696$, $P=0.000$) while females' first period contributions in *Mug* ($N=16$) do not significantly differ from *Ice-cream* ($N=21$, $z=1.376$, $P=0.169$).

However, contribution momentum in *Mug* may not be sustainable over periods in the presence of free-riders, in light of substantial theoretical and empirical evidence that free-riding is contagious^{19,20, 25,26,27,28}. To examine this, we classify each subject as

either a co-operator or free-rider based on their conditional cooperation (see SI, Note 2). We find the frequency of male co-operators in *Mug* (72.5%) is significantly higher than in *Ice-cream* (44.4%, $z=2.294$, $P=0.022$, Table 1a); while the frequency of male co-operators in *Mug* is similar to *Baseline* (75%, $P=0.812$, $z=0.239$), yet their contributions (mean=16.3, N=12 groups) are significantly higher (mean=13.3, N=11 groups, $P=0.021$, $z=-2.309$). This evidence suggest unique and displayable rewards promotes cooperation.

Frequencies of female co-operators are statistically identical between treatments (see Table 1a). Moreover, female co-operators' contributions do not statistically differ between *Mug* (mean=15.5, N=7 groups) and *Baseline* (Table 1b, mean=14.7, N=8 groups, $z=0.926$, $P=0.354$). Female co-operators' contributions are significantly higher in *Mug* than *Ice-cream* (mean=11.7, N=9 groups, $z=1.747$, $P=0.081$), but this difference seems driven by males' unconditional generosity in *Mug* combined with female conditional cooperation (see SI, Table 2). Moreover, not only does competition promote co-operators' contributions, free-riders' contributions also increase as a result of competition (Table 1c).

Our results leave open the question of why contagious free-riding is mitigated in the *Mug* condition. One possibility is that receiving approval, or status, diminishes co-operators' negative emotions^{29,30}. In particular, free-riders can reciprocate by assigning approval points to co-operators, increasing the chance that a co-operator receives the trophy reward. In light of the evolutionary arguments above, we would expect to observe more approval assigned in *Mug* than *Ice-cream* or *Baseline*, and would also expect female free-riders to be especially generous with approval.

Indeed, we find female free-riders in *Mug* (N=4 groups, see SI Note 3) assign significantly more approval points than either male free-riders in *Ice-cream* (N=4, $z=2.021$, $P=0.043$) or female free-riders in *Ice-cream* (N=10 groups, $P=0.048$, $z=1.980$). Trophy does not, however, modulate co-operators' approval behaviour. Approval points assigned by female co-operators in *Mug* (N=7) differ neither from female co-operators in *Ice-cream* (N=9, $z=0.053$, $P=0.958$), nor male co-operators in *Ice-cream* (N=10, $z=0.781$, $P=0.435$), nor male co-operators in *Mug* (N=12, $z=0.423$, $p=0.673$). A random

effect GLS regression analysis provides additional evidence that only the approval behaviour of female free-riders is modulated by trophy rewards (SI, Table 3).

Our results support the view that males hold preferences for displayable rewards, and that these preferences can promote cooperation in a social dilemma environment through a generosity competition. We examined behaviour under both Ice-cream and Mug (trophy) rewards, and found only trophy rewards to promote cooperation. Our *Ice-cream* treatment constitutes a powerful control for the effects of mug rewards on males' behavior in that it is identical to Mug, except that the Ice-cream reward is neither unique nor displayable. Further, our willingness-to-pay comparison between *Ice-cream* and *Mug* rules out explanations for our results that appeal to differences in subjective values; the comparison also rules out competition per se³¹ as an explanation for differences. We speculated that the proximate mechanism generating cooperation under trophy rewards could be built on the combination of two forces: changes in expectations due to the presence of *Mug* and the use of approval by free-riders as a currency of reciprocity, perhaps especially among females. Our results suggest new paths for designing institutions to promote cooperation in groups of genetic strangers; mechanisms that turn on reward rather than sanctions.

Methods Summary

A total of 182 students from George Mason University participated in our experiments. 152 subjects (34.9% female) in the 'public goods' experiments and another 30 subjects (43.3% female) who had not participated the 'public goods' experiment took part in the hand-run Willingness-to-pay elicitation²⁴ (see methods).

A total of thirteen sessions each with 8-12 subjects took place for three different conditions in 'public goods' experiment. Each subject only participated in one session for one condition. The experiments lasted 45-50 min and on average subjects earned \$16.00 per session.

