

Decentralized mechanisms for  
the provision of public goods:  
An experimental study on the effects of  
communication in nine-person groups

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# Motivation

Previous experimental research:

- ▶ On average, subjects contribute positive amounts to the public good.
- ▶ Yet, average contributions are lower than the efficient level.

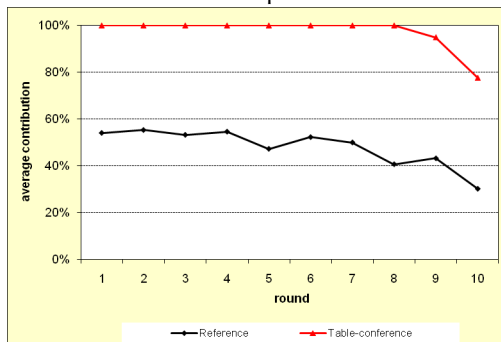
Do mechanisms exist that help to provide public goods in an efficient way?

- ▶ In a meta-study involving over 100 experiments on dilemma games Sally (1995, p. 78) concluded:  
'A few of the factors that should not affect a participant guided by self-interest are, in fact, quite important. Of greatest consequence are the communication variables.'

# Motivation

“We see that communication increases contributions in no-threshold environments with small groups. We do not know why. We also do not know what would happen in large groups.” Ledyard (1995, p. 158)

Observation: Pre-play face-to-face communication leads to stable nearly efficient contributions in four-person PG Games



Brosig, Ockenfels, Weimann 2003

# Research agenda

- ▶ Can we replicate the contribution-enhancing effect of communication in larger groups?
- ▶ Does communication within subgroups of a large group have a contribution-enhancing effect?
- ▶ Can we identify elements of the communication content that have a (positive/negative) impact on contributions?
- ▶ If so, do these factors have a long-term effect?

# Experimental Design

Nine-person ten-rounds linear public good game

$$\pi_i(c) = 60 - c_i + \frac{1}{3} \sum_{j=1}^9 c_j$$

At the end of each round subjects were informed about

- ▶ their individual contribution in that round,
- ▶ their individual round payoff, and
- ▶ the sum of contributions made by all nine group members

# Experimental Design - Treatments & Procedure

Treatment	Pre-play communication	Information on the sum of contributions by own subgroup	number of subjects	number of independent observations
NoCom	no	—	54	6
ComAll	within group	—	54	6
ComPart	within subgroup	no	54	6
ComPartInfo	within subgroup	yes	54	6

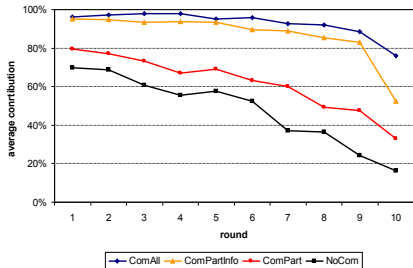
## Communication treatments:

- ▶ All 9 (subgroups of 3) subjects were led into (separate) rooms where they could talk face-to-face with each other for a maximum of 15 minutes.
- ▶ The content of discussions was not restricted up to personal information.
- ▶ For content analyzing the arguments, all discussions were videotaped.
- ▶ After pre-play communication, subjects went back to their cabins with experimenters taking care that they did not communicate any more.

# Experimental Procedure & Sample

- ▶ Computerized experiments (Fischbacher 2007)
- ▶ 216 students
- ▶ Laboratory for Experimental Economics in Magdeburg (MaXLab)
- ▶ Students took part in one treatment only and were recruited via ORSEE (Greiner, 2004)
- ▶ Session lasted for about 60 minutes
- ▶ Overall average payoff: €19.69
  - ▶ minimum €12.02, maximum €23.53
  - ▶ including €5.00 show-up fee

# Results – Treatments



- ▶ In 9-person groups (ComAll), face-to-face pre-play communication significantly increases contributions compared to the baseline treatment (NoCom) and leads to nearly full cooperation.

- ▶ Face-to-face pre-play communication within subgroups (ComPart) does not significantly increase contributions compared to NoCom.
- ▶ Giving subjects additional information on the sum of contributions in their subgroup (ComPartInfo) leads to similarly high cooperation as in large groups (ComAll).
- ▶ Contributions in ComAll and ComPartInfo are significantly higher than in ComPart.



# Communication Content



The video-taped discussions in the communication treatments are transcribed word for word into verbal text protocols by graduate students particularly trained and instructed for this task.

- ▶ We apply content analysis to investigate the transcripts.
  - ▶ The communication content is classified into 27 non-exclusive categories designed to capture potentially important elements for contribution decisions by two independent (undergraduate student) raters.
- conditional cooperation, information and communication conditions, payoff calculations, last round effect, agreement within group/subgroup, focus on similarities/differences w.r.t. to other participants, focus on large group/subgroup

# Communication Content – Factor Analysis

- ▶ 27 categories are too many to use in a regression analysis.
- ▶ We reduce the number of categories by conducting a factor analysis and constructing new (latent) variables that reflect the factors found.
- ▶ A “parallel analysis” of the data (Humphreys and Montanelli 1975) indicates that 4 factors are sufficient to describe the data appropriately.

