Cooperation in a Prisoners Dilemma with Losses. Results from an Experimental Study.

Roger Berger
Institute for Sociology, University of Leipzig and SNF
Venice International University 2006
Rational Choice Sociology: Theory and Empirical Applications

Contents

• Theoretical framework
  – Basic ideas
  – Application on a negative PD
• Experimental design
• Results and interpretation
Prisoners Dilemma: Theory

• In a prisoners dilemma that is one-shot played, there exists one Nash-equilibrium (in dominant strategies) that is: (d, d) i.e, *no cooperation.*

• If actors are not completely sure to act in a one-shot situation, the „folk theorem“ - that can lead to cooperation – might come into work.

Prisoners Dilemma: Empirical Evidence

• Cooperation rates are consistently higher than theoretically expected: About half of the probands cooperate.

• How can this anomaly be explained?
  – Material explanation: Actors are *not* fully *rational* and/or *selfish*: cf. „Behavioral Game Theory“.
  – Methodological explanation: The predictions were *not adequately tested.*
Methodological failure: One-shot play

- Existing groups like scholars of one class, soldiers of military formations, students of one course, cohorts of probands etc.
  - always have a common past.
  - always have a common future (with an open end), not in the experiment, but afterwards in the real world.
- PD testing with such groups should result in some cooperation.

Methodological failure: Anonymous play

- If the probands are not sure to act completely anonymous, there is always a chance of recognition after the experiment (especially with probands as described above). This again can create a „folk theorem“-situation.
- Anonymity should be given against
  - the other probands, otherwise: see above
  - the experimentators, otherwise Hawthorne- and other effects of social desirability can lead to cooperation.
  - This doubleblindness is hard to get, because experimentators often have to know how the probands acted, in order to carry through the experiment and/or to pay the participants (see e.g. corresponding rules of the DFG).

• Diktatorspiele im Labor:
  – one-shot, einfach blind, windfall gains: „Nash“-Angebot in 19 % (10 $) bzw. 15 % (40 $) der Fälle.
  – one-shot, einfach blind, verdientes Geld: „Nash“-Angebot in 79% (10 $) bzw. 70 % (40 $) der Fälle.
  – one-shot, doppelblind, verdientes Geld: „Nash“-Angebot in 95 % (10 $) bzw. 97 % (40 $) der Fälle.

Methodological failure: „Manna“ play

• The vast majority of experimental payoffs have the property of „windfall gains“/ „manna“ / „house money“.
• For windfall gains „prospect theory“ predicts easier sharing and therefore higher coope-
rations rates (see also e.g. Ackert et al. 2006, Güth/Kliemt 2003, List/Levitt 2005).
Main thesis

• The equilibrium (d,d) in a prisoners dilemma is reached, if
  – play is real one-shot and anonymous and perceived as this by the probands.
  – there are no windfall gains on stake. This is especially the case with losses.
• In short: People act rational in real situations (see Aumann 2005).

The game: Negative PD

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-4, -4</td>
<td>-7, -2</td>
</tr>
<tr>
<td>D</td>
<td>-2, -7</td>
<td>-5, -5</td>
</tr>
</tbody>
</table>

• Endowment (Quiz):
  – **Low: 10 €**
    • Real money payoff: S=3; P=5; R=6; T=8.
  – **High: 15 €**
    • Real money payoff: S=8; P=10; R=11; T=13.
Experimental Design: Place and Procedure

- **Place**: two computer-pools located above each other.
  - Both pools with separate doors, but connected by a staircase.
  - Probands placed behind paper screens, in order to avoid sight
    - to other screens (completely reached),
    - to other probands (only partly reached),
    - from the experimentators to the probands an vice versa (only partly reached),
- **Probands earn money** by answering a multiple choice quiz
  (30 very difficult questions, designed to give the impression of hard earned money.)
- The better half of the probands earn **15 €**, the others **10 €**.
- Probands get to know the game by written instructions and playing it **once hypothetically** at the computer.
- The gain is given to the probands **in cash in a purse** (black in one room, red in the other).

Experimental Design: Place and Procedure

- Probands play the negative PD with a partner in the other room by **taking money** from the **purse** and **keeping it**.
- The experimentators exchange the purses in a doubleblind procedure between the two rooms and notice the actions played by **counting the remaining money** in the purses.
- The experimentators induce loss by removing additional money from the purses:
  - 4 € if C was played (5 € are passed to the probands).
  - 5 € if D was played (2 € are passed to the probands)
- The exchanged purses (indicated by changed colours) are randomly distributed in the other room.
- Probands take the remaining money out of the purse and leave their rooms.
Decision structure and payoffs

• High endowment (15 €):
  – Play C: Pass -9 € and keep 6 €.
    • Another -4 € are removed from the passed purse. 5 € go to a partner.
  – Play D: Pass -7 € and keep 8 €.
    • Another -5 € are removed from the passed purse. 2 € go to a partner.
  – Hope to get matched with a C-Player and get 5 €. Otherwise get 2 € from a D-Player.

