

Cooperation and Public Goods Provision

- A basic design
- Determinants of voluntary cooperation
 - Marginal private benefits
 - Group size
 - Communication
- Why do people cooperate?
 - Strategic cooperation
 - Cooperation as a mistake
 - Conditional Cooperation
- Testing an incentive compatible mechanism for the private provision of public goods
- Cooperation and private punishment

Cooperation problems

- Cooperative hunting and warfare (important during human evolution)
- Exploitation of common pool resources
- Clean environment
- Teamwork in organizations
- Collective action (demonstrations, fighting a dictatorship)
- Voting

Basic economic problem

- Cooperative behavior has a positive externality.
- Hence, private marginal benefit is smaller than social marginal benefit → underprovision relative to the efficient level.

A Basic Design

- Group with n subjects.
- y_i is endowment of player i .
- 2 investment possibilities
 - Private account
 - Public good (called “project”, “alternative B”)
- c_i = contribution to the public good.
- Simultaneous contribution decision.
- One-shot game or finitely repeated game.
- Average contribution in the group or contribution vector as feedback.
- Income per period:

$$\pi_i = (y_i - c_i) + \alpha \sum_{j=1}^n c_j$$

Prediction

- If $\alpha < 1$: $c_i = 0$ is a dominant strategy
- If $n\alpha > 1$ surplus maximization requires $c_i = y_i$
- Typical example
 - $n = 4$
 - $y_i = 20$
 - $\alpha = 0.4$
 - Groups randomly rematched for 10 periods (stranger design)
 - or stable group composition for 10 periods (partner design)

Determinants of Voluntary Cooperation

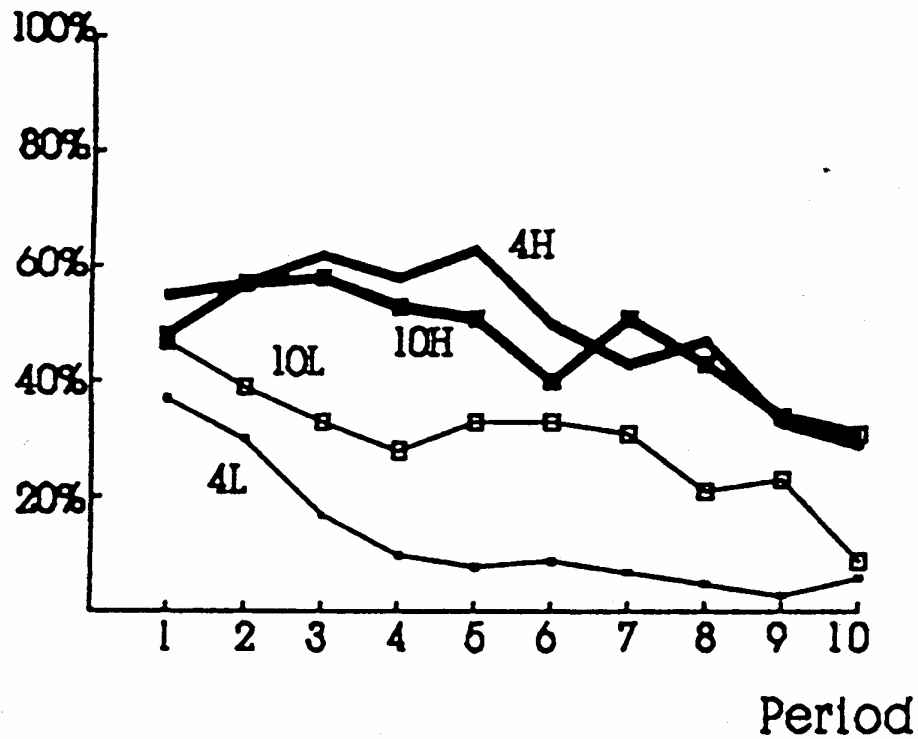
Isaac, Walker, Thomas (1984)

- Aim: Isolate effects of group size and the MPCR α .
- $\pi_i = y - c_i + \alpha \sum c_i$
- α measures the private marginal benefit, $n\alpha$ the social marginal benefit.
- Income from private account $y - c_i$ was private information; income from group account ($\alpha \sum c_i$) was public information.
- 10 periods, public information
- Information feedback at the end of each period: sum of contributions and private income.

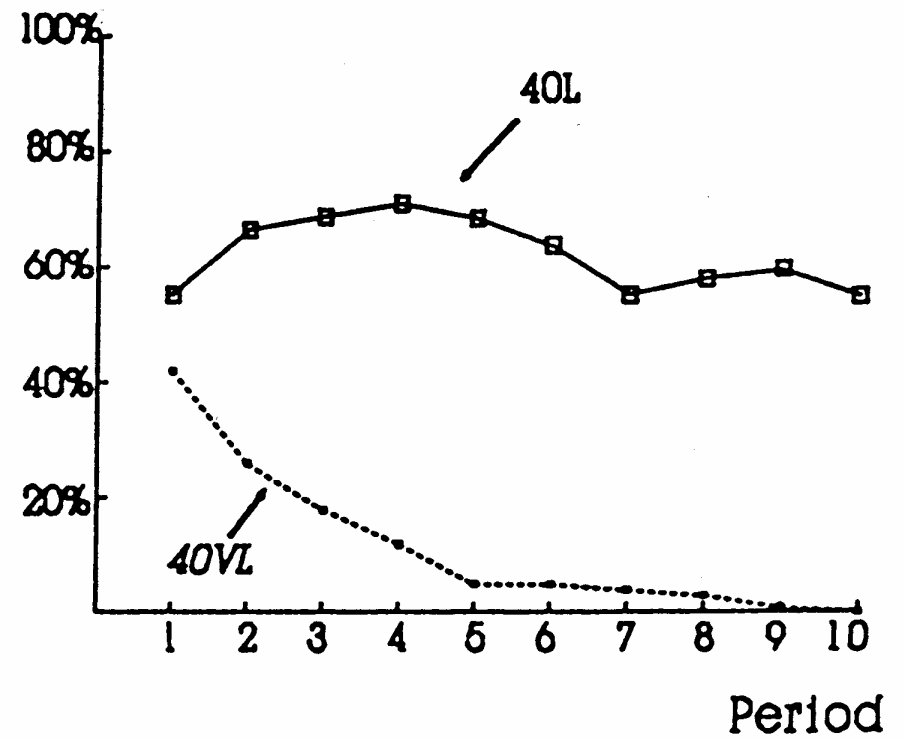
A: $n=4$, MPCR=.3, $n\alpha=1.2$	C: $n=4$, MPCR=.75, $n\alpha =3$
B: $n=10$, MPCR=.3, $n\alpha =3$	D: $n=10$, MPCR=.75, $n\alpha =7.5$

- A-C, B-D: MPCR-effect
- A-B, C-D: Group size effect with constant MPCR
- B-C: Group size effect with constant group benefit $n\alpha$

Contributions to Group Exchange
(% of Efficient Level)



Contributions to Group Exchange
(% of Efficient Level)



Results

	MPCR=.3	MPCR=.75
n=4	A: 19	C: 57
n=10	B: 33	D: 59

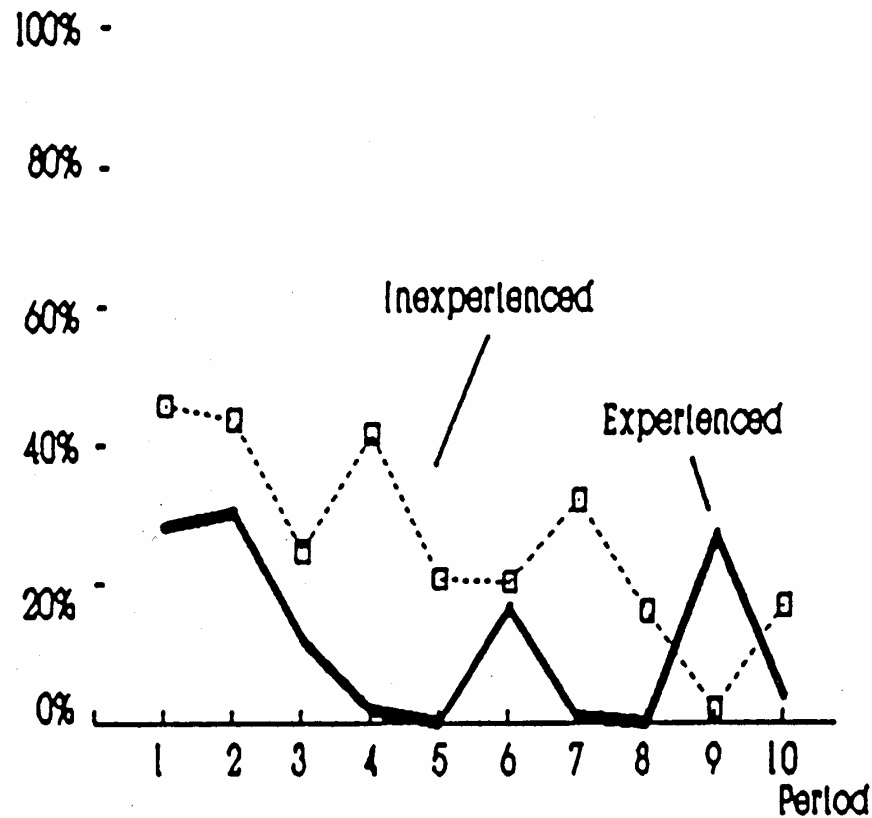
- Table shows average contributions in percent
- Cooperation increases with MPCR for both n.
- Cooperation increases with n if MPCR is low (not when it is high).
- Cooperation decreases with n if group benefit $n\alpha$ constant.

- Cooperation decreases over time, in particular in treatments with low MPCR.
- MPCR-effect is present in all periods.
- Group size effect at low MPCR vanishes over time.

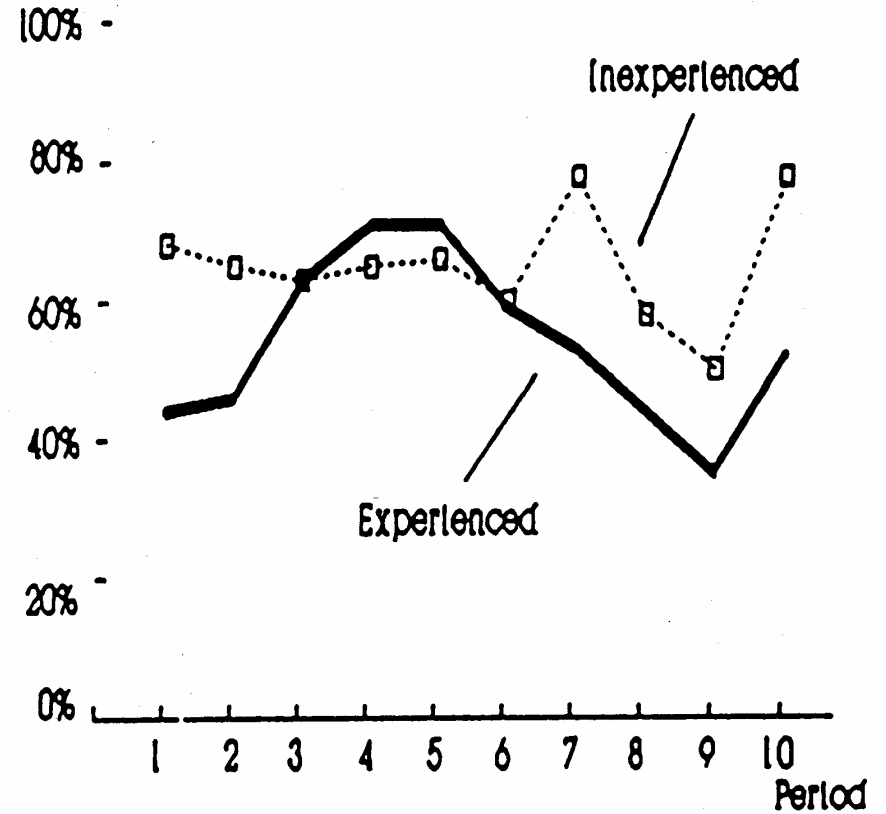
Further Results

- Experienced subjects cooperate significantly less.
- Experiments with larger groups (40 and 100)
 - Cooperation does not decline over time if $MPCR = .3$ and $n = 40$.
 - If $MPCR = .03$ and $n = 40$ cooperation rapidly declines.
 - Conjecture: If n increases at a constant $MPCR$ the probability of “beneficial” coalitions rises.
 - Assumes that subjects’ earnings at zero cooperation are a reference point. If sufficiently many cooperate they earn more although they also cooperate.

