Experimental Economics
Slides 10

Susana Peralta

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Based in part on course materials by Sandra Maximiano

ISEG
Lisbon School
of Economics
& Management
Universidade de Lisboa

Real world problems of cooperation

- Teamwork in firms
- Charities and gift-giving
- Environmental protection
- Public goods
  - Paying taxes
  - Fishing
  - Security
- Political collective action
  - Voting
  - Lobbying
  - Revolutions
- Classical literature: Samuelson 1954, Olson 1965, Hardin 1968

Outline

- The voluntary contributions mechanism (VCM)
- Reasons for cooperation
  - Cooperation due to errors
  - Conditional cooperation
  - Learning and strategic cooperation
- Centralized institutions that promote cooperation
  - Taxation
  - Competition
- Decentralized institutions that promote cooperation
  - Communication
  - Social sanctioning (punishment)
  - Punishment vs. rewards

Main questions

- What is a VCM?
  - Group of n members
  - Each member gets an endowment: e_i
  - Each member has two investment possibilities
    - Keep on private account
    - Contribute to public account: c_i
  - Investment in the private account yields β_i
  - Investment in the public account yields α_i
- The profit of each subject is: $\pi_i = \beta_i(e_i - c_i) + \alpha_i \sum c_i$
  - if no one contributes: $\pi_i = \beta_i e_i$
  - if everyone contributes: $\pi_i = \alpha_i \sum e_i$
  - if $\alpha_i < \beta_i$ you maximize π_i by contributing zero
  - α_i/β_i is commonly called the marginal per capita return (from contributing to the public good)
- What is the standard prediction in VCM?
- Why do subjects cooperate?
- How do centralized and decentralized institutions help subjects to coordinate?

The voluntary contribution mechanism

Possible designs

- One-shot or (infinitely) repeated
- Partners or strangers
- Equal or unequal endowments
- Equal or unequal MPCRs
- Simultaneous or sequential decisions
- Feedback on all contributions or average contribution
- α_i, β_i , and e_i are common knowledge or private information

The voluntary contribution mechanism

Standard result

- Initial cooperation of 40-60%
- Cooperation declines with repetition
- Some stylized facts:
  - Positive effect of MPCR
  - Positive effect of partners
  - No effect of group size
  - Negative effect of experience

The voluntary contribution mechanism

Less robust findings

- Negative effect of heterogeneity
- No effect of number of periods
- Women contribute more and econ students less
- Positive effect of framing

Reasons for cooperation

- By mistake
  - Do not understand that $c_i = 0$ is dominant
  - Do understand dominance but make systematic errors
- Social preferences
  - Altruism, warm glow, efficiency-seeking motives
  - Conditional cooperation, reciprocity
- Strategic cooperation
  - Strategies such as Tit-for-Tat can support cooperation among selfish players in infinitely repeated games

Cooperating by Mistake

- Brandts, J., and Schram, A. (2001). Cooperation and noise in public goods experiments: Applying the contribution function approach. *Journal of Public Economics*
- VCM: $n = 4$, $e = 9$, repeated for 10 periods
- 72 subjects, within subjects
- Marginal rate of private investment=1
- On every period the MPCR is randomly drawn from 10 values
- $MPCR \leq 0.1875$: efficient $\rightarrow c_i = 0$, dominant strategy $\rightarrow c_i = 0$
- $0.3125 \leq MPCR \leq 0.9375$: efficient $\rightarrow c_i = 9$, dominant strategy $\rightarrow c_i = 0$
- $MPCR \geq 1.0625$: efficient $\rightarrow c_i = 9$, dominant strategy $\rightarrow c_i = 9$

Can Contributions Be Explained by Errors?

- In standard public goods experiments, the dominant strategy is to contribute nothing.
- This creates a problem for interpreting the results: any decision error necessarily produces a contribution above the equilibrium level.
- Brandts and Schram (2001) address this problem by varying the relative return from private and public investments.
- In each period, participants allocate 9 tokens between a public and a private account under 10 different payoff situations.
- Using a contribution function approach, participants specify their allocation for all 10 situations before one is randomly selected for payment.
- This allows the researchers to observe deviations from dominant strategies in different incentive environments.

Distinguishing Errors from Intentional Cooperation

- The experiment distinguishes three types of situations:
  - Contributing everything is individually optimal and socially efficient (situations 1–2).
  - Contributing nothing is individually optimal, but full contribution is socially efficient (situations 3–8).
  - Contributing nothing is both individually optimal and socially efficient (situations 9–10).
- If deviations mainly reflect errors, we should observe mistakes in different situations, including when cooperation is socially inefficient.
- If contributions are intentional, deviations should be concentrated in situations where cooperation generates collective gains.
- The key test is whether contributions follow a systematic pattern consistent with cooperation, rather than random deviations from optimal choices.

