Sustaining Cooperation in Laboratory Public Goods Games: A Selective Survey of the Literature

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Introduction

• I will provide an overview of developments in the experimental literature on linear public goods games since the survey article by Ledyard (1995)

• Along the way I will discuss some of my own work in the area
A one-shot generic linear public goods game

• A group of n participants, each with an endowment of $\omega$ tokens.
• Each participant $i$ must make a decision $C (0 \leq C \leq \omega)$ on how many tokens to contribute to a public account.
• Any remaining tokens are allocated to a private account.
• Contributions are made simultaneously, without any communication and typically in whole tokens.
A one-shot generic linear public goods game

• In addition to the tokens allocated to the private account, each participant $i$ receives a fixed percentage ($\alpha$) of the total group contribution to the public account, with $0 < \alpha < 1 < n\alpha$.

• Pay-off to player $i$: $\Pi_i = (w_i - c_i) + \alpha \sum_{j=1}^{n} c_j$

• $\alpha$ is the marginal per capita return (MPCR) from the public good.
A one-shot generic linear public goods game

• At the end of a round participants get to see
  – either the individual contributions made by members of the group
  – or the total (and therefore average) contributions to the public account without learning the identity of the group members.

• For finitely repeated games, this one-shot game is played over a number of rounds, which proceeds in the same manner, starting with a new endowment of $\omega$ for each participant.
A numerical example: Ledyard (1995)

- Group of 4 players
- Each of them have $5
- Can contribute to either a *private* account or a *public* account
- Money put in the *private* account remains unchanged
- Money contributed to the *public* account *doubled* and redistributed equally among group members
A linear public goods game

• Analogous to a multi-person Prisoner’s Dilemma game

• From society’s point of view the best outcome is for each player to invest all $5 into the public account

• A total of $20 which gets doubled to $40

• Each player gets back $10; 100% return on investment
A public goods game

- But self-regarding behaviour suggests otherwise

- Suppose I contribute $1 into the public account; and suppose no one else puts in anything...

- $1 gets doubled to $2

- Redistributed equally: $0.50 for each member

- I lose $0.50 while the others, who have not contributed anything, gain $0.50
A public goods game

• Rational self-interest suggests that an individual player has **no** incentive to contribute

• *Economists suggest that the inevitable outcome of this process is zero contribution!*
Problems of cooperation

- Voluntary contributions of money and/or effort to charitable causes or public goods
- Cooperative hunting and warfare
- Exploitation of common pool resources
- Clean environment
- Teamwork in organizations
- Collective action
- Voting
A typical pattern of contributions when the game is played ten times with a known end-point

Chaudhuri & Paichayontvijit (2006)
A public goods game

• So there is good news and bad news…

• Clearly people are not as self-interested as the theory suggests, given that contributions are high in the beginning

• But over time, self-interested behaviour becomes more pronounced and free-riding increases
A public goods game

• There are actually *two separate* questions here

• Why do the contributions decay over time?

• How can we sustain cooperation by reducing free-riding over time?
One major area of advance since 1995

- A greater understanding of the fact that there are distinct types of players in such games

- The most notable finding in the area is that many participants behave as "conditional cooperators",

- whose contribution to the public good is positively correlated with their beliefs about the contributions to be made by their group members.
One major area of advance since 1995

• It was also not entirely clear as to what led to contributions decay.
  
  – kindness and/or confusion (Andreoni, 1995)
  – the “warm glow” of giving (Andreoni, 1990)
  – a combination of learning and strategic play (Andreoni, 1988, Andreoni and Croson, 2008)
  – decision errors of various types (Palfrey and Prisbrey, 1997 or Anderson, Goeree and Holt, 1998).

• The pattern of decay can be explained better by appealing to the interaction between heterogeneous players.
One major area of advance since 1995

• Conditional cooperators are often willing to engage in costly monetary punishment of free-riders
  – even when such punishment is personally costly and confers no long-term benefits.

• They are often successful in sustaining cooperation even without resorting to monetary punishments via other mechanisms which can broadly be categorized as moral suasion.

• Experimental economists have used their understanding of such type heterogeneity to design better institutions that can help sustain cooperation.
A second major area of advance since 1995

• Development of theoretical models of behavior
• Two distinct types of models
  – (i) models that focus on distributional concerns
    • Fehr and Schmidt (1999), Bolton and Ockenfels (2000)
  – (ii) intentions based models that focus on participants’ beliefs about each others’ actions and a concern for reciprocity.
A second major area of advance since 1995

- Models that combine elements of both
  - Charness and Rabin (2002)
  - Cox, Friedman and Gjerstad (2007)
  - Cox, Friedman and Sadiraj (2008)

- A recent theoretical paper that does not quite belong to either group is Ambrus and Pathak (2009).
A second major area of advance since 1995

- I will not discuss these theoretical advances here.