## 1. Dissent and pessimistic view

- ▶ negative reciprocity, calculation full defection payoff, different argumentation of others, (missing) communication of all nine members of the whole group is (not) good ( $\alpha = 0.85$ ),

## 2. Consent and optimistic view

- ▶ agreement necessary, last round effect, calculation of full cooperation and maximum individual payoff, cooperation payoff comparison, similar argumentation of others ( $\alpha = 0.72$ ),

## 3. Coordination (focus on subgroups)

- ▶ contribution infos, conditional cooperation, full coop payoff, guaranty, subgroup communication ( $\alpha = 0.69$ ),

## 4. Conditional cooperation (focus on large groups)

- ▶ sanction, conditional cooperation, contribution info ( $\alpha = 0.57$ ).

# Contributions & Communication Content

- ▶ Preplay communication content variables are statistically significant (joint LR-test,  $p < 0.01$ ).
- ▶ The inclusion of the communication content variables reduces the amount of unexplained variation at the group level substantially.
- ▶ There is no interaction between the content variables and the treatment
- ▶ There are, however, interactions between “Dissent” and “Consent” and between “Consent” and “Conditional Cooperation”
- ▶ Treatments ComAll and ComPartInfo can be pooled (LRT,  $p = 0.13$ )

	coef.est
Intercept	41.97** (4.33)
CC1	6.48 (4.47)
CC2	11.68** (3.24)
CC3	4.20 (3.48)
CC4	-8.91* (3.27)
ComAll/PartInfo	14.39* (5.37)
Period	-2.52** (0.20)
Period <sup>2</sup>	-0.12* (0.05)
Last Period	-8.37* (3.28)
CC1:CC2	-20.70* (9.50)
CC2:CC4	-22.57** (5.89)
Period: ComAll/PartInfo	1.63** (0.23)

# Conditional cooperation and the long-term effect of communication

- ▶ Due to conditional cooperation, contributions in period  $t$  could be largely determined by the average contribution in one's group in period  $t-1$ .
- ▶ In the extreme case, contributions in period 1 together with a declining trend over time may explain contributions in later periods regardless of the treatment. Therefore, the effect of communication may be restricted to first-period contributions.
- ▶ We first test whether contributions in period 1 and in periods  $t-1$  can explain at least some of the variance in contributions in periods  $t > 1$ .
- ▶ Second, we test whether the content of pre-play communication has any additional explanatory power after the inclusion of contributions in period 1 and periods  $t-1$ .

# Conditional cooperation & communication

- ▶ Average contributions in the large group in  $t=1$  and average contributions in  $t-1$  are statistically significant (LR-test,  $p < 0.01$ ) in a model without communication content variables.
- ▶ When we include communication content variables, these are highly significant (LR-test,  $p < 0.01$ ).
- ▶ While average contributions in period  $t-1$  stay highly significant, average contributions in period 1 are not statistically significant any more (LR-test,  $p = 0.37$ ).
- ▶ Even after controlling for past average contributions and communication, there are still treatment differences in contributions (LR-test,  $p = 0.02$ ).

	coef.est
Intercept	3.36 (10.32)
Contr. in $t=1$	0.17 (0.23)
Contr. in $t-1$	0.74** (0.07)
CC1	0.98 (3.54)
CC2	7.71** (2.62)
CC3	7.16* (2.97)
CC4	-5.87* (2.56)
Period	-0.53** (0.15)
ComAll	5.98 (4.18)
ComPartInfo	-4.43 (3.48)
Last Period	-9.86** (2.41)
CC1:CC2	-13.48 (7.01)
CC2:CC4	-17.11** (4.91)

# The long-term effect of communication – Last round

- ▶ Contributions depend strongly on average contributions in t-1.
- ▶ Yet, communication content variables directly influence contributions over a longer time horizon. Their direct impact is not restricted to first-period contributions.

	coef.est	coef.est
(Intercept)	-8.68 (6.61)	0.30 (5.66)
Contr. in t-1	1.06** (0.19)	0.89** (0.16)
CC1		6.62 (5.70)
CC2		8.56* (4.27)
CC3		8.12 (4.83)
CC4		-9.71* (4.04)
ComAll	-1.83 (7.91)	2.23 (6.67)
ComPartInfo	-12.53 (6.78)	-15.33* (5.71)
CC1:CC2		-27.87* (11.24)
CC2:CC4		-29.33** (7.98)
R <sup>2</sup>	0.32	0.43

# Conclusion

- ▶ Could we replicate the contribution-enhancing effect of communication in larger groups?
  - yes
- ▶ Does communication within subgroups of a large group have a contribution-enhancing effect?
  - yes: when information on subgroup contribution is given
- ▶ Can we identify elements of the communication content that have a (positive/negative) impact on contributions?
  - yes: 4 variables focussing on dissent and consent, coordination on the subgroup and on conditional cooperation on the large group.
- ▶ Do these content variables have a long-term effect?
  - yes: communication content directly influences contributions over a longer time horizon. The direct impact is not restricted to first-period contributions