In each period, the subjects knew nothing about the history of contributions of specific group members, thus ruling out reputation formation. At the end of each period subjects were informed of the accumulated gold stars they won, total approval they received, the

highest contribution among gold star winners in their group (if tied), their own contribution, and their current and accumulated monetary pay-off.

Those who earned stars in *Mug* or *Ice-cream* treatments had the opportunity to draw once from a deck of ten cards, numbered 1 through 10. Subjects would receive the reward if the number they drew were equal to or smaller than the number of stars they earned during the experiment. The experimenter distributed the reward along with the cash payment to each subject privately.

Upon entering the laboratory each subject was seated in a carrel separated from other subjects in a way that ensured anonymity. Participants then received written instructions. After the experimenter read aloud the instructions, participants were quizzed to ensure they understood the procedures and the payoff structure. The experiment did not proceed until each subject completed the quiz successfully. The public goods game was written using the experimental software Z-tree³².

Methods:

Willingness-to-Pay (WTP) Elicitation: We recruited 30 students (43.3% female) who had not participated in the ‘public goods’ experiment to take part in the WTP elicitation. This experiment adopted the Becker-DeGroot-Marschak (1964) random auction mechanism to elicit WTP for the ICES mug and the Haagen-Dazs ice-cream bar. Subjects were endowed with \$10 and prices ranged from \$0 to \$10 in increments of \$0.50. The maximum value \$10 exceeds maximum expected WTP and the minimum \$0 is at least equal to their WTP. Subjects in the WTP experiment were provided with the same information about the auctioned items as subjects in the respective rewards treatments of the “public goods” game.

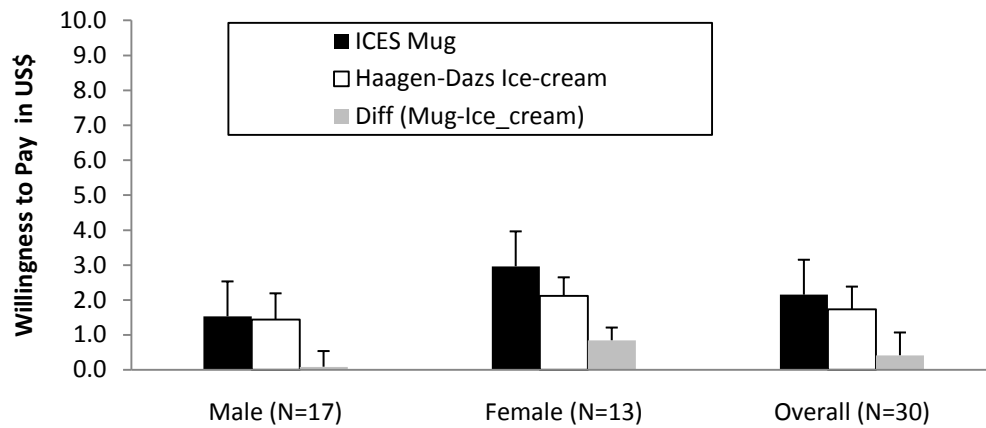
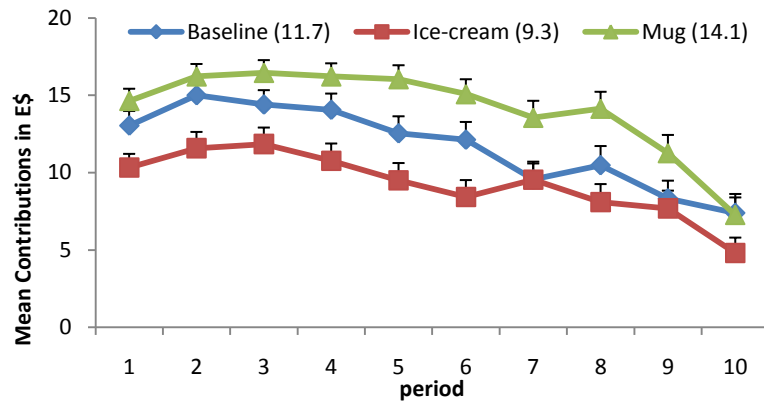


Figure 1: Willingness-to-pay (WTP) for ICES Mug and Haagen-Dazs Ice-cream. The Fig. describes males' and females' WTP for the ICES Mug (filled black bars), the Haagen-Dazs Ice-cream (open bars) and differences between them (filled grey bars). WTPs are statistically identical between males and females for both the ICES mug ($z=1.593$, $P=0.111$) as well as the Haagen-Dazs Ice-cream bar ($z=1.418$, $P=0.156$). WTP are statistically identical within the same gender for both the Mug (Wilcoxon signed-rank test: for male, $z=0.049$, $P=0.961$; for female, $z=0.956$, $P=0.339$, two-tailed). The differences in WTP for Mug and Ice-cream for the two items are also statistically identical between males and females ($z=0.727$, $P=0.467$).

a.



b.