- The chapter on other-regarding preferences by David Cooper and John Kagel (2009) forthcoming in the second volume of *The Handbook of Experimental Economics* provides an overview.
Overview of my presentation

• I will start by looking at the issue of preference heterogeneity, particularly the issue of conditional cooperation.

• Then I will explore the role of costly monetary punishments in sustaining cooperation.

• After that, I will look at how mechanisms other than monetary punishments can also sustain cooperation.
Overview of my presentation

• In looking at mechanisms other than monetary punishment, I will first look at what happens in “unsorted” groups

• Then I will look at behaviour in “sorted” groups
  – Sorted on the basis of preferences or behaviour

• Among “sorted” groups again, I will look at “exogenous” sorting followed by “endogenous” sorting
Role of beliefs and conditional cooperation

• Fischbacher, Gächter and Fehr (2001)
• Players are asked to choose

  – An *unconditional contribution*

  – A *conditional contribution*, i.e., for *every given average contribution of the other members* they decide how much to contribute.
    • A selfish player is predicted to always choose a conditional contribution of zero.
The role of beliefs and conditional cooperation

• After this players play the actual game
• Some are free to choose any contribution regardless of what they said they would choose
• *But*, some others, picked randomly, have to contribute what they said they would contribute based on others’ contributions – This means…
Free riding

45 degree line

Average tokens contributed to the public account by the other group members

Participant's own contribution (in tokens)

Fishchbacher, Gächter and Fehr, (2001); Chaudhuri and Paichayontvijit (2006)
Fishchbacher, Gächter and Fehr, (2001); Chaudhuri and Paichayontvijit (2006)
Fishchbacher, Gächter and Fehr, (2001); Chaudhuri and Paichayontvijit (2006)
Hump-shaped Strong Conditional cooperation
Free riding Weak conditional cooperation

Fishcbacher, Gächter and Fehr, (2001); Chaudhuri and Paichayontvijit (2006)
Implications of conditional cooperation

• Across many studies, a plurality of participants are *conditional cooperators*

  • Brandts, J. and A. Schram (2001)
  • Bryan, J. and M. Test, (1967)
  • Kelley, H and A. Stahelski, (1970)
  • Keser, C. and F. van Winden, (2000)
  • Sonnemans, J., A. Schram and T. Offerman (1999)
Implications of conditional cooperation

• This in turn suggests one reason why contributions may decay over time

• Conditional cooperators can have optimistic beliefs or pessimistic beliefs

• In order to enhance cooperation one must generate beliefs that are optimistic about others’ contributions
Implications of conditional cooperation

• Those with optimistic beliefs start out with high contributions…

• But over time they begin to understand that there are others who are contributing less…
  • Maybe because they have pessimistic beliefs…

• Inducing the optimists to reduce their contribution over time
Manipulating feedback in a public goods game
Chaudhuri and Paichayontvijit (2010)

• Groups of 4 play a public goods game for 24 rounds with 10 tokens in each round

• In one treatment, they do not get any feedback about others’ contributions or their own earnings; in other treatments they get feedback as usual

• Participants classified into three groups (based on their prior beliefs about others’ contributions)
  – Optimists (others will contribute 7 tokens or more)
  – Realists (others will contribute 4 - 6 tokens)
  – Pessimists (others will contribute 3 tokens or less)
Pattern of contributions over time

No feedback treatment; Virtually no decay in contributions

Chaudhuri and Paichayontvijit (2010)
Pattern of contributions over time

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Chaudhuri and Paichayontvijit (2010)
We propose that a possible explanation for the decay is learning about the heterogeneity of types, where the type is characterized by initial beliefs.

We use the intermittent feedback treatment to examine the social learning hypothesis.