N = 4, MPCR = .3



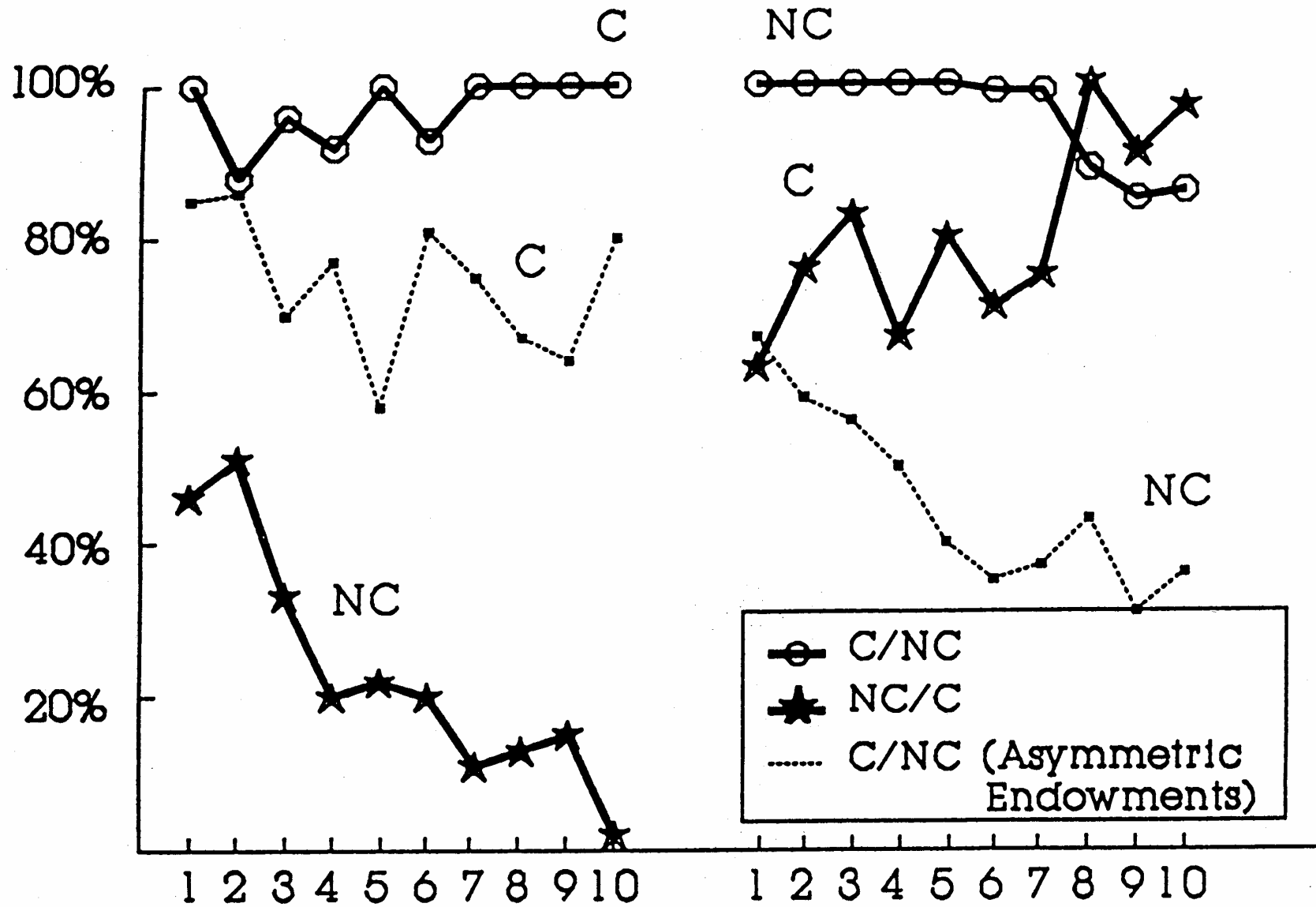
N = 10, MPCR = .75



From Davis & Holt 1993

Communication & Voluntary Cooperation (Isaac & Walker 1988)

- $n = 4$, $\alpha = .3$, two sequences with 10 periods each, partner design.
- Communication opportunities (C): Players can discuss what they want to do in the experiment. Yet, no revelation of endowments, no threat and no side payments allowed.
- Treatments
 1. C – NC, players have the same endowment.
 2. NC – C, players have the same endowment
 3. C – NC, asymmetric endowments.



Results

- Start with C: High cooperation rates; also in the second NC-phase.
- Start with NC: Unraveling of cooperation in NC but after C rapid increase in cooperation.
- Asymmetric endowments partly undermine positive communication effects.
- Interpretation
 - If selfishness and rationality is common knowledge communication should play no role.
 - Suggests that subjects have motives beyond self-interest
 - Keeping promises, sympathy, social approval
 - Conditional cooperation

Why do people cooperate?

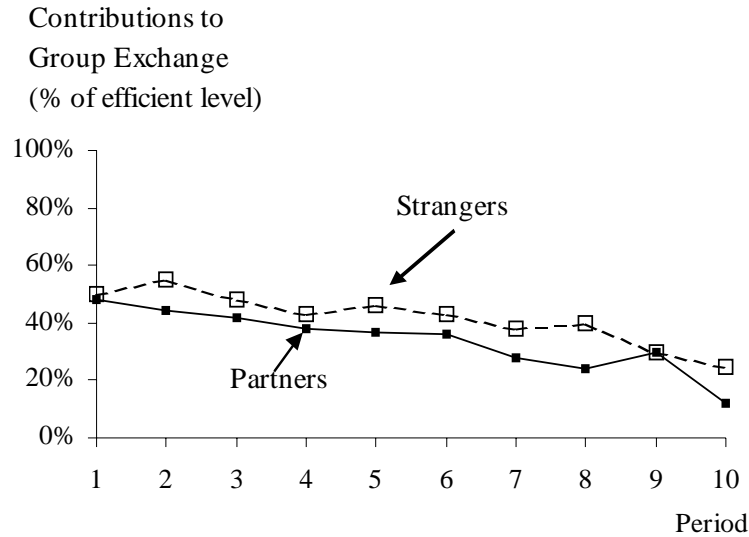
- Mistakes, initially they don't understand that zero cooperation is a dominant strategy.
- Strategic cooperation (Kreps et al., JET 1982)
 - There are strategic (rational) and tit-for-tat players.
 - Strategic players cooperate (except in the final period) if they believe they are matched with tit-for-tat players.
 - Strategic players mimic tit-for-tat players (i.e. they cooperate) to induce other strategic players to cooperate.
 - Holds for certain parameter values
- Social preferences
 - Altruism, “warm glow”, “efficiency”-seeking motives
 - Conditional cooperation, Reciprocity

Why does cooperation decline over time?

- Mistakes
 - It takes time to learn to play the dominant strategy.
- Strategic cooperation if group composition is constant.
- Social preferences
 - Subjects are conditionally cooperative and learn that there are free-riders in the group.
 - As a response they punish other group members by choosing lower cooperation levels.

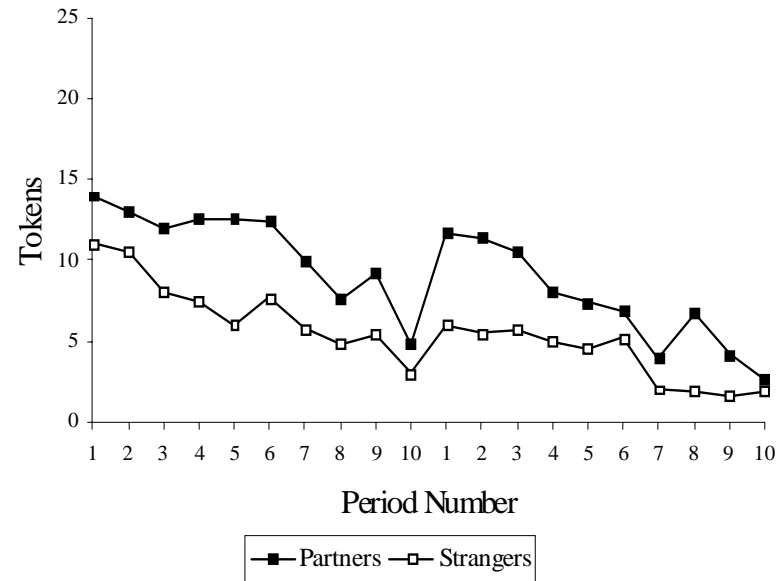
Discriminating between competing explanations

- One-shot-game rules out strategic cooperation but it also rules out learning to play the dominant strategy.
- Partner-Stranger-Comparison (Andreoni 1988)
 - Partner: same group composition in all periods.
 - Stranger: random recomposition of groups in every period.
 - If partners cooperate more: support for strategic cooperation hypothesis
 - However: It is also consistent with a miscoordination hypothesis. Conditional cooperators can better avoid miscoordination in a partner design.
- Surprise restart: if subjects cooperate again after a surprise restart the decline in cooperation cannot be explained with “learning to play the dominant strategy”.



Andreoni JPubE 1988

Claims that strangers cooperate more than partners. However, significance is only achieved by treating each individual decision as an independent observation.

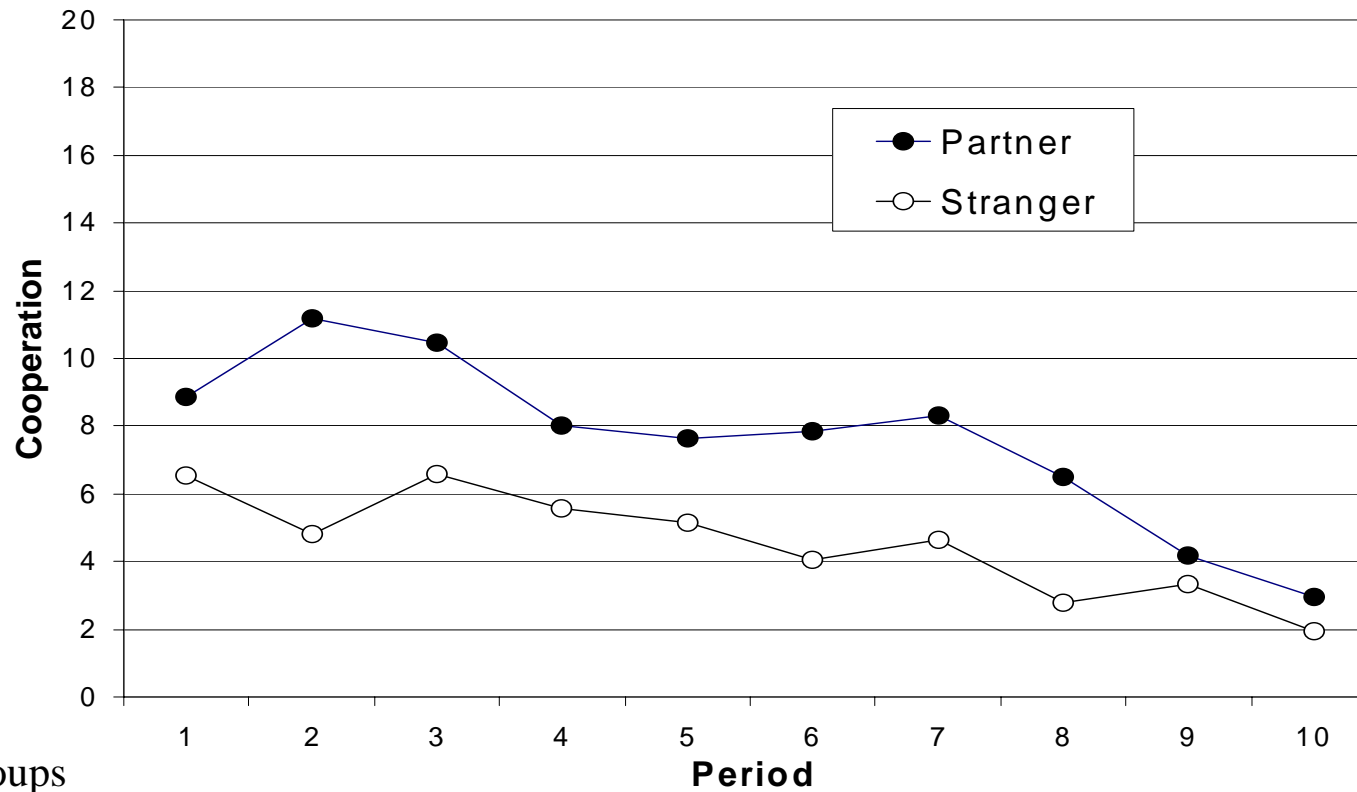


Croson 1996

Partners contribute more than strangers
 Note the increase after the restart in period 11.
 Andreoni 1988 also observed a restart effect.

Partners versus Strangers

Cooperation of Partners and Strangers (Source: Fehr and Gächter AER 2000)



6 partner groups

2 stranger sessions with 6 groups each

Is voluntary cooperation a mistake?