Brandts and Schram

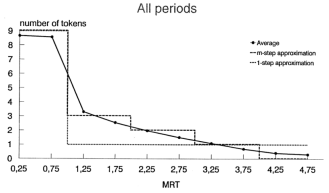


Fig. 1. Aggregate contribution functions and step function approximations.

difference in contributions in situations 1 and 2 appears to be quite small. The data exhibit a rather large jump after situation 2, with a steady decline from there on

Fischbacher, Gächter, and Fehr (2001): Design

- Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. *Economics Letters*
- Research question: Are individuals willing to contribute more to a public good when others contribute more?
- One-shot public goods game with 44 participants in 11 groups of four.
- Each participant receives 20 tokens. The marginal per capita return is 0.4.
- The experiment uses the strategy method:
  - Subjects choose an unconditional contribution.
  - They also specify how much they would contribute for each possible average contribution of others (from 0 to 20 tokens).
- In each group, one randomly selected participant's contribution schedule determines their contribution; the other three use their unconditional decisions.
- The one-shot design rules out reputation-building and repeated-game incentives.

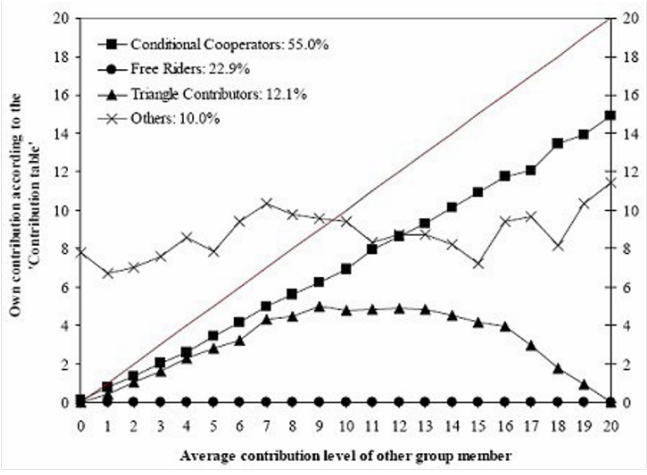
Fischbacher, Gächter, and Fehr (2001): Results

- Figure 1 shows that average contributions increase with the average contribution of other group members.
- Participants display heterogeneous preferences:
  - 50% are conditional cooperators.
  - About 30% are free riders.
  - 14% display hump-shaped contribution schedules.
  - The remaining participants show other patterns.
- Conditional cooperators generally contribute less than others, displaying a self-serving bias.
- Average unconditional contributions are 6.7 out of 20 tokens (33.5% of the endowment).
- Implication for repeated public goods games:
  - Free riders reduce average contributions.
  - Conditional cooperators respond by lowering their own contributions.
  - This can generate a downward spiral of cooperation over time.
- The experiment directly measures conditional cooperation; the explanation of declining contributions over time is a theoretical implication, not a direct test.

Conditional Cooperation

- Little unconditional cooperation
- Heterogeneity in types:
- 55% conditional cooperators
- 23% selfish
- 12% 'hump-shape' contributors
- 10% other

Conditional Cooperation



Strategic Cooperation

- Keser, C., & van Winden, F. (2000). Conditional cooperation and voluntary contributions to public goods. *Scandinavian Journal of Economics*
- Compare partners vs. strangers
- If partners cooperate more $\rightarrow$ supports strategic cooperation?
- VCM: $n = 4$, $e = 10$, repeated for 25 periods, $MPCR = 0.5$
- 160 subjects, between subjects

Keser and van Winden (2000): Experimental Design

- Research question: How does repeated interaction affect cooperation in public goods games?
- Groups of four play a public goods game for 25 periods.
- Each participant allocates 10 tokens between:
  - A private account: 10 cents per token to oneself.
  - A public account: 5 cents per token to each group member.
- Two treatments:
  - Partners: the same four participants remain together.
  - Strangers: groups are randomly reshuffled each period.
- After each period, participants observe total group contributions, but not individual contributions.
- Standard theory predicts zero contributions in every period.