This allows us to focus on how subjects respond to new information.
Random effects Tobit regression for the intermittent feedback treatment

Contribution in round $t$ by subject $i$ is determined by the following equation:

$$C_{it} = \beta_0 + \beta_1 C_{it-1} + \beta_2 \text{round} + \beta_3 \text{optimist} \times \text{round} + \beta_4 \text{pessimist} \times \text{round} + \beta_5 \text{NewInfo} + \beta_6 \text{NewInfo} \times \text{optimist} + \beta_7 \text{NewInfo} \times \text{pessimist} + \beta_8 \text{LagDiff} + \beta_9 \text{LagDiff} \times \text{optimist} + \beta_{10} \text{LagDiff} \times \text{pessimist} + \nu_i + C_{i0} \xi_0 + X_i' \xi + \epsilon_{it}$$

*NewInfo* - dummy for the rounds after subjects receive feedbacks; i.e., rounds 5, 9, 13, 17, 21

*LagDiff* - the difference between one’s average contribution of the previous 4 rounds and the average contribution of other group members in the previous 4 rounds
Random effects Tobit regression for the intermittent feedback treatment

• The realists and the optimists decrease their contributions over time, while the pessimists increase their contributions with respect to the realists

• When the optimists receive the information on how much their group members have been contributing in the past four rounds, they decrease their contributions
Random effects Tobit regression of the absolute difference between one’s contribution and group average contribution in the intermittent feedback treatment

\[
\left| C_{it} - \frac{1}{4} \sum_{j=1}^{4} C_{ij} \right| = (-) + (-) \\
\beta_0 + \beta_1 \text{Round} + \beta_2 \text{optimist} + \beta_3 \text{pessimist} \\
+ \beta_4 \text{optimist} \times \text{Round} + \beta_5 \text{pessimist} \times \text{Round} + \epsilon_{it}
\]

• Difference between one’s contribution and the group average contribution decreases over the course of the game

• This result suggests subjects attempt to contribute at the same level as the group average contribution as they play more rounds
Robustness of conditional cooperation
Kurzban and Houser (2005)

• Sequence of one-shot linear public goods games in randomly formed groups of four.
• Stage 1: each player allocates endowment between a private account and the public account.
• Stage 2: A number of rounds:
  – one player in each group is provided with the current aggregate contribution to the public account and is given a chance to change his allocation.
  – Then the next player is given the same opportunity and so on.
  – Payoffs to participants in each game are determined by the final allocation of tokens between the private and public accounts at the point where the game ends.
  – Each person gets at least one chance to change his mind and 4% chance the game will continue
Robustness of conditional cooperation  
Kurzban and Houser (2005)

• This multiple elicitation of contribution responses should attenuate the tendency to behave in a conditional manner over time.

• 63% are conditional cooperators, 20% are free-riders and 13% are unconditional cooperators.

• The authors find that these classifications are stable by having the participants take part in three additional games
Robustness of conditional cooperation
Fischbacher and Gächter (2010)

• **P-experiment:**
  – participants first play a one-shot public goods game and then fill out a conditional cooperation questionnaire

• **C-experiment:**
  – participants play 10 rounds of a linear public goods game with random re-matching.
  – After each round participants asked to estimate the other group members’ average contribution.

• Within subjects design with treatments counter-balanced between sessions
Robustness of conditional cooperation
Fischbacher and Gächter (2010)

• 55% of participants are conditional cooperators; 23% free-riders.

• Positive and stable correlation between beliefs and contributions for conditional cooperators.

• Participants classified as conditional cooperators using questionnaire in P-experiment behave in the same way when playing for 10 rounds in C-experiment.

• Hence eliciting participants’ beliefs after they have participated in the public goods game does not affect their preferences.
Robustness of conditional cooperation
Chaudhuri and Paichayontvijit (2006)

• What happens when conditional cooperators get to know that there are others like them in the group?

• Use approach similar to FGF to elicit conditional cooperation information

• Then provide progressively more information about the presence of conditional cooperators

• Contributions increase particularly among conditional cooperators
  – Replicated by De Oliveira, Croson and Eckel (2009)
Sustaining cooperation over time

- Costly monetary punishments

- Non-monetary *punitive* measures such as social ostracism or exclusion

- Non-punitive measures based on *moral suasion*
  - Non-sorted groups
  - Sorted groups
Altruistic punishments
Fehr and Gächter (2000, 2002)

• Stage 1: typical public goods game
• Stage 2: Punishment opportunity
  – Subjects are informed about each member’s contribution.
  – Subjects can punish other group members

• *Punishments are costly!*
  – Eg. If you are willing to give up $1 to punish a particular group member then the latter’s earnings are reduced by $3
Costly punishments
Fehr and Gächter (2000, 2002)

- Either groups are **fixed**
  - “*partners*” protocol

- Or players are **randomly re-matched** at the end of each round
  - “*strangers*” protocol
Who gets punished?