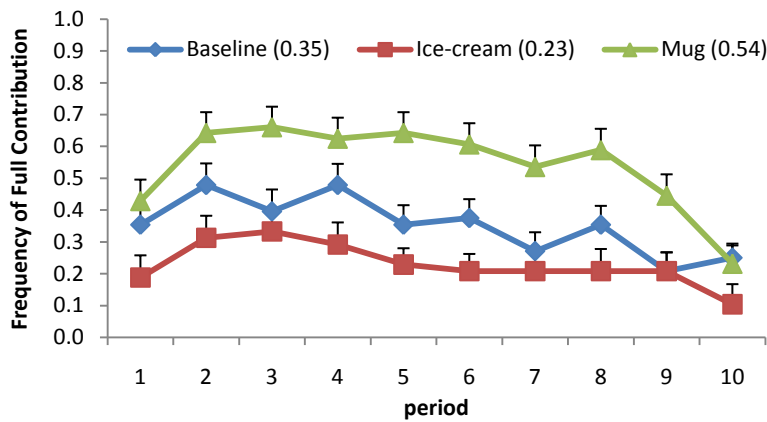
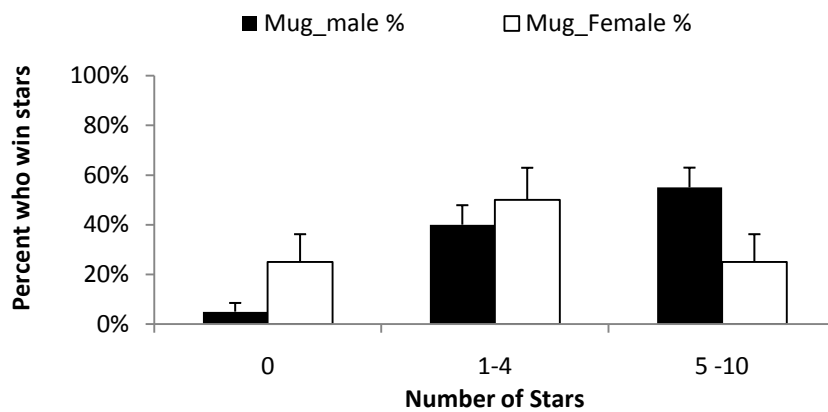


Figure 2. Contributions to the public goods over 10 periods across treatments. Cooperation is highest in *Mug* both by **a**, average contribution or **b**, frequency of the full contribution. **a**. The numbers in parentheses indicate mean contribution (over 10 periods) for that treatment. Contributions are significantly higher in *Mug* (N=14 groups), compared to both *Ice-cream* (N=12 groups, $z=2.675$, $P=0.008$) and *Baseline* (N=12 groups, $z=-1.800$, $P=0.072$). **b**. The numbers in parentheses indicate mean frequency (over 10 periods) of full contributions in that treatment. In *Mug* treatment, most subjects contribute their full endowment (54%), significantly more than both *Baseline* (35%, N=12 groups, $z=-1.987$, $P=0.047$) and *Ice-cream* (23%, $z=2.734$, $P=0.006$).

a.



b.