- In previous experiments: Zero cooperation is a dominant strategy for selfish players.
- Every mistake causes a contribution above the equilibrium.
- Question: Do subjects play an interior dominant strategy equilibrium or do they still overcontribute relative to the standard prediction?

- $\pi_i = v(y - c_i) + \alpha \sum c_i$, v is concave and v' is linear in $y - c_i$
- FOC: $v'(y - c_i) = \alpha$
- Generates an interior dominant strategy equilibrium (with the right parameters)

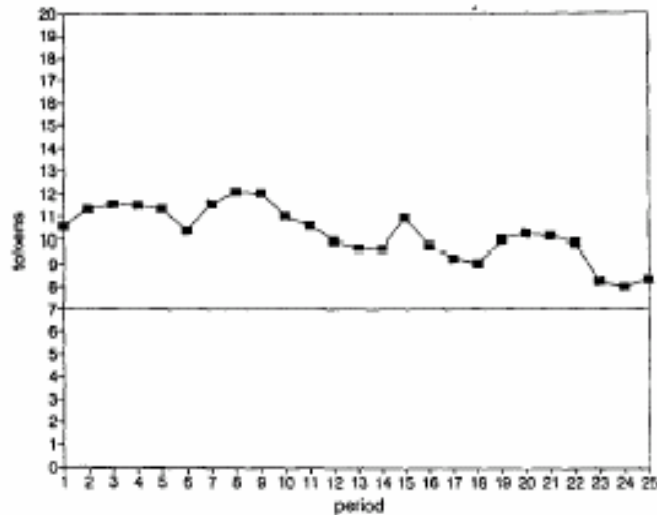


Fig. 1. Time path of the average contribution to activity B.

Keser (Economic Letters 1996)
 Willinger&Ziegelmayer (Exp. Econ 2001)
 Overcontributions also occur if the dominant strategy equilibrium implies very high contributions.
 Mistakes cannot explain voluntary cooperation

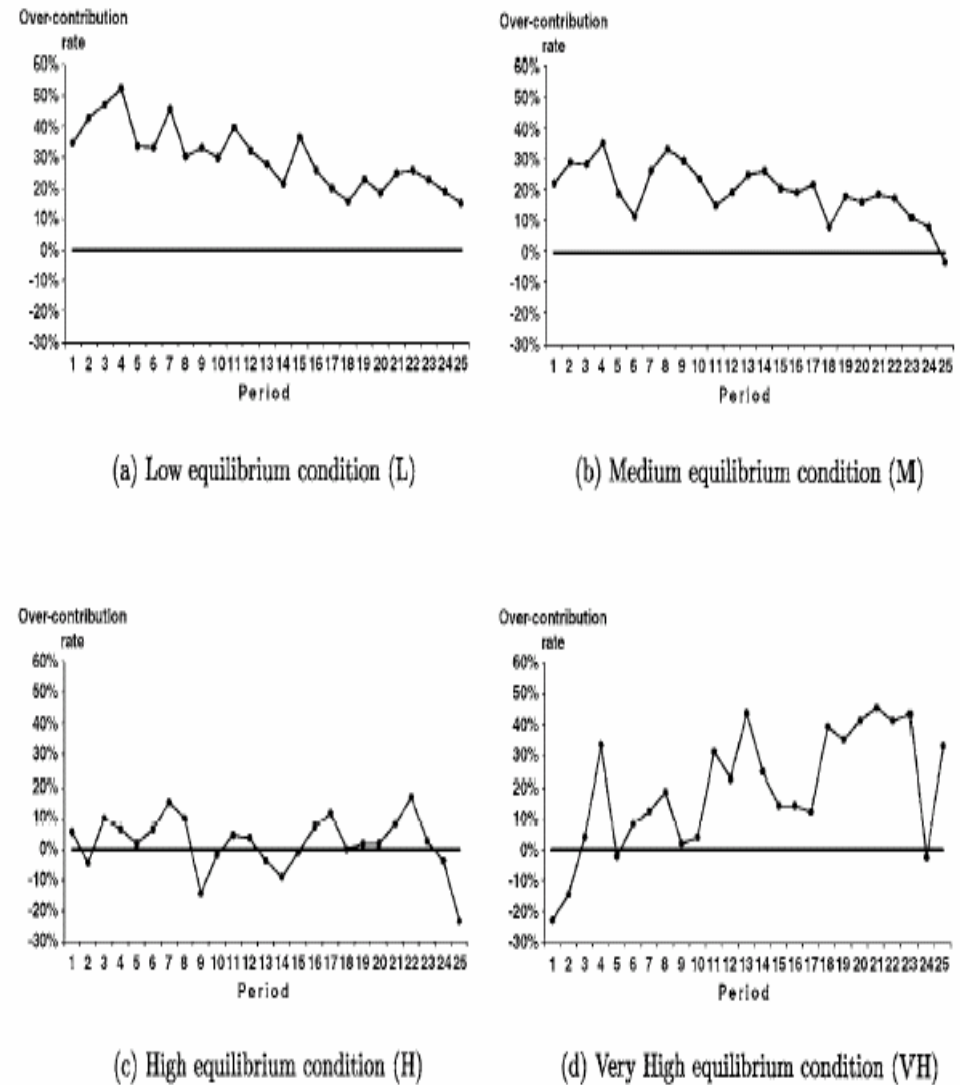


Figure 2. Time paths of the average over-contribution rate to the public activity.

Direct Evidence for Conditional Cooperation (Fischbacher, Gächter & Fehr Econ Lett 2001)

- $n = 4$, MPCR = .4
- One-shot game
- Subjects choose...
 - An unconditional contribution
 - A conditional contribution, i.e., for every given average contribution of the other members they decide how much to contribute.
- At the end one player is randomly chosen. For her the contribution schedule is payment relevant, for the other three members the unconditional contributions is payment relevant.
 - A selfish player is predicted to always choose a conditional contribution of zero.
 - Note that a selfish player may have an incentive to choose a positive unconditional contribution if she believes that others are conditionally cooperative.

Decision Screen

Periode 1 von 1 Verbleibende Zeit [sec]: 28

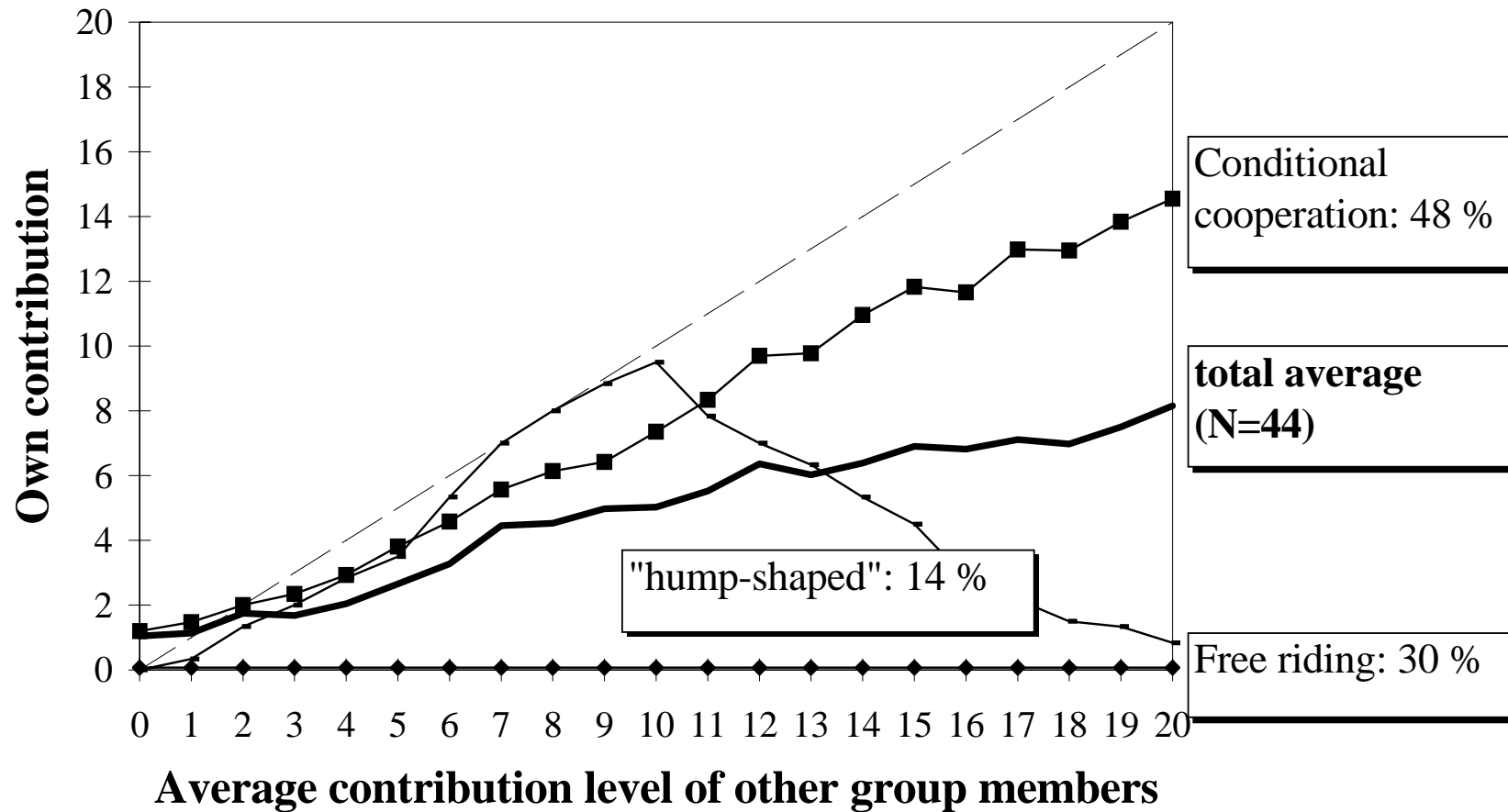
Ihr bedingter Beitrag zum Projekt (Beitragstabelle)

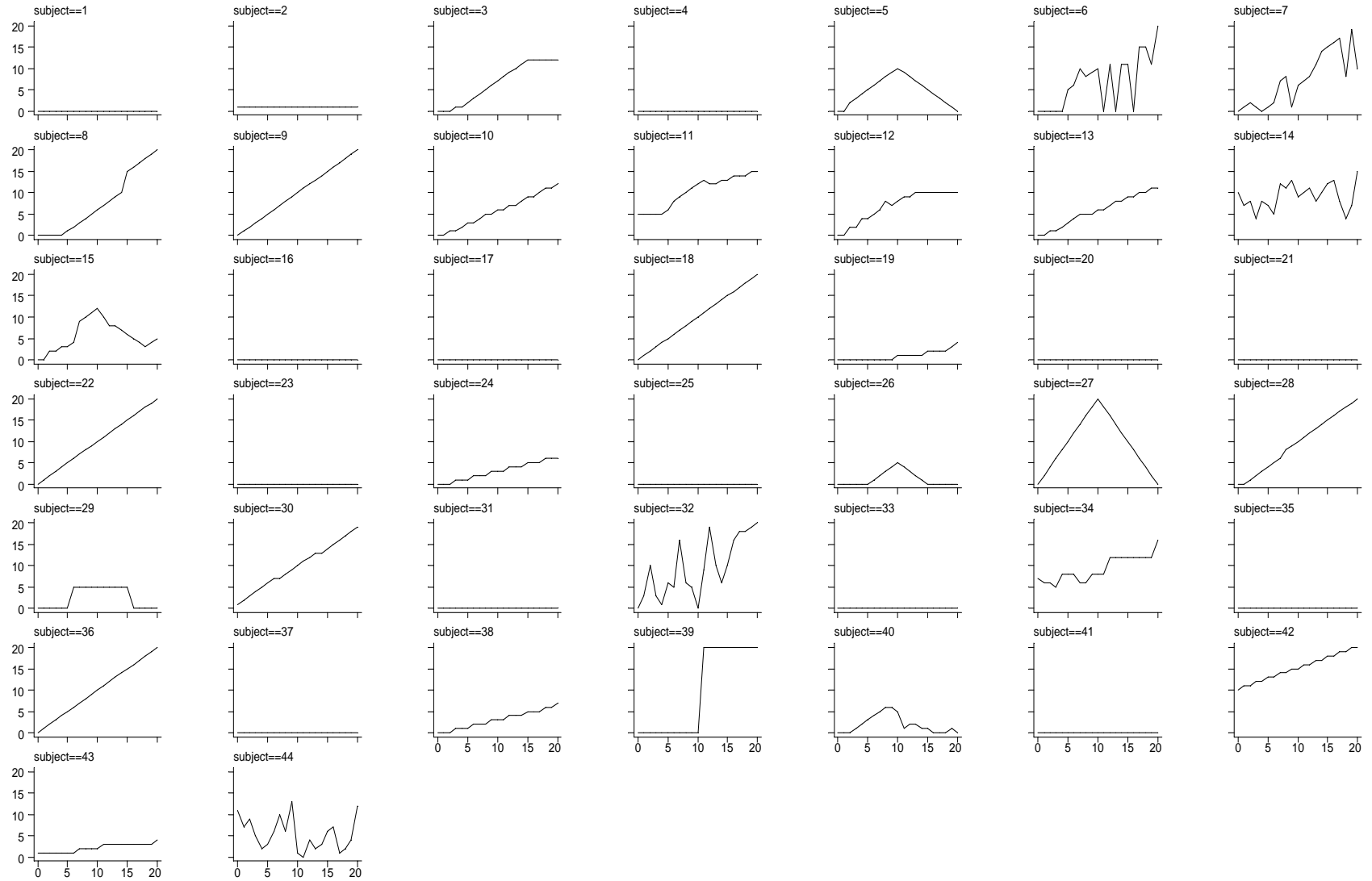
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5	<input type="text"/>	12	<input type="text"/>	19	<input type="text"/>
6	<input type="text"/>	13	<input type="text"/>	20	<input type="text"/>

Hilfe

Geben Sie in den Feldern ein, welchen Beitrag zum Projekt Sie leisten, wenn die anderen im Durchschnitt den Beitrag zum Projekt geleistet haben, der links vom Eingabefeld steht.
Wenn Sie alles eingegeben haben, drücken Sie "OK".