Received punishment points per deviation from average and percentage of decisions

Deviation from the mean contribution of the other group members
Choosing whether to punish or not
Gürerk, Irlenbusch and Rockenbach (2006)

• Multiple stages in each one of 30 rounds
• Stage 1, participants have an opportunity to choose to be in either a sanctioning or a sanction-free institution.
• Stage 2 participants participate in a linear public goods game.
  – The round ends here for participants who choose to be in the sanction-free institution.
• Participants who choose to be in the sanctioning institution continue to stage 3 where they can allocate either positive or negative sanction points to other members.
  – Reward ratio 1 token: 1 token
  – Punishment ratio 1 token for sender: 3 tokens for recipient
On the effectiveness of costly monetary punishments

- Nikiforakis and Normann (2008)
- Egas and Riedl (2007)

- While monetary punishments may lead to increased contribution, the impact on efficiency (earnings) ambiguous

- Cost-effectiveness of punishments is crucial
  - 1 token sacrificed in punishment must inflict a cost of 3 tokens or more on the recipient for increasing efficiency
The possibility of “perverse” or “anti-social” punishments

- Nikiforakis (2008)
- Three stages
- Stage 1: standard linear public goods game
- Stage 2: Punishments using the FG (2000) approach
- Stage 3: Counter-punishments
  - Those punished in stage 2 can engage in counter-punishment with similar punishment costs as in Stage 2
  - Must have money to punish
  - “Targeted” punishment
The possibility of “perverse” or “anti-social” punishments

• The counter-punishment treatment leads to lower contributions compared to the punishment treatment and lower average earnings compared to both the punishment and the control treatments.

• Participants in this treatment engage in substantial amounts of “anti-social” punishment which can be attributed to one of two factors or a combination of those.

• One is the anticipation by some free-riders of the forthcoming punishment from cooperators and their willingness to retaliate those sanctions.
The possibility of “perverse” or “anti-social” punishments

• Here participants use counter-punishments strategically to signal that future sanctions will not be tolerated.

• The second factor is the desire to avenge sanctions meted out to them in previous periods.

• Participants in the counter-punishment treatment are 15% less likely to punish free-riding compared to the punishment treatment.
The possibility of “perverse” or “anti-social” punishments

The possibility of “perverse” or “anti-social” punishments

- Cinyabuguma, Page and Putterman (2005)

- No “targeted” punishments

- Each participant is told the pattern of punishing high, average and low contributors in the group

- Then that participant can decide who to counter-punish, i.e. whether counter-punish of “pro-social” or “anti-social” punishers.

- Efficiency not lower in the counter-punishment treatment
Most people are not WEIRD! (Western, Educated, Industrialized, Rich and Democratic)

Hermann, Thöni and Gächter (2008)
Caveats: The verdict on costly monetary punishments

1. Punishment creates a second-level public good
   - Requires the creation of “meta-norms” of punishment in the words of Axelrod (1986).
   - But, given a long enough time horizon, as in Gächter, Renner and Sefton (2008), the threat of punishment might be enough to sustain cooperation without the punishment actually having to be carried out.
   - 50 rounds with punishment as opposed to 10 rounds

2. The issue of “anti-social” punishments
   - cooperation enhancing effect of punishments seems more prominent in particular participant pools
   - the exact implementation of counter-punishment – whether targeted punishments are feasible or not - matters.
The verdict on costly monetary punishments

3. Efficiency implications ambiguous.
   - Across majority of studies, efficiency is actually lower in treatments with punishment compared to control treatments without punishment.
   - Whether efficiency is higher or not depends on:
     • cost-effectiveness of the punishment
     • The length of the time horizon

• Guala (2010): ethnographic evidence from tribal societies or historical evidence on common pool resource usage does not provide support for either the use or the efficacy of costly monetary punishments.
Sustaining cooperation via non-monetary punitive mechanisms

- Noussair and Tucker (2005)
  - Expressions of disapproval
  - Voting to expel group members
Even non-monetary punishments (scoldings?) seem to matter!