Keser and van Winden (2000): Main Findings

- Partners contribute significantly more than strangers: 4.53 versus 1.90 tokens on average.
- The difference emerges already in the first period.
- Strangers' contributions decline steadily, while partners maintain relatively high contributions until the final periods.
- Conditional cooperation has two components:
  - Future-oriented behavior: participants cooperate more when they expect continued interaction.
  - Reactive behavior: participants adjust their contributions toward others' previous average contribution.
- Approximately 80% of contribution changes follow the predicted direction of reciprocity in both treatments.
- Cooperation depends on expectations about future interactions and responses to others' behavior.

dent subject group, the average contributions to the public good over all 25 repetitions. Applying a two-tailed Mann–Whitney U-test, we can reject the null hypothesis that average contribution levels are the same at the 5 percent significance level. We conclude that the contribution levels of strangers and partners are significantly different.

Figure 1 further suggests that already in the first period, partners start out with a higher contribution level than strangers. Applying a Mann–Whitney

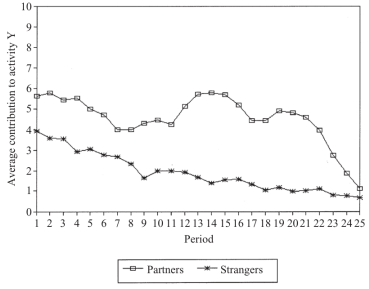


Fig. 1. Time paths of average contributions to the public activity Y (partners/strangers)

© The editors of the *Scandinavian Journal of Economics* 2000.

Explaining the decline in cooperation

- Croson, R. (1996). Partners and strangers revisited. *Economics Letters*
- Why does cooperation decline with time?
- Strategic cooperation
- Learning to play the dominant strategy
- Design: use a surprise restart
- VCM: $n = 4$, $e = 25$, $MPCR = 0.5$
- Repeated $10 + 10$ periods
- 24 subjects
- Results: clear evidence of restart, specially for partners

Croson (1996): Partners and Strangers Revisited

- Replicates Andreoni (1988) to investigate why contributions decline in repeated public goods games.
- Two competing explanations:
  - Learning: participants gradually discover the incentives to free ride.
  - Strategic behavior: participants contribute initially to encourage future cooperation.
- Groups of four; each participant allocates 25 tokens between a private and a public account.
- Two treatments:
  - Partners: group composition remains fixed.
  - Strangers: groups are randomly reshuffled each period.
- Ten rounds followed by an unexpected restart of another ten rounds.

Croson (1996): Main Findings

- Contributions decline over time in both treatments, but increase again when the game restarts.
- The restart effect is statistically significant for partners, contradicting the simple learning hypothesis.
- Partners contribute significantly more than strangers, consistent with incentives to encourage future cooperation.
- The difference between partners and strangers becomes smaller toward the end of each game, as opportunities for strategic cooperation disappear.
- Unlike Andreoni (1988), the results support strategic behavior as an explanation for declining contributions.
- Higher contribution variance among partners may help explain differences across experimental studies.

ten restart rounds. The increase in average contribution at the beginning of the second ten rounds (the restart effect) was observed in Andreoni's experiment as well as this one and is inconsistent with the simple learning hypothesis. In contrast to Andreoni's results, strangers contributed less than partners in this experiment, with the difference between the two

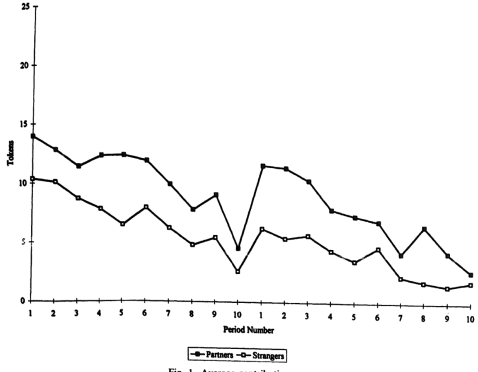


Fig. 1. Average contributions.

Summary so far...

- Positive contributions in VCM experiments
  - Contributions are not due to errors
- Decline in contributions with repetition
  - Some effect of experience but restart effect hints that it is not (only) learning
- Conditional cooperation
  - Majority of subjects behave reciprocally
  - Partly for social preferences
  - Partly for strategic cooperation
- Contributions still positive in stranger treatments
  - Strong reciprocity?
  - Miscalculated strategic cooperation?