Average own contribution level for each average contribution level of other group members (Source: Fischbacher, Gächter & Fehr EL 2001)

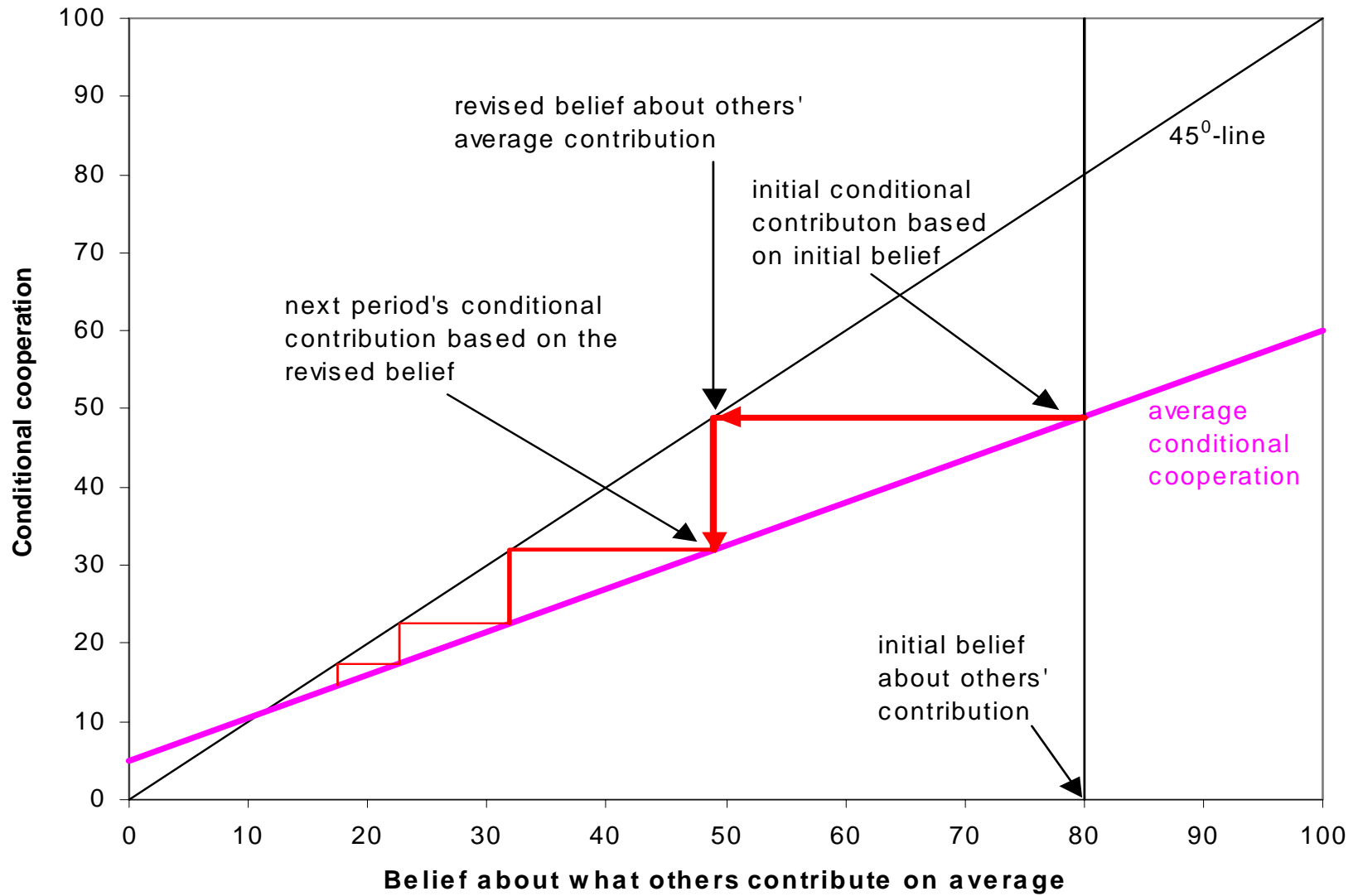




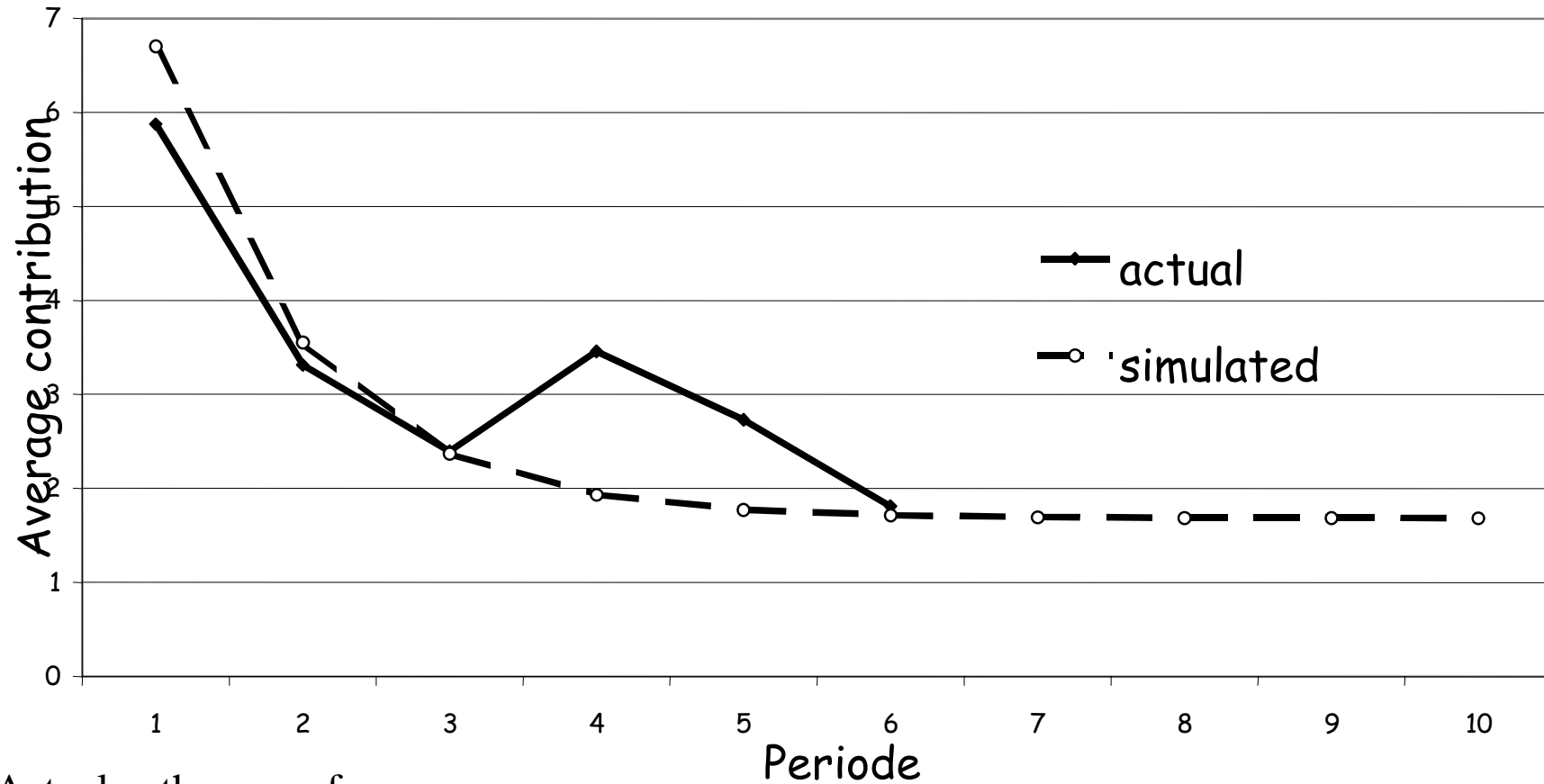
Contribution other group members
Contribution schedules per subject

Results

- Unconditional cooperation is virtually absent.
- Heterogeneity:
 - Roughly half of the subjects are conditional cooperators.
 - Roughly one third is selfish.
 - A minority has a “hump-shaped” contribution schedule
- **Question:** Can the observed pattern of conditional cooperation explain the unraveling of cooperation?
 - Assume adaptive expectations. Subjects believe that the other group members behave in the same way as in the previous period.
 - This implies that over time the conditional cooperators contribute little although they are not selfish.
 - This result holds qualitatively for any kind of adaptive expectations.



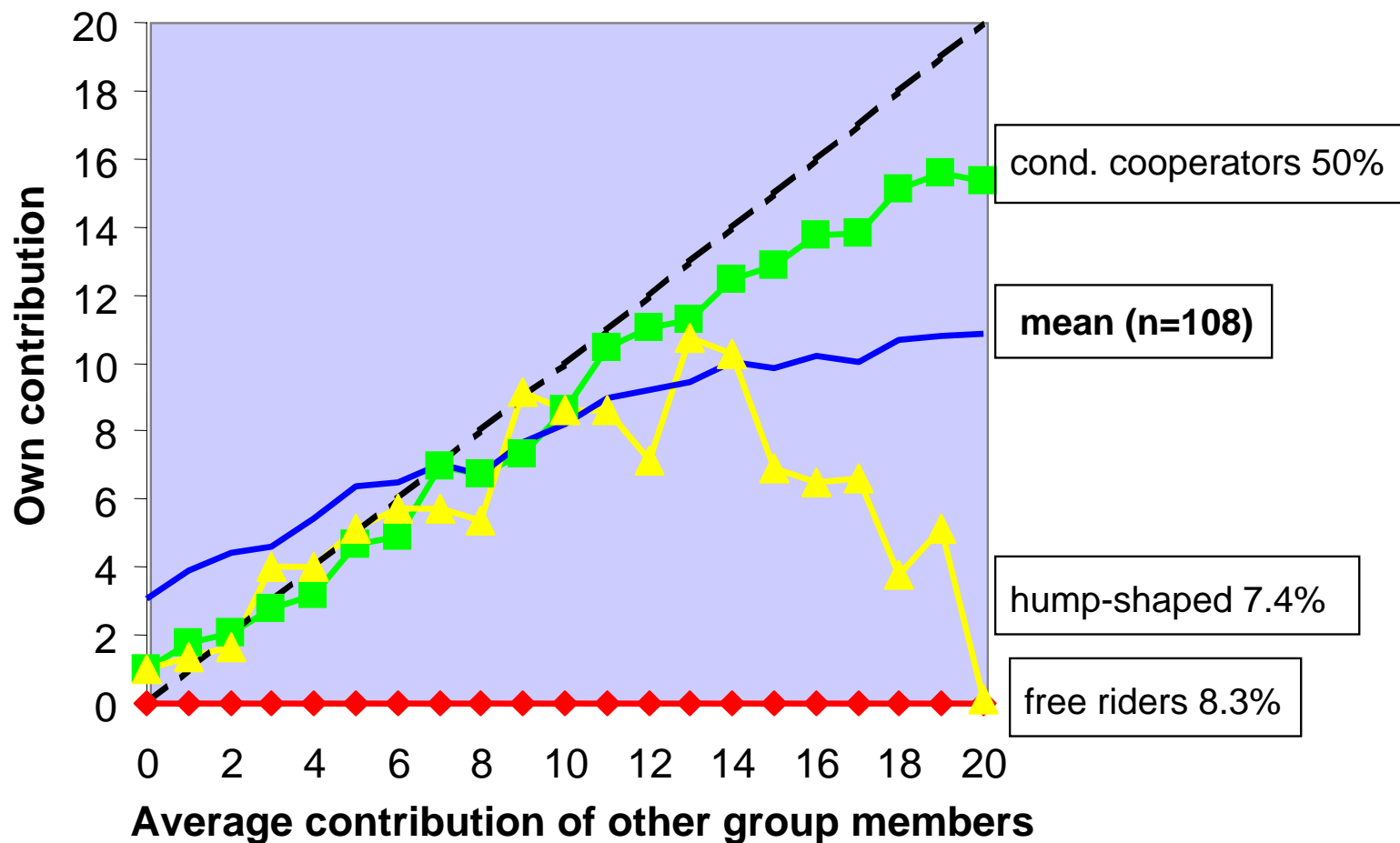
Simulated path and actual experimental path of average



Actual path comes from a perfect stranger treatment by Fehr & Gächter

Conditional Cooperation in Russia (Belgorod, Bryansk and Kinel, N=108)

Gächter & Herrmann (2002)



The relevance of conditional cooperation

- Part of an explanation of several features of actual cooperation behavior in experiments.
 - Positive contributions
 - Unraveling of cooperation
 - Restart effect
 - Cooperation enhancing effect of communication
- Open question
 - Why are many people conditionally cooperative?