- Masclet et al. (2003) look at a “partners” treatment where participants play for 30 periods divided into 3 segments
  - No sanction (periods 1 through 10)
  - Monetary Sanction OR Non-Monetary Sanction (Periods 11 through 20)
  - No sanction (Periods 21 through 30)
Group Contributions Over Time

Monetary punishment

Non-monetary punishment

Period

Contribution

Restart

Restart

 Monetary Average Contribution  Non-Monetary Average Contribution
Sustaining cooperation via non-punitive mechanisms

- A group of interventions that can be referred to as moral suasion

- **Two** types of studies
  - Studies that *do not sort* participants in any way
  - Studies that *sort* their participants on the basis of similarity of preferences or behaviour

- Sorting can be one of two types
  - **Exogenous** sorting carried out by the experimenter on the basis of a rule that may or may not be known to the participants
  - **Endogenous** sorting carried out by participants
Isaac and Walker (1988)
Dawes, McTavish and Shaklee (1977)
Role of communication

Communication vs. No communication

Percentage Contributions to the Public Account

Rounds

1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20

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Are punishments necessary? Comparing the impact of punishments and communication

  - Face-to-face communication
  - Internet chat room
  - Numerical Cheap talk
  - Each type of communication combined with punishment
  - Fixed groups

- Chaudhuri and Paichayontvijit (2010)
  - Recommended play versus punishments
  - Both fixed groups and random re-matching
Chaudhuri and Paichayontvijit (2010)

• Public goods game with 20 rounds
• Three treatments
• In each treatment, participants play 10 rounds at the beginning without any intervention
• In the control treatment, after the first set of 10 rounds end, they are told to continue playing for another 10 rounds
Recommended play and punishments

• **Recommendation treatment**
  
  Prior to beginning of round 11 and at the beginning of each successive round, public announcement:

  – “**You should contribute 10 tokens in each round.**

    NOTICE that if all participants in a group follow the message then every participant will make 100% return on their contributions. For example, if in a particular round all 4 players in your group contribute all 10 tokens to the public account, then each group member will receive 20 tokens in return of their investment of 10 tokens. You will be helping yourself and everyone else in the group if you contribute all 10 tokens in every round.”
Recommended play and punishments

- **Punishment treatment**
  - Beginning with round 11, in the second stage of each round participants allowed to engage in costly punishment of group members

- Two matching protocols
- Participants are either
  - in *fixed groups for all rounds*
  - *randomly re-matched from one round to the next*
Contributions in randomly re-matched groups

Round

Percentage Contribution

Control
Contribution in randomly re-matched groups

- **Control**
- **Punishment**

Percentage Contribution vs. Round

- Y-axis: Percentage Contribution
- X-axis: Round (0 to 20)

- Control line shows a decrease in contribution over rounds.
- Punishment line shows an increase in contribution over rounds.

Round 20 marks a significant deviation from the trend observed in earlier rounds.
Contributions in randomly re-matched groups

- Control
- Recommendation
- Punishment

Graph shows contributions over rounds for Control, Recommendation, and Punishment conditions.
Contributions in fixed groups

- Contributions in fixed groups

- Percentage Contribution

- Round

- Control
Contributions in fixed groups

- **Recommendation**
- **Punishment**
- **Control**

![Graph showing the percentage contributions in fixed groups over rounds with lines for recommendation, punishment, and control.]
Earnings in randomly re-matched groups
Earnings in randomly re-matched groups

Average Earnings

Round

Control
Punishment

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Control
Punishment
Earnings in randomly re-matched groups

![Graph showing earnings over rounds for Control, Recommendation, and Punishment groups.](image)
Earnings in fixed groups

Average Earning

Round

- Control
Earnings in fixed groups

Average Earning

Round

Control

Punishment

Earnings in fixed groups
Earnings in fixed groups

Round

Average Earning

Control

Recommendation

Punishment
Punishments more effective in the longer term?

- Henrich and Boyd (2001)
- Gächter, Renner and Sefton (2008)
- 50 round public goods game
- Punishments more effective over time because the threat of punishments is enough to sustain cooperation
- There is no need for punishments to be actually carried out and so no costs incurred
- One would then need to compare other mechanisms played out over a similar time horizon
- This is an open research question
Cooperation among sorted groups: *exogenous sorting*

- Gächter and Thöni (2005)
  - Participants first take part in a “ranking experiment”
  - One-shot linear public goods game with an MPCR of 0.6 in randomly formed groups of three.
  - Three highest contributors in the ranking experiment are put together in one group, the next three in the second group and so on.
  - Participants get to know how these groups are formed and are also informed how much their *new group members* contributed in the ranking experiment.
  - Play linear public goods for 10 rounds
Cooperation among sorted groups: 

**exogenous sorting**

- Four separate conditions:
  - (1) *Sorted no punishment*
  - (2) *Random no punishment*
  - (3) *Sorted punishment*
  - (4) *Random punishment*.
Sorted groups with no punishment

![Graph showing contributions over periods with different groups and periods.]