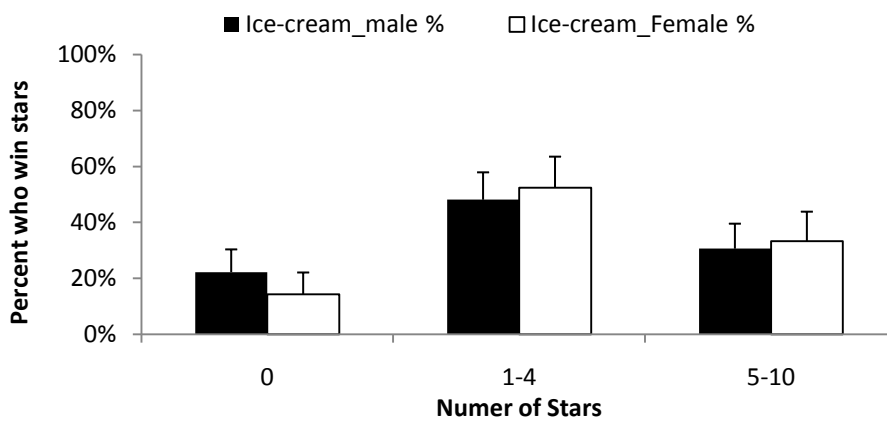


Figure 3: Number of stars won in *Mug* and *Ice-cream* treatments. Each panel describes percent of males and females who won different numbers of stars (tying allowed) in *Mug* or *Ice-cream*. a. Percent of males (filled bars, N=40) and females (open bars, N=16) winning 0, 1-4 or 5-10 stars in *Mug*. Significantly more males than females won at least one star, or at least five stars over 10 periods. b. Percent of males (filled bars, N=27) and females (open bars, N=21) winning 0, 1-4 or 5-10 stars in *Ice-cream*.

Table 1a. Percent of Cooperators

Pairwise Comparison between Male				Pairwise Comparison between Female			
Mug	Baseline	Ice-cream	P-Value	Mug	Baseline	Ice-cream	P-Value
73%	71%	-----	0.812	75%	63%	-----	0.453
73%	-----	44%	0.022**	75%	-----	71%	0.811
-----	71%	44%	0.017**	-----	63%	71%	0.571

Level of significance for Table 1a-1c: *p<0.1, **p<0.05, ***p<0.01

Table 1b Mean Contribution of Cooperators

Pairwise Comparison between Male				Pairwise Comparison between Female			
Mug	Baseline	Ice-cream	P-Value	Mug	Baseline	Ice-cream	P-Value
16.3	13.3	-----	0.021**	15.5	13.7	-----	0.355
16.3	-----	12.8	0.147	15.5	-----	11.7	0.081*
-----	13.3	12.8	0.725	-----	13.7	11.7	0.387

Contribution level controlled at group level (see SI, Note 3)

Table 1c Mean Contribution of Free-riders

Pairwise comparison between male				Pairwise comparison between female			
Mug	Baseline	Ice-cream	P-Value	Mug	Baseline	Ice-cream	P-Value
8.7	7.7	-----	0.427	7.7	6.6	-----	0.564
8.7	-----	4.4	0.050*	7.7	-----	5.2	0.083*
-----	7.7	4.4	0.040**	-----	6.6	5.2	0.564

Contribution level controlled at group level (see SI, Note 3)

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Note 1: Nash Equilibrium Contribution for Subjects Placing Value on Rewards

If subjects place sufficient pecuniary value on the rewards, then it is easy to see that positive contributions could be consistent with Nash Equilibrium in reward treatments. Any such pecuniary effects would be identical between reward treatments and so cannot explain between treatment differences.

Table 1: Determinants of Approval Received	
Random Effect GLS	
Ice-cream	-2.613* (1.427)
Mug	-2.753 (1.706)
Ice-cream x Others Avg. Contribution	1.021*** (.120)
Mug x Others Avg. Contribution	0.821*** (.139)
Baseline x Others Avg. Contribution	0.882*** (.093)
Baseline x Positive Deviation from others' average	0.999*** (.095)
Mug x Positive Deviation from others' average	0.726*** (.168)
Ice-cream x Positive Deviation from others average	1.041 (.119)
Baseline x Negative Deviation from others' average	-1.287*** (.090)
Mug x Negative Deviation from others' average	-1.053*** (.109)
Ice-cream x Negative Deviation from others' average	-1.312*** (.107)
Constant	5.174*** (1.141)
Period Dummies	Yes
# of Obs.	1520

Note : Dependent variable: Approval Points i received in period t
 Random Effect GLS regression, robust standard error clustered by group
Level of significance : * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note for Table 1(SI) :

Table 1 shows that determinants of approval points received follow a similar pattern across the treatments. In particular, the greater (smaller) the contribution in relation to others, the greater (smaller) was the amount of approval a person received, and the strength of this effect is identical among treatments. This is shown by the coefficient for

“Treatment variable (Baseline/Mug/Ice-cream) x Positive/Negative Deviation from Others’ average”. Moreover, in all treatments, the groups’ highest contributor is a star winner with frequency 90% or greater.