The laboratory as a wind tunnel

(Falkinger, Fehr, Gächter, Winter-Ebmer AER 2000)

- The Falkinger mechanism for public goods provision
 - For every \$ above the average contribution of the others (in your income class) you are paid \$ β . For every \$ below you have to pay \$ β .
- Mechanism has nice features.
 - Simple
 - In the Nash-equilibrium the public good is provided at an efficient level.
 - Low information requirements for the regulator.
 - The public budget is always (in and out of equilibrium) balanced.
- The mechanism in a linear PG
 - $\pi_i = y - c_i + \alpha \sum c_i + \beta(c_i - C_{-i}/(n-1))$
 - $d\pi_i/dc_i = -1 + \alpha + \beta$; positive, if $\beta > 1 - \alpha$

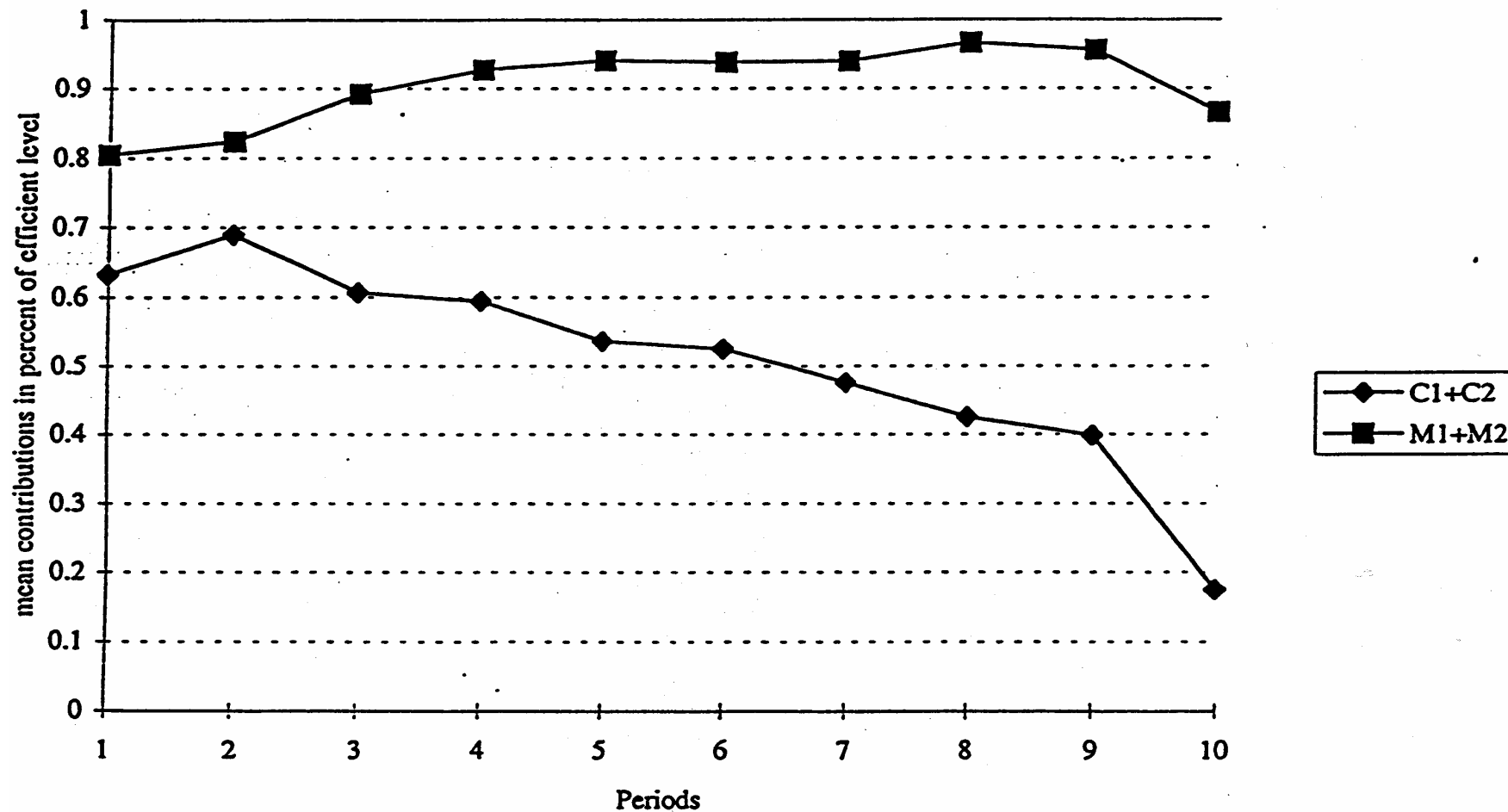
Does the mechanism work in practice?

- ...with boundedly rational subjects.
- ...if a percentage of the subjects exhibits social preferences.
 - Contributing \$1 creates a net gain of $\alpha + \beta - 1$ and the other group members gain $\alpha - \beta / (n - 1)$, which is higher if $\beta < (n - 1) / n$
 - Does envy induce people to contribute inefficiently little?
- How does a potential interaction between bounded rationality and social preferences play out.

Design

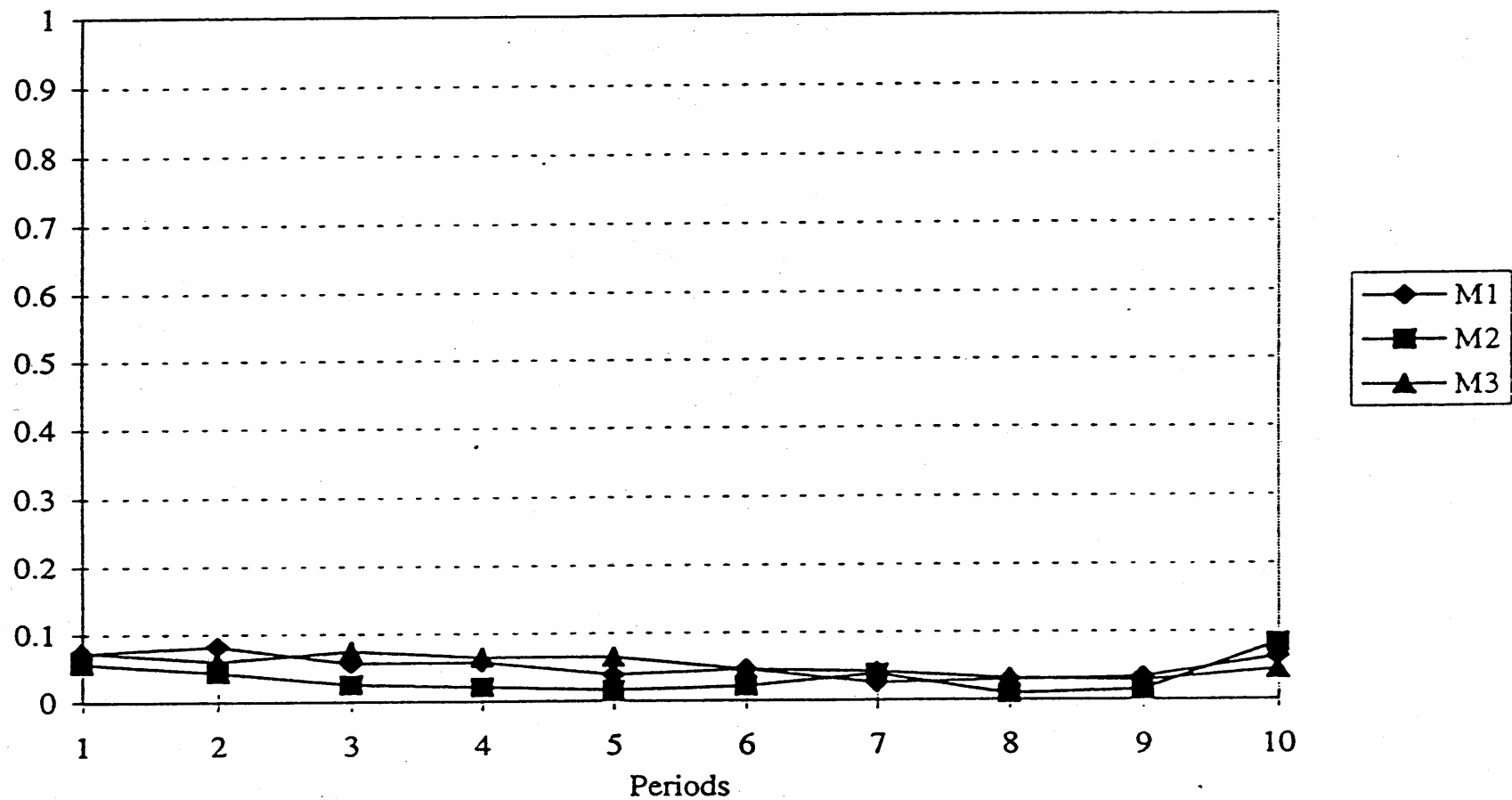
- Main experiment
 - $n=4$, $\alpha=0.4$, $\beta=0.7$
 - 10 periods
 - Treatment with the mechanism and a control treatment without the mechanism.
- Checking the mechanism's robustness with further experiments
 - $n=8$, $n=16$
 - Interior Nash-equilibrium (concave utility of the private good).
 - Heterogeneity: Subjects have different returns from the private good.
 - 20 periods

Fig. 1: Mean contributions in mechanism treatments M1 and M2 and control treatments C1 and C2