- **Top**
- **Middle**
- **Low**
- **Average**

Periods range from 1 to 10.
Random groups with punishment
Sorted groups with punishment
Cooperation among sorted groups: *endogenous sorting*

- Page, Putterman and Unel (2005)

- There are 16 participants in each one of four sessions.

- At periodic intervals, participants shown a list of each of the other 15 participants’ average contribution to the public account till that point.
Cooperation among sorted groups: \textit{endogenous sorting}

- The four individuals with the lowest rank are then put together in the same group, the next four in the second group; group size is always equal to four.

- After new groups are formed, participants resume play without information about whom they have been grouped with, a matter on which only indirect inference can be made by observing one’s three partners’ contributions.

- The authors also look separately at a punishment treatment and a combined treatment with regrouping and punishment.
Page, Putteman and Unel (2005)

The diagram shows the average contribution over 20 periods for four different conditions: Baseline, Regrouping, Punishment, and Combined. The y-axis represents the average contribution, ranging from 0 to 10, and the x-axis represents the period, ranging from 0 to 20. Each condition is represented by a different line and marker type.

- Baseline (blue triangles) shows a steady decrease in average contribution over time.
- Regrouping (red squares) fluctuates more than Baseline, with periods of increase and decrease.
- Punishment (black crosses) starts at a high contribution and then steadily decreases, showing a clear effect of punishment.
- Combined (brown diamonds) combines the effects of Baseline, Regrouping, and Punishment, showing a more complex pattern with periods of increase and decrease.
Cooperation among sorted groups: *endogenous sorting*

- Keser and Ehrhart (1999)
- Charness and Yang (2007)

- 9 people in a “society” are placed into 3 groups of 3 and play for 3 rounds.
- The returns from the public account increasing in group size
- Highest group returns achieved by forming a “grand coalition” of all 9 members
Cooperation among sorted groups: *endogenous sorting*

- After first 3 periods, participants learn about the average contribution of each other individual in their group for those three periods.

- Participants can choose to either exit the group or vote to expel other group members.

- Groups are allowed to merge as well.

- Two blocks of 15 rounds
Cooperation among sorted groups: **endogenous sorting**

- Contribution rate in exogenously formed groups in a control treatment steadily decline to around 25% of the social optimum, in endogenously formed groups the rate increases to above 95% in the later periods.

- most commonly occurring group composition in this treatment is the grand coalition followed by 8-1 and 7-2 splits respectively and these larger groups tend to be quite stable over time.
Cooperation among sorted groups: *endogenous sorting*

- Participants are less likely to exclude another group member the higher that member’s contribution vis-à-vis the group average.

- Individuals/groups are more likely to merge with another group, when that latter group is larger and achieves higher average contributions vis-à-vis the contributions in the former group.

- Given the ability to sort cooperators in this treatment, profit-maximizing participants find that it pays to cooperate given that they manage to belong to groups where others also contribute.
Applications to Economics

• The applications of these ideas to real life economic problems are probably obvious to all of you

• They range from creating a cleaner environment to preserving common-pool resources

• Besides the other examples I talked about at the outset such as contributions to public goods or to charitable causes
Where to from here?

- Apply the lessons learned to “field” settings in designing institutions that deal with social dilemmas.
  
  
  
  
  - labour relations (Bewley, 1999, 2005)
  
  - legal enforcement (Bohnet, Frey and Huck, 2001, Kahan, 2005)
Where to from here?

• Phenomenon of contributions decay might lead to further work in the area in terms of both experiments and theory.
• Current models assume complete information
• A potential area of advance would involve assuming asymmetric information regarding types.
  – heterogeneity in types (such as conditional cooperators and free riders)
  – heterogeneity in prior beliefs among conditional cooperators and then look for sequential equilibria in such games.
Where to from here?

• It is also clear that there will continue to be substantial contributions to this literature from a neuroeconomic perspective especially in terms of understanding the motives behind altruistic punishments and norm compliance.

  – de Quervain et al. (2004), Fehr and Camerer (2007), Knoch et al. (2010) and Spitzer et al. (2007)
Where to from here?

- Emerging literature on “strong reciprocity”

- *homo reciprocans*

- Traditional theories of human cooperation: emphasis on individual selection: kin selection, reciprocal altruism, costly signaling.

- New results – especially those carried out among small-scale tribal societies – provide evidence in favour of group (or multi-level) selection and clues to human evolutionary processes.