Table 2: Dynamic Contribution

	Random Effect GLS	Random Effect Tobit
Mug_male	5.657*** (2.049)	14.479*** (5.376)
Mug_Female	1.369 (2.215)	6.931 (6.301)
Ice-cream_Male	1.175 (2.157)	6.245 (4.977)
Ice-cream_Female	0.778 (1.659)	7.420 (5.065)
Baseline_Male	.943 (1.261)	3.208 (4.105)
Approval Points Received	.201*** (.030)	.286*** (.050)
Male in Mug x Others Avg. Contribution	.324*** (.088)	.819*** (.200)
Female in Mug x Others Avg. Contribution	.635*** (.111)	1.277*** (.288)
Male in Ice-cream x Others Avg. Contribution	.339*** (.113)	.492*** (.224)
Female in Ice-cream x Others Avg. Contribution	.490*** (.085)	0.793*** (.239)
Male in Baseline x Others Avg. Contribution	.502*** (.092)	.991*** (.174)
Female in Baseline x Others Avg. Contribution	.580*** (.061)	1.284*** (.225)
Constant	4.203*** (1.235)	-1.340 (3.859)
Period Dummies	Yes	Yes
# of Obs.	1368	1368

Note : Dependent variable: Contribution of i in period t , independent variable in period $t-1$.

Random-effects GLS regression, robust standard error clustered by group

Level of significance : * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note for Table 2 (SI): Female Conditional Cooperation and Male Unconditional Generosity. First period contributions are identical among co-operators’ between *Mug* ($n=12$) and *Ice-cream* ($N=15$, $z=1.001$, $P=0.317$), while significant different initial differences emerge between female co-operators’ (mean=14.0, $N=12$) and male co-operators’ in *Mug* in the first period (mean=17.4, $N=29$, $z=-2.356$, $P=0.019$). Over time,

female co-operators' (N=7 groups) contributions increase so that overall average contributions do not differ between male (N=12 groups) and female co-operators (N=7 groups) in *Mug* ($z=-0.466$, $P=0.641$). Table 2 provides evidence support female conditional cooperation. We see coefficient for female conditional cooperation in *Mug* is 0.635 ($z=5.72$, $P=0.000$), which is significantly higher than 0.324, the coefficient for male in *Mug* ($\chi^2(1) = 6.94$, $P=0.008$).

Table 3: Allocation of Approval Points

Random Effect GLS	(1)	(2)
Cooperator_Mug	6.505** (2.905)	4.584* (2.359)
Cooperator_Ice-cream	5.684** (2.471)	4.229* (2.533)
Free-rider_Mug	4.908* (2.731)	
Free-rider_Mug_Male		1.897 (2.479)
Free-rider_Mug_Female		7.347*** (2.592)
Free-rider_Ice-cream_Male		-1.527 (1.614)
Pos. Dev. from Others' Avg. Contri in Mug	-0.690*** (.225)	-0.451*** (.126)
Pos. Dev. from Others' Avg. Contri in Ice-cream	-0.598* (.311)	-0.494*** (.163)
Neg. Dev. from Others' Avg. Contri in Mug	-0.008 (.225)	0.032 (.180)
Neg. Dev. from Others' Avg. Contri in Ice-cream	0.282 (.191)	0.269 (.139)
Constant	7.796*** (1.055)	15.613*** (1.235)
Period Dummies	Yes	Yes
# of Obs.	1040	1040

Note : Dependent Variable: Approval points assigned by person i in period t
Random GLS regression with robust standard error clustered by group.

Note 2: Classify Cooperator and Free-rider

Subjects are classified as either a Free-Rider or Cooperator. One is a cooperator if the majority of his nine (from period 2 to period 10) classifiable decisions are cooperative, or otherwise a Free-Rider. We define a decision as cooperative if the contribution for the current period is at least as great as the mean (rounded down to the nearest integer) of the other group members' previous period's contribution.

Note 3: Controlling for the group effect

To control for the group effect, we only take unique observation of each type in a group.

For the Approval Points: We first use mean approval points assigned by each individual over ten periods as an observation. Instead of using it as a unit observation, we calculate the average of the approval points assigned of that type in that group and take it as an observation. For example, suppose a group has two female free-riders and two male cooperators, rather than having four observations, we only have two observations, with one observation for each type that equals to the average approval points assigned by that type.