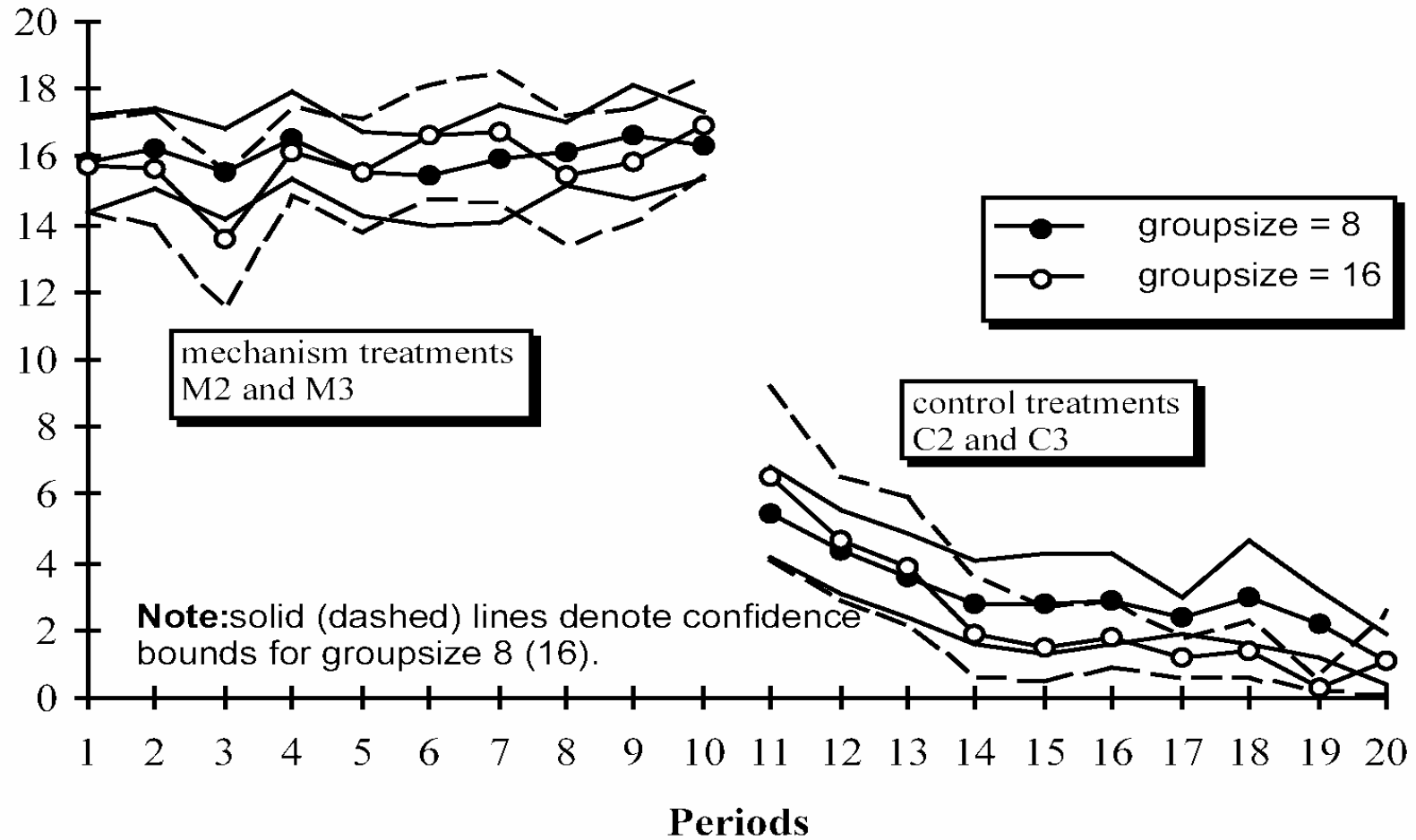
From Falkinger et al. AER 2000
Corner equilibria

Fig. 3: average tax or transfer payment as a percentage of subjects' endowment



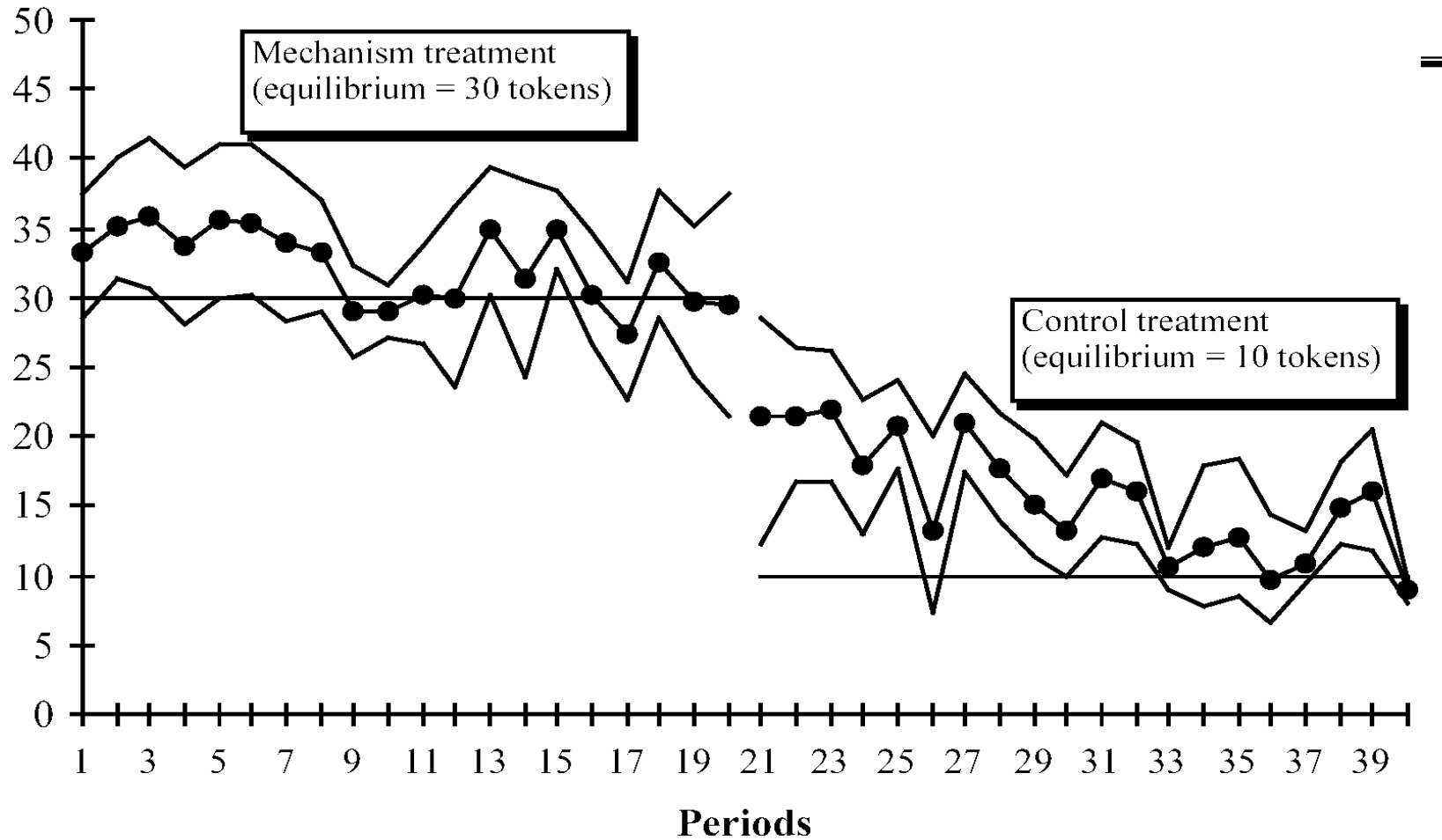
From Falkinger et al. AER 2000
Corner equilibria

Figure 3: The effects of group size



From Falkinger et al. AER 2000
 Corner equilibria

Heterogeneous (Induced) Preferences



From Falkinger et al. AER 2000
Interior equilibria

Results

- Contributions in the linear control treatment converge towards 18%.
- Contributions in the linear mechanism treatment are 90% from period 3 onwards.
- If the mechanism treatment comes after the control treatment it takes longer to reach high contribution levels but even then contributions quickly converge towards 90%.
- Variance of contributions in the mechanism treatment is much lower.
- Actual transfer payments are relatively low.

Cooperation, Punishment & Social Norms

(Fehr & Gächter AER 2000, NATURE 2002)

- A social norm is
 - a behavioral regularity that
 - rests on a common belief of how one should behave and
 - is enforced by informal sanctions.
- Remark: In the case that there is no conflict between privately optimal behavior and the behavior prescribed by the norm there is nothing to enforce.
- Coleman (Foundations of Social Theory, 1990) proposes that there is a demand for social norms (i.e. the should component emerges naturally) in situations where private actions create externalities.
- Coleman (1990): “A norm exists only when others assume the right to affect the direction an actor’s action will take. [...] Acceptance of the legitimacy of others’ right to partially control his action is necessary to establish the norm that gives him a legitimate right to control others’ similar actions.”
- Example: The no-smoking norm emerged after it became clear that passive smoking is detrimental for health.

Examples of Social Norms

- Don't lie
- Keep promises.
- Wear similar cloth as your peers.
- Norms with regard to club membership, union membership and preferences for political parties. (Akerlof 1980).
- Norms against rate busters in piece rate systems (Whyte 1955), Roethlisberger, Dickson 1947).
- Norms against strike breaking: “To isolate those who supported the ‘scab union’, cinemas and shops were boycotted, there were expulsions from football teams, bands and choirs and ‘scabs’ were compelled to sing on their own in their chapel services. ‘Scabs’ witnessed their own ‘death’ in communities which no longer accepted them” (Francis’ 1985, p. 269, strike of the British miners in 1984).
- Norms against the overexploitation of common resources (Ostrom 1991).
- Many of these examples indicate a public goods aspect of social norms.

Standard Economic Approach of Modeling Social Norms

- Subgame perfect equilibria in infinitely repeated games.
- Approach shows nicely what is possible.
- Standard approach is incomplete in important respects.
 - Little predictive content because of too many equilibria.
 - Does not deal with the normative component of a social norm, i.e. it makes not prediction what individuals should do.
 - Emotions are typically left out of the picture although they are likely to be a driving force of norm enforcement.
- Idea: violations of social norms trigger negative emotions which in turn trigger a willingness to punish the violators.
- This contributes to the enforcement of the norm.

A Cooperation and Punishment Experiment

- Stage 1: typical linear public goods design: $n = 4$, $\alpha = 0.4$.
- Stage 2: Punishment opportunity
 - Subjects are informed about each member's contribution.
 - Subjects can punish other group members at a cost to themselves.
 - A punished subject could not lose more than the first-stage income.

Punishment	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Costs	0	1	2	4	6	9	12	16	20	25	30

Treatments

- Two partner sessions: no pun – pun and pun – no pun.
- Each part of the sequence lasted 10 periods.
- Subjects in the first part of the sequence did not know that there is a second part.
- 3 Stranger-Session: two times pun – no pun. Once no pun – pun.

- In the Nature (2002) paper we had 5 perfect stranger sessions with pun – no pun and 5 sessions with no pun – pun.

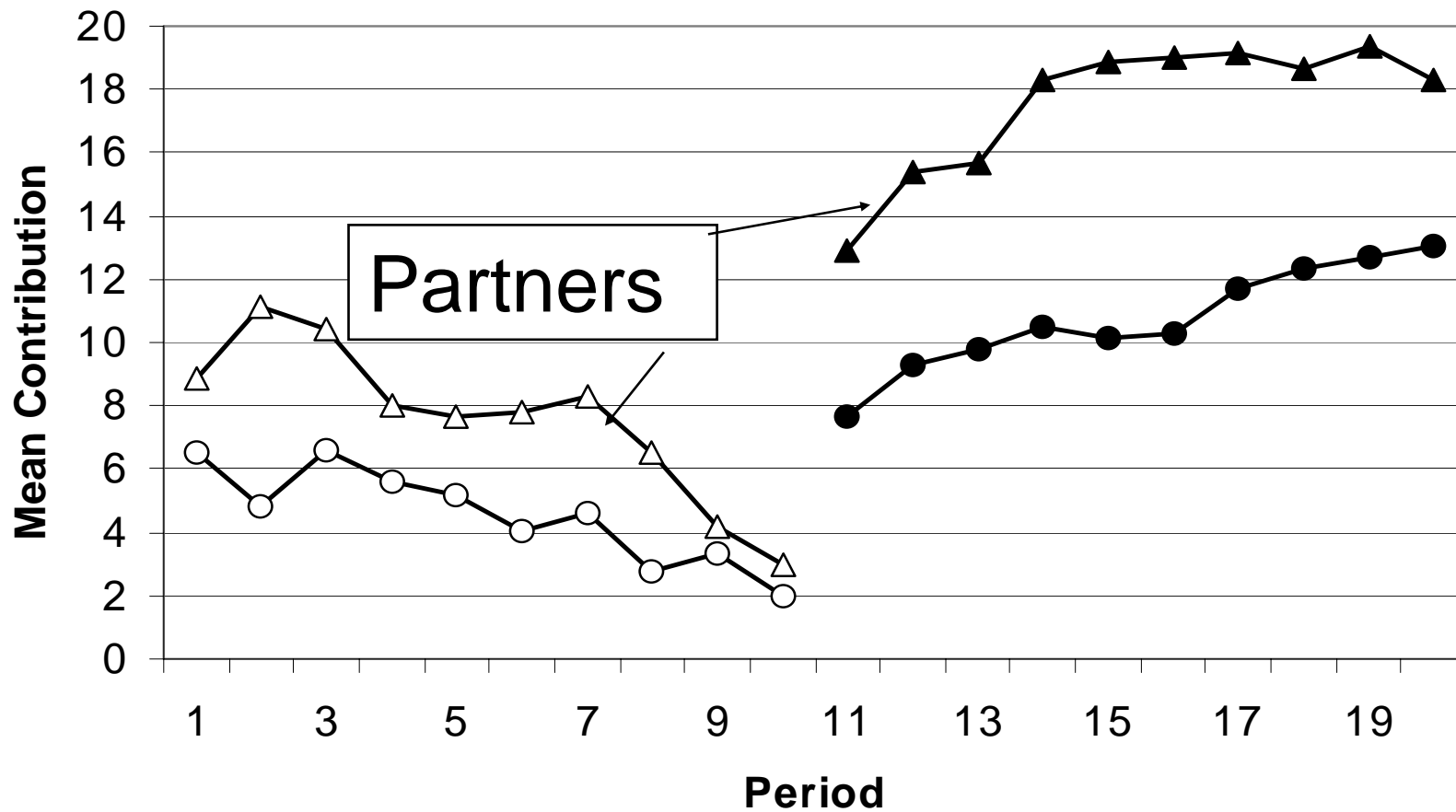
Predictions

- It is common knowledge that each subject is a money maximizer and rational:
 - No punishment
 - No contribution regardless of whether there is a punishment opportunity.
- If common knowledge is absent, subjects in the partner treatment are able to build up a group reputation (“There are punishers in the group, hence it is better to cooperate”)
 - Partner: Cooperate and punish in early periods but stop cooperating and punishing at least in the final period.
 - Stranger: no punishment and no cooperation.