Centralized Institutions: Taxation

- Falkinger, J., Fehr, E., Gächter, S., & Winter-Ebmer, R. (2000). A simple mechanism for the efficient provision of public goods: Experimental evidence. *American Economic Review*
- If you contribute more than the average: bonus of $\beta(c_i - C_{-i})$
- If you contribute less than the average: tax of $\beta(c_i - C_{-i})$
- Design
  - VCM: $n = 4$, $e = 20$, 10 periods
  - $MPCR = 0.4$
  - 2 treatments: $\beta = 0$ and $\beta = 0.7$
  - 240 subjects
- Results
  - The mechanism clearly works
  - Robust to different group sizes

Research Question and Design

- Can a simple incentive mechanism overcome free-riding and induce efficient contributions to public goods?
- The authors test a tax-subsidy mechanism:
  - Contributions above the average are rewarded.
  - Contributions below the average are penalized.
  - The mechanism is budget-balanced: total subsidies equal total taxes.
- Two main treatments:
  - Control: standard voluntary contribution game.
  - Mechanism: the same game with the tax-subsidy scheme.
- The experiment varies group size (4, 8, or 16), payoff functions, and preference heterogeneity.
- Subjects play repeated rounds, allowing the authors to study learning and convergence to equilibrium.

Falkinger et al. (2000): Predictions and Results

- In the standard linear public goods game:
  - Control: zero contribution is the Nash equilibrium.
  - Mechanism: full contribution is the Nash equilibrium.
- In the Control treatment, contributions decline over time, consistent with standard free-riding results.
- Under the mechanism, contributions increase and approach the predicted equilibrium:
  - Average contributions reach 93% of the endowment in the last three rounds of M1 (previously inexperienced groups).
  - The median contribution is 100% of the endowment.
- The mechanism works immediately, even before subjects have opportunities to learn.
- Its effectiveness is robust to group size, heterogeneous preferences, and previous experience with free-riding.

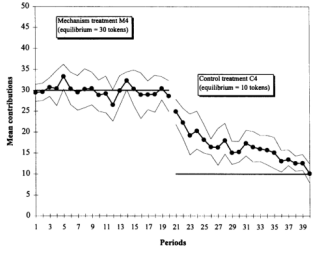


FIGURE 5A. EVOLUTION OF MEAN CONTRIBUTIONS (AND CONFIDENCE BOUNDS) IN GROUPS WITH HOMOGENEOUS PREFERENCES WITH AND WITHOUT THE MECHANISM (GROUPS 1–12 IN M4 AND C4)

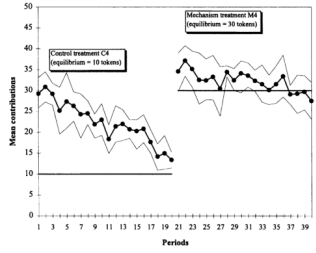


FIGURE 5B. EVOLUTION OF MEAN CONTRIBUTIONS (AND CONFIDENCE BOUNDS) IN GROUPS WITH HOMOGENEOUS PREFERENCES WITHOUT AND WITH THE MECHANISM (GROUPS 13–18 IN C4 AND M4)

the equilibrium we increased the number of periods in both treatment conditions to 20.

this slow convergence in C4, contributions in the Mechanism treatment again are close to the

Decentralized Institutions: Communication

- Bochet, O., Page, T., & Putterman, L. (2006). Communication and punishment in voluntary contribution experiments. *Journal of Economic Behavior & Organization*
- Allow subjects to communicate but not make any binding contracts
- Design: VCM: $n = 4$, $e = 10$, 10 periods, $MPCR = 0.4$, 172 subjects
- Look at 4 treatments:
  - No communication
  - Face to face communication
  - Chat room communication
  - Numeric cheap talk communication
- Face to face communication dramatically increases cooperation
- The effect of communication is eroded as it becomes more restricted

Communication and Punishment: Experimental Design

- Individual earnings before punishment are:

$$\pi_i = 10 - c_i + 0.4 \sum_{j=1}^{4} c_j$$

  Contributing is individually costly but socially beneficial.
- Eight treatments combine four communication conditions with or without punishment:
  - No communication (baseline).
  - Face-to-face communication.
  - Anonymous online chat.
  - Numerical cheap talk (non-binding announcements).
- Punishment allows participants to reduce another player's earnings at a personal cost.

Communication and Punishment: Main Results

- Without communication or punishment, average contributions decline over time (from 6.29 to 1.94 out of 10).
- Face-to-face communication produces nearly full cooperation (average contribution: 9.62).
- Anonymous online chat is almost as effective (average contribution: 8.14), suggesting that visual and vocal cues are not essential.
- Numerical cheap talk has no significant effect on contributions relative to the baseline.
- Punishment increases contributions but does not improve average earnings, because punishment is costly.
- Adding punishment to verbal communication provides little additional benefit.

