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
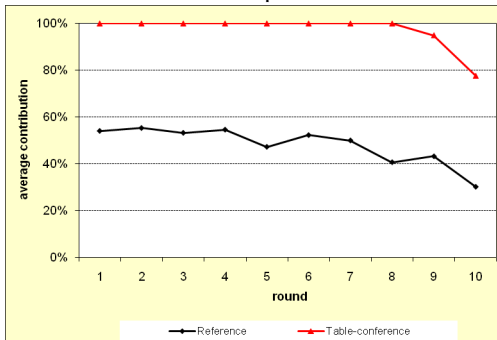
Brosig, Ockenfels, Weimann 2003

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

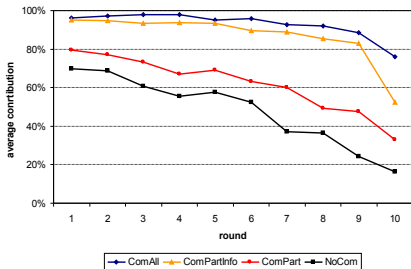| Treatment	Pre-play communication	Information on the sum of contributions by own subgroup	number of subjects	number of independent observations
NoCom	no	—	54	6
ComAll	within group	—	54	6
ComPart	within subgroup	no	54	6
ComPartInfo	within subgroup	yes	54	6

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

average contribution vs round — ComAll, ComPartInfo, ComPart, NoCom

- ▶ 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^2	-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

	coef.est	coef.est
(Intercept)	-8.68	0.30
	(6.61)	(5.66)
Contr. in t-1	1.06**	0.89**
	(0.19)	(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	2.23
	(7.91)	(6.67)
ComPartInfo	-12.53	-15.33*
	(6.78)	(5.71)
CC1:CC2		-27.87*
		(11.24)
CC2:CC4		-29.33**
		(7.98)
R^2	0.32	0.43

- ▶ 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.

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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