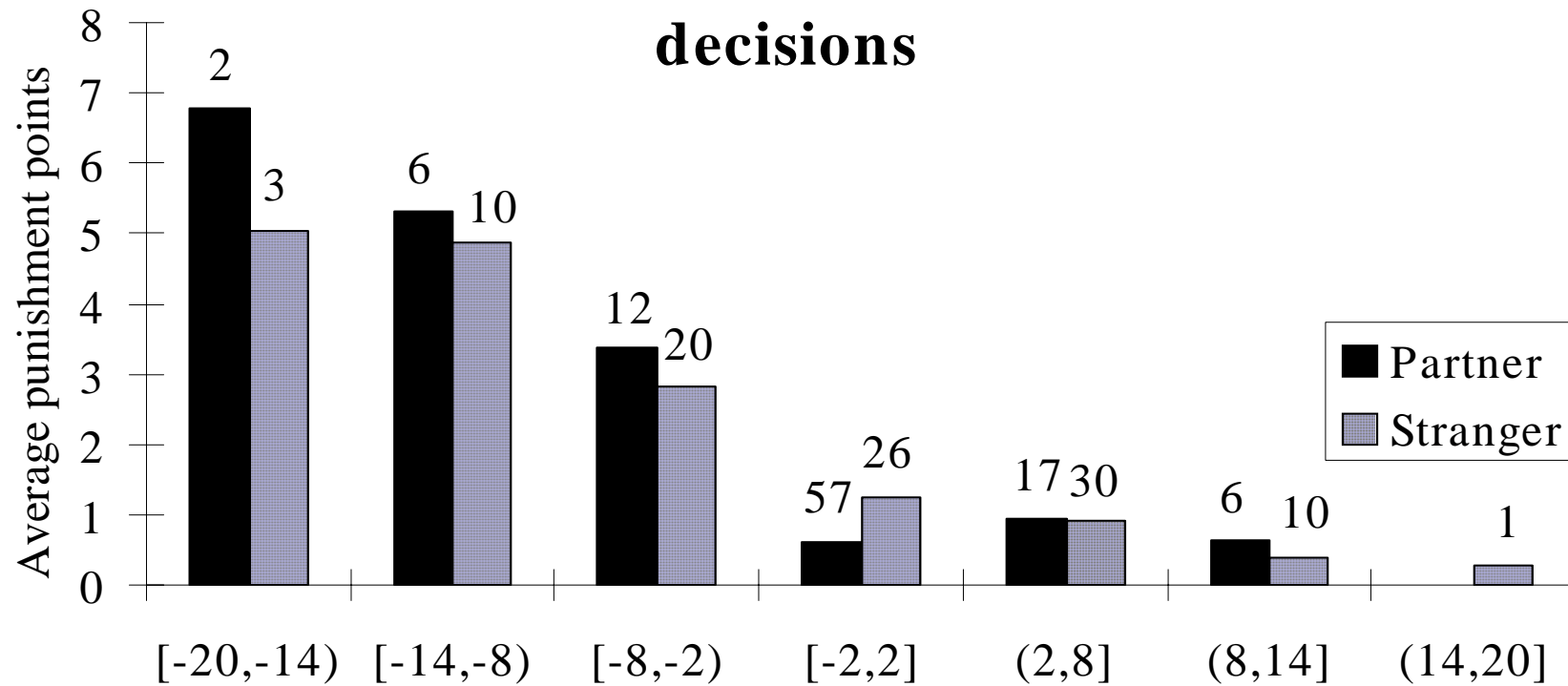
Alternative Views

- Part of the subjects have a preference for reciprocity. They reward nice and punish hostile behavior.
- The relevant reference point for the definition of kindness is “conditional cooperation”. Two variants:
 - If I cooperate the other members should cooperate as well.
 - The other group members’ average cooperation as a reference point.
 - Reference point question is unsolved yet.
- Conditional cooperation is perceived as nice. Free-riding relative to the reference point is perceived as hostile and is, hence, punished.
- Punishment stabilizes cooperation in the group.

Cooperation with and without Punishment (Fehr & Gächter AER 2000)



Received punishment points per deviation from average and percentage of decisions



Deviation from the mean contribution of the other group members

A More Detailed Picture

Figure 1a: Average punishment points and average contributions in Session 1 (partner)

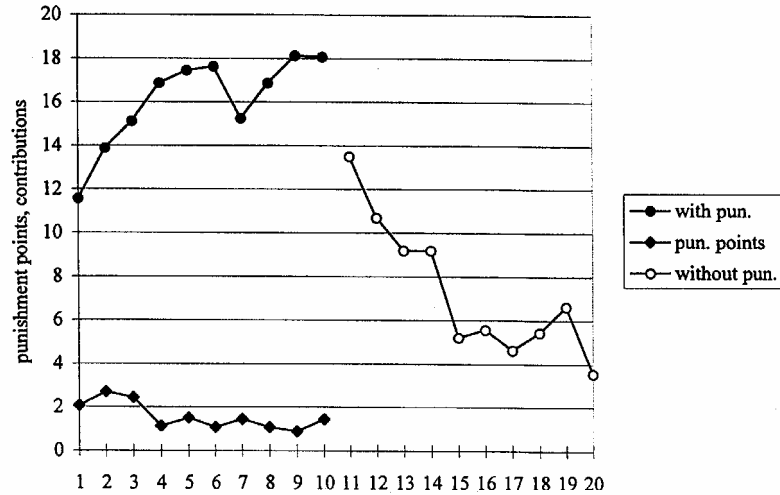


Figure 1b: Average punishment points and average contributions in Session 2 (partner)

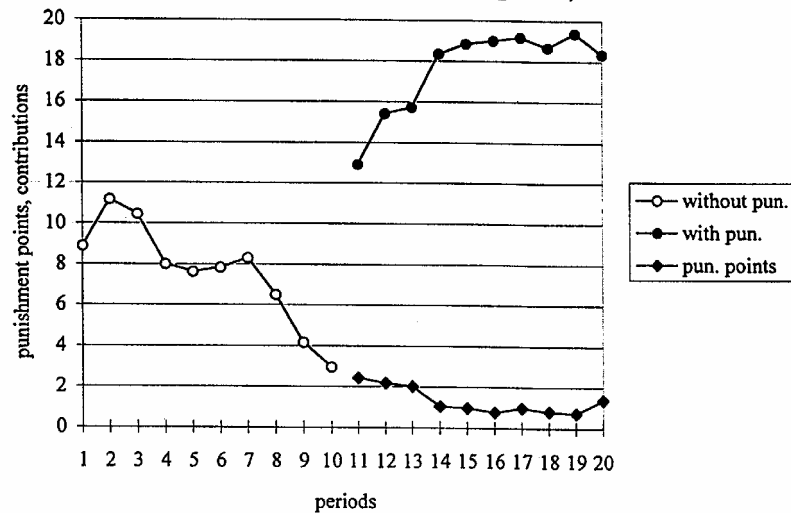


Figure 1e: Average punishment points and average contributions in Session 5 (stranger)

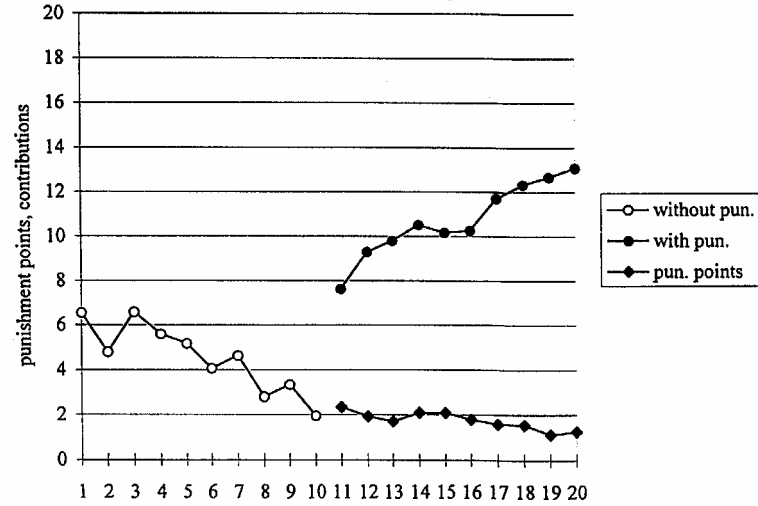
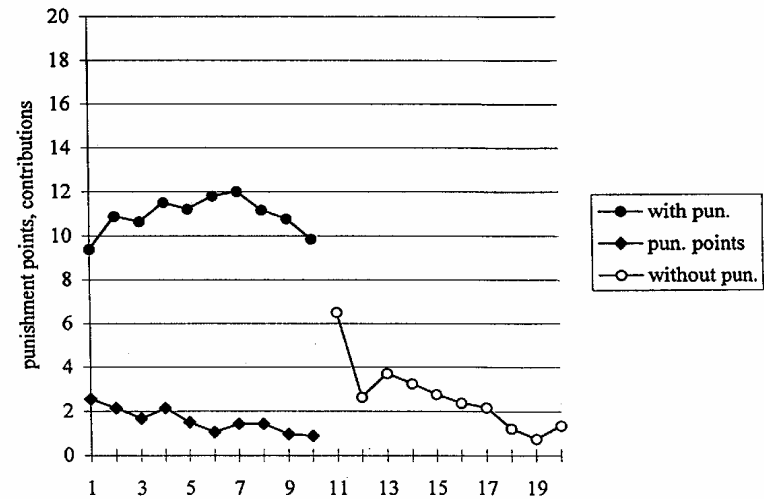


Figure 1c: Average punishment points and average contributions in Session 3 (stranger)



Distribution of Contributions over all periods

Figure 2: Distribution of contributions in partners and strangers treatments with and without punishment