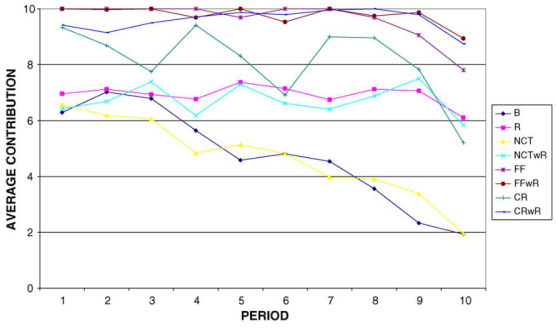


Fig. 2. Average contribution by period, sorted by treatment.

Decentralized Institutions: Punishment

- Fehr, E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *American Economic Review*
- VCM, $n = 4$, $e = 20$, 20 periods, $MPCR = 0.4$
- Four experimental conditions:
  - Partners: fixed group composition.
  - Strangers: random rematching each period.
  - Each matching condition is played with and without punishment opportunities.
- Subjects can punish other group members at a cost to themselves
- A punished subject could not lose more than the Stage 1 income
- The cost of punishment is approximately 1 point for 3 points of damage
- With standard assumptions
  - Punishment is not credible since the game is finitely repeated
  - Punishment itself is a public good prone to free riding
- Punishment is concentrated on low contributors
- Punishment does not always increase earnings

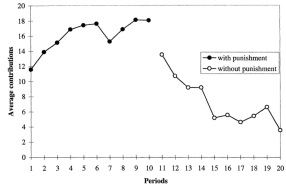


FIGURE 3A. AVERAGE CONTRIBUTIONS OVER TIME IN THE PARTNER-TREATMENT (SESSION 4)

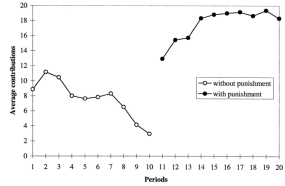


FIGURE 3B. AVERAGE CONTRIBUTIONS OVER TIME IN THE PARTNER-TREATMENT (SESSION 5)

vidual contributions in the final periods of the C. Why Do Punishment Opportunities Raise

Choosing the Carrot or the Stick?

- Sutter, M., Haigner, S., & Kocher, M. G. (2010). Choosing the carrot or the stick? Endogenous institutional choice in social dilemma situations. *Review of Economic Studies*,
- Research question: Which institutions do groups choose to promote cooperation, and does choosing the institution increase cooperation?
- Public goods experiment with groups of 4, interacting for 10 periods with fixed group membership.
- Each participant receives 20 ECU per period and chooses a contribution to the public good (MPCR $= 0.4$).
- Three possible institutions:
  - Standard voluntary contribution mechanism (VCM).
  - VCM with costly punishment.
  - VCM with costly rewards.
- Experimental variation:
  - Low versus high effectiveness of sanctions or rewards ($|L| = 1$ versus $|L| = 3$).
  - Institutions imposed by the experimenter versus chosen by participants through voting.

Institutional Choice and Cooperation: Results

- Institutional preferences depend on effectiveness:
  - With $|L| = 1$, 63% of groups choose the standard VCM.
  - With $|L| = 3$, 85% choose rewards; no group chooses punishment.
- When institutions are imposed, high-leverage punishment and rewards both increase contributions relative to the standard VCM.
- Endogenous institutional choice increases cooperation compared with the same institution imposed externally.
- For example, average contributions under high-leverage rewards increase from 11.20 (exogenous) to 14.59 (endogenous), out of 20 ECU.
- Main conclusion: Groups prefer rewards, even though punishment can be highly effective in sustaining cooperation. Participation in institutional choice itself promotes cooperation.

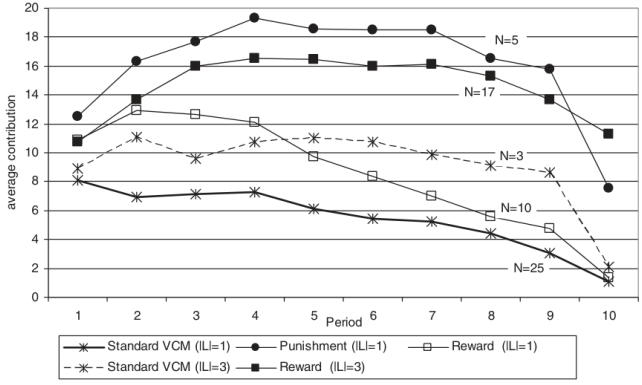


FIGURE 4

Average contributions in the endogenous treatments

Summary: Institutions that promote cooperation

1. Facilitate coordination
   - Communication, particularly face-to-face
   - Signaling through institution formation
2. Penalize free-riders
   - Punishment
   - Taxation
   - Competition