

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

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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.

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3

## 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 explanantion:** The predictions were *not adequately tested*.

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4

## 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*.

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5

## 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).

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6

Ein Beispiel: Cherry, Frykblom und  
Shogren, 2002, „Hardnose the Dictator“,  
AER 92: 1218-1221

- 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.

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7

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 cooperations rates (see also e.g. Ackert et al. 2006, Güth/Kliemt 2003, List/Levitt 2005).

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8

## 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).

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9

## The game: Negative PD

	C	D
C	-4, -4	-7, -2
D	-2, -7	-5, -5

- 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.

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10

## Experimental Design: Place and Procedure

- **Place:** two computer-pools located above each other.
  - Both pools with separate doors, but connected by a staircase.
  - Proband 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 and 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 €**
- Proband gets 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).

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11

## Experimental Design: Place and Procedure

- Proband plays 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.
- Proband takes the remaining money out of the purse and leaves their room.

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12

## 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:**
  - Proband 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:**
  - Proband 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:**
  - Proband 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

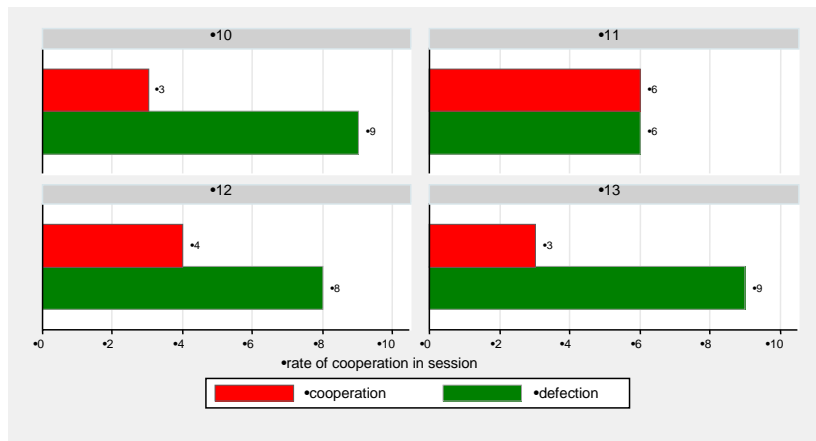
- Probands were randomly recruited from a population of interested students (from different faculties).
- Number of probands: 136
  - 48 probands treatment 1 (= 4 sessions with 2x6 probands).
  - 40 probands treatment 2 (= 2 sessions with 2x10 probands).
  - 48 probands treatment 3 (= 4 sessions with 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%**



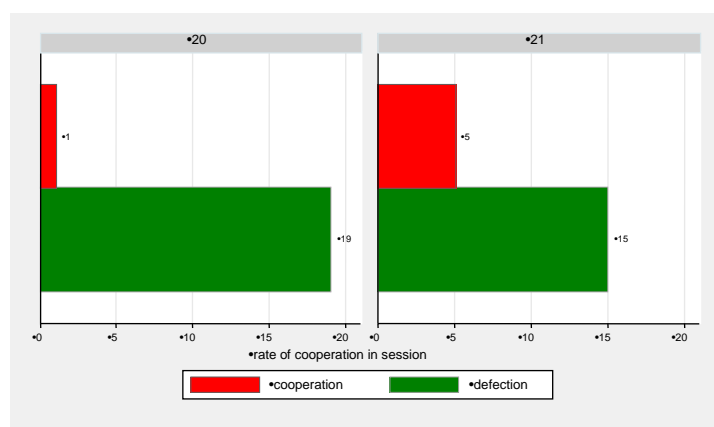
## Results: Cooperation in treatment „fully doubleblind, earned money“ (sessionwise)



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17

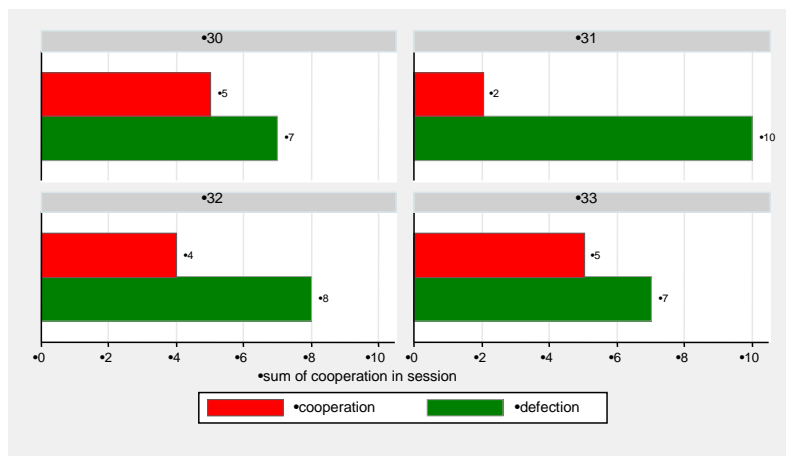
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18

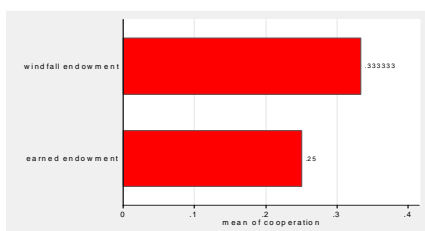
## Results: Cooperation in treatment „fully doubleblind, windfall gains“ (sessionwise)



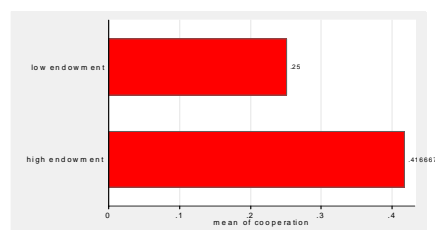
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19

## 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 ( $t=1,00$ ).

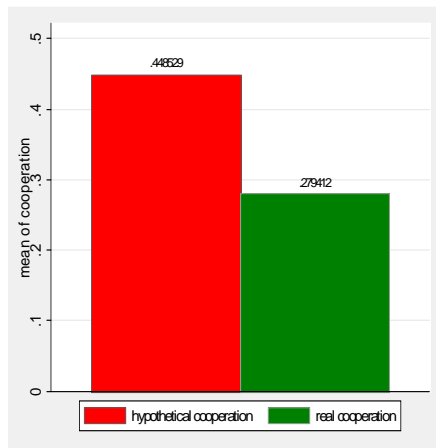


- Low vs high endowment:
  - Difference in cooperation rates in the expected direction,
  - but not significant ( $t=1,22$ ).

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20

## Bivariate results: Real vs hypothetical decision

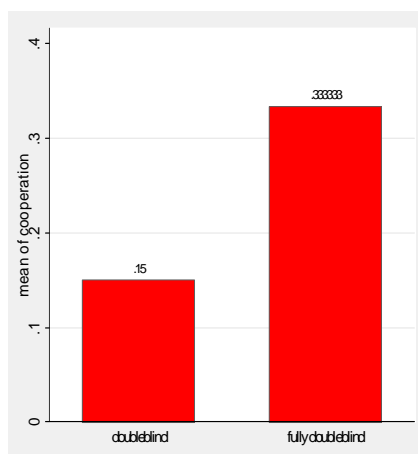


- Difference is significant
  - overall ( $t = 2,98$ ),
  - in the „windfall“ treatment ( $t = 2,37$ ),
  - but not in the other treatments.

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21

## Results: „normal“ vs full doubleblindness



- Difference in cooperation rates, but in the opposite direction than expected,
- and this difference is significant ( $t = 2,45$ ).

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22

## 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.