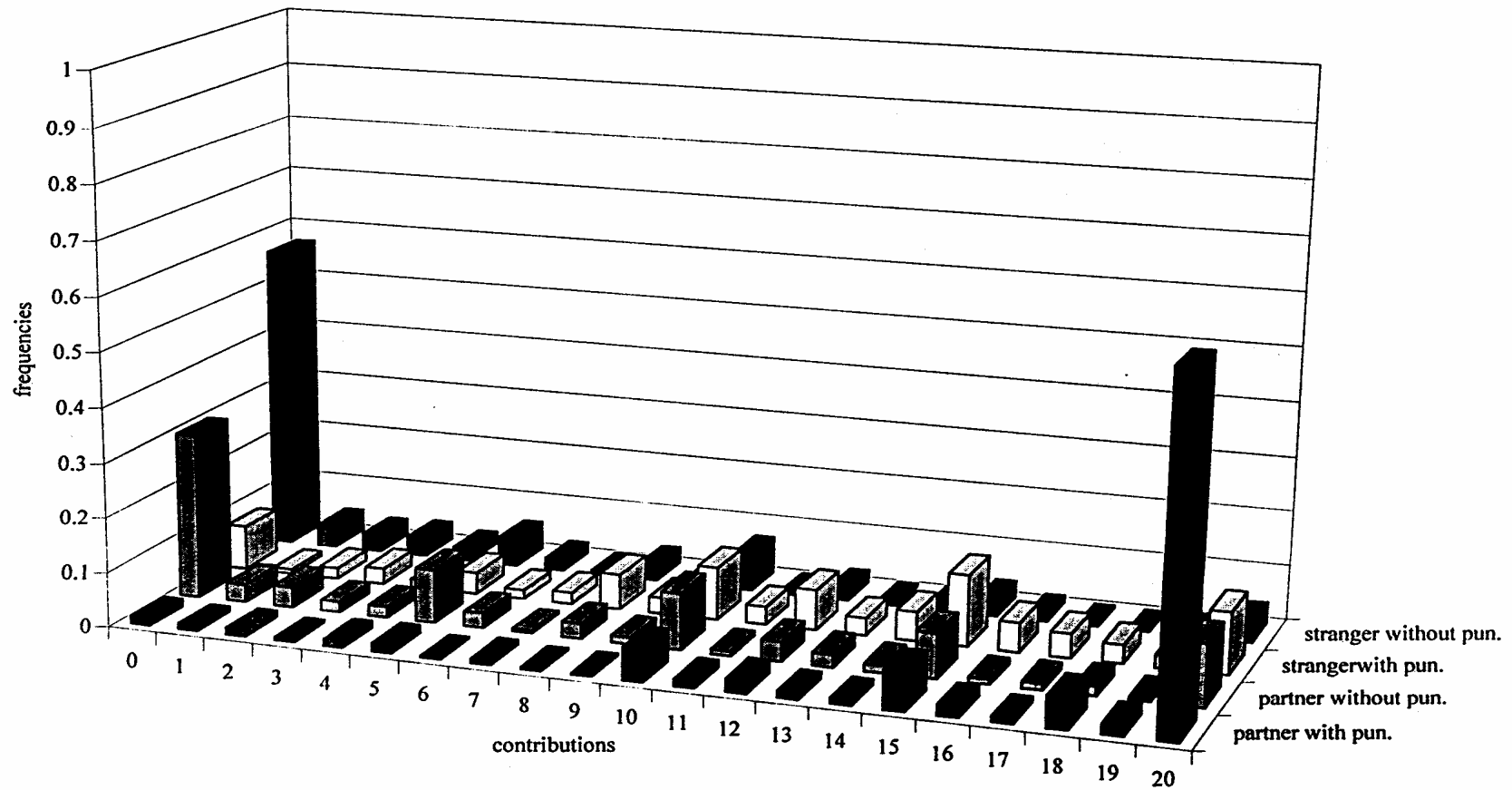
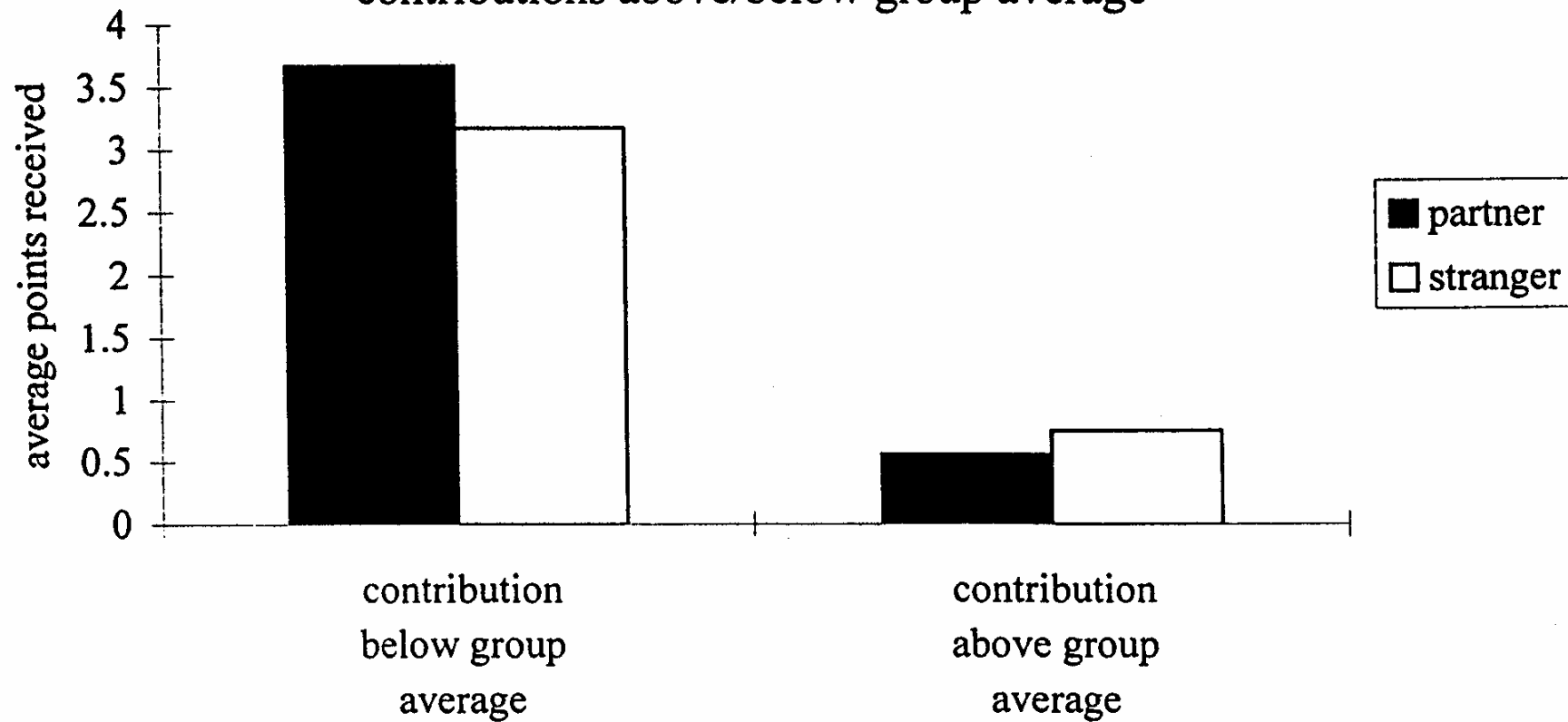
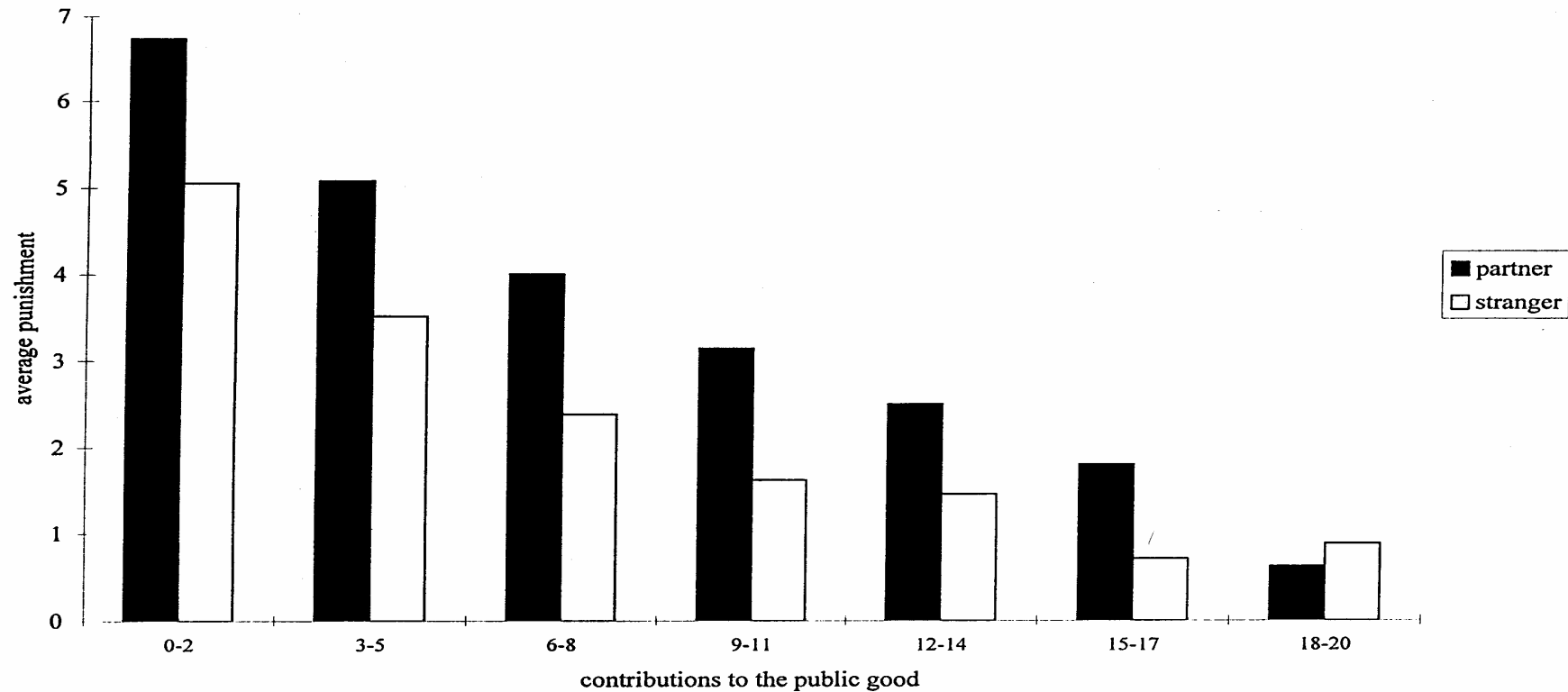


Figure 5: received points in PARTNER and STRANGER for contributions above/below group average



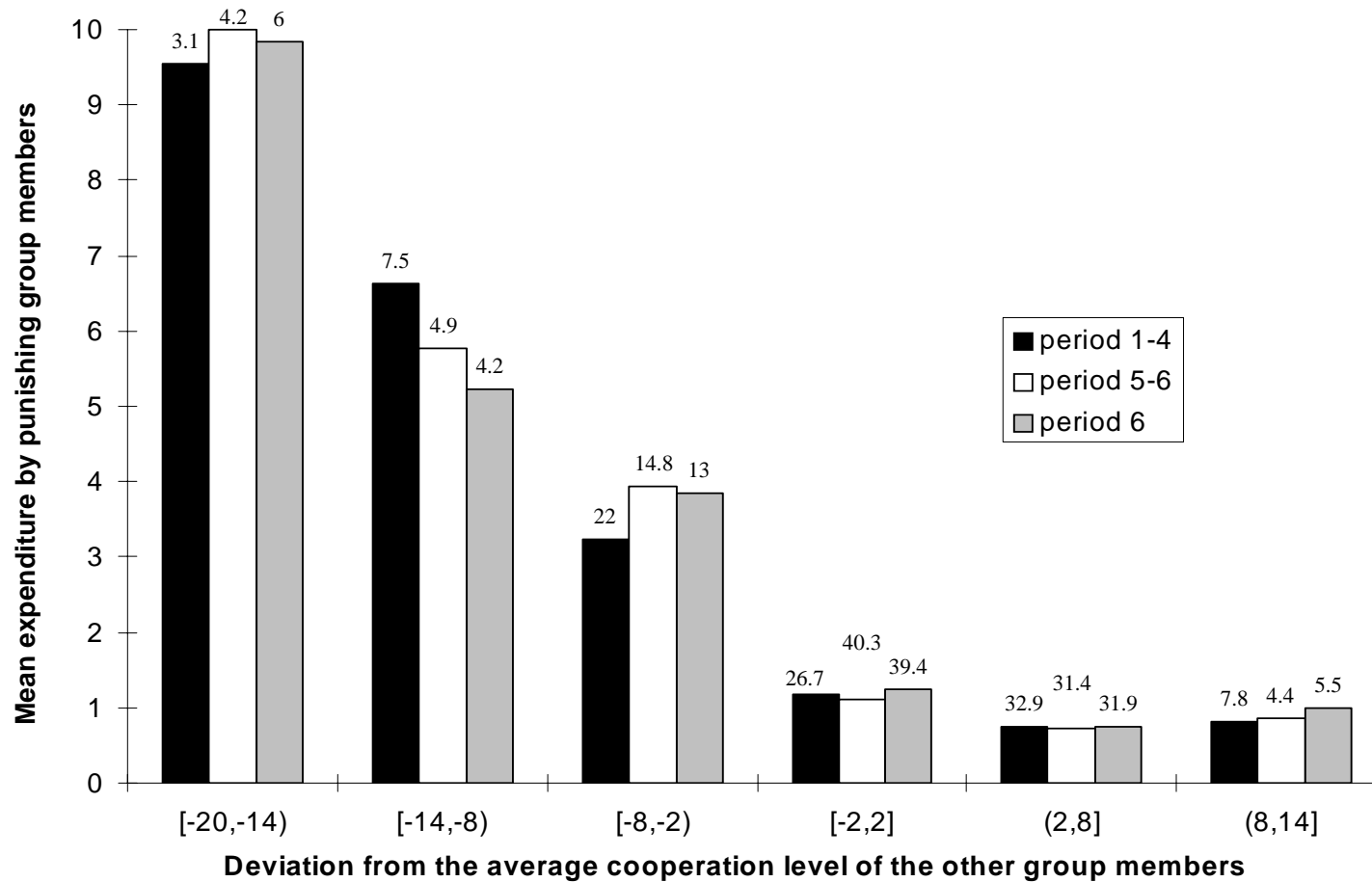
Received punishment for given contribution

Figure 3: received punishment for a given contribution to the public good: comparison of PARTNER and STRANGER treatment



Reference point below which subjects are punished is lower in stranger treatment