• Low endowment (10 €):
  – Play C: Pass -9 € and keep 1 €.
    • Another -4 € are removed from the passed purse. 5 € go to a partner.
  – Play D: Pass -7 € and keep 3 €.
    • Another -5 € are removed from the passed purse. 2 € go to a partner.
  – Hope to get matched with a C-Player and get 5 €. Otherwise get 2 € from a D-Player.

Treatments

1) Fully doubleblind with earned money:
   - Probands never get to see each other before, during and after the experiment (entrance and exit through separated doors).
   - Doubleblind play. Neither the probands nor the experimentator are able to attribute the decisions to an individual actor.
   - Earning money by a quiz.

2) Doubleblind with earned money:
   - Probands get to see each other before, but not during and after the experiment.
     - Entrance and joint additional oral instructions in one room.
     - Experiment and exit in separated rooms with separated doors.
   - Doubleblind play. Neither the probands nor the experimentator are able to attribute the decisions to an individual actor.
   - Earning money by a quiz.

3) Fully doubleblind with windfall gains:
   - Probands never get to see each other before, during and after the experiment (entrance and exit through separated doors).
   - Doubleblind play. Neither the probands nor the experimentator are able to attribute the decisions to an individual actor.
   - Money is randomly provided.
Results: Description of the experiments

- Probands were randomly recruited from a population of interested students (from different faculties).
- Number of probands: 136
  - 48 probands treatment 1 (= 4 sessions with 2x6 probands).
  - 40 probands treatment 2 (= 2 sessions with 2x10 probands).
  - 48 probands treatment 3 (= 4 sessions with 2x6 probands).
- Comments of probands show that
  - the experiment was fully understood.
  - some probands thought about taking all the money (only one really did).
  - the experiment was interesting for the participants and they were satisfied with the payoffs.
- Sex ratio: 58% female, 42% male.
  - about equal sex distribution in each group of each session.
  - except in one purely female group (in treatment 2).

Results: Average overall distributions

- Average number of correct answers in the quiz: 13 of 30.
- About 10% of the probands knew somebody else taking part in their experiment (by name or by sight).
  - 9.4% knew somebody in their own room.
  - 3.1% knew somebody in the other room (potential partner).
- Hypothetical cooperation rate: 45%
- Real cooperation rate: 28%
Results: Cooperation in treatment „fully doubleblind, earned money“ (sessionwise)

Roger Berger, University of Leipzig and SNF, VIU 2006

Results: Cooperation in treatment „doubleblind, earned money“ (sessionwise)

Roger Berger, University of Leipzig and SNF, VIU 2006
Results: Cooperation in treatment „fully doubleblind, windfall gains“ (sessionwise)

Bivariate results: windfall vs earned endowment high vs low windfall endowment

- Windfall vs earned:
  - Difference in cooperation rates in the expected direction,
  - but not significant (t=1.00).

- Low vs high endowment:
  - Difference in cooperation rates in the expected direction,
  - but not significant (t=1.22).
Bivariate results: Real vs hypothetical decision

- Difference is significant
  - overall ($t = 2.98$),
  - in the „windfall“ treatment ($t = 2.37$),
  - but not in the other treatments.

Results: „normal“ vs full doubleblindness

- Difference in cooperation rates, but in the opposite direction than expected,
- and this difference is significant ($t = 2.45$).
Methodological conclusions

- Doubleblind testing of equilibrium-predictions in a PD is not trivial.
- Particularly (most) observations only can be done on aggregate level.
- Credible losses are hard to induce in an experimental setting.

Theoretical conclusions

- PD-situations with losses and one-shot and doubleblind play,
  - seem to lead in a lot more defection than the hitherto evidence.
  - can be explained by standard game theory.
- Nevertheless there remains a substantial and rate of cooperation to be explained:
  - Some probands still might not have perceived the decision as doubleblind and one-shot.
  - Obviously all the probands still are basically cooperative / interested. Otherwise they would not have taken part and the experiment could not have been carried through (see comments).
Further research: Testing ... 

- for real windfall gains (positive PD).
- with real suspension of anonymity (payment after the experiment).
- with control for effects of „economics of information“ (uncertainty about payoffs) by repeating the experiment with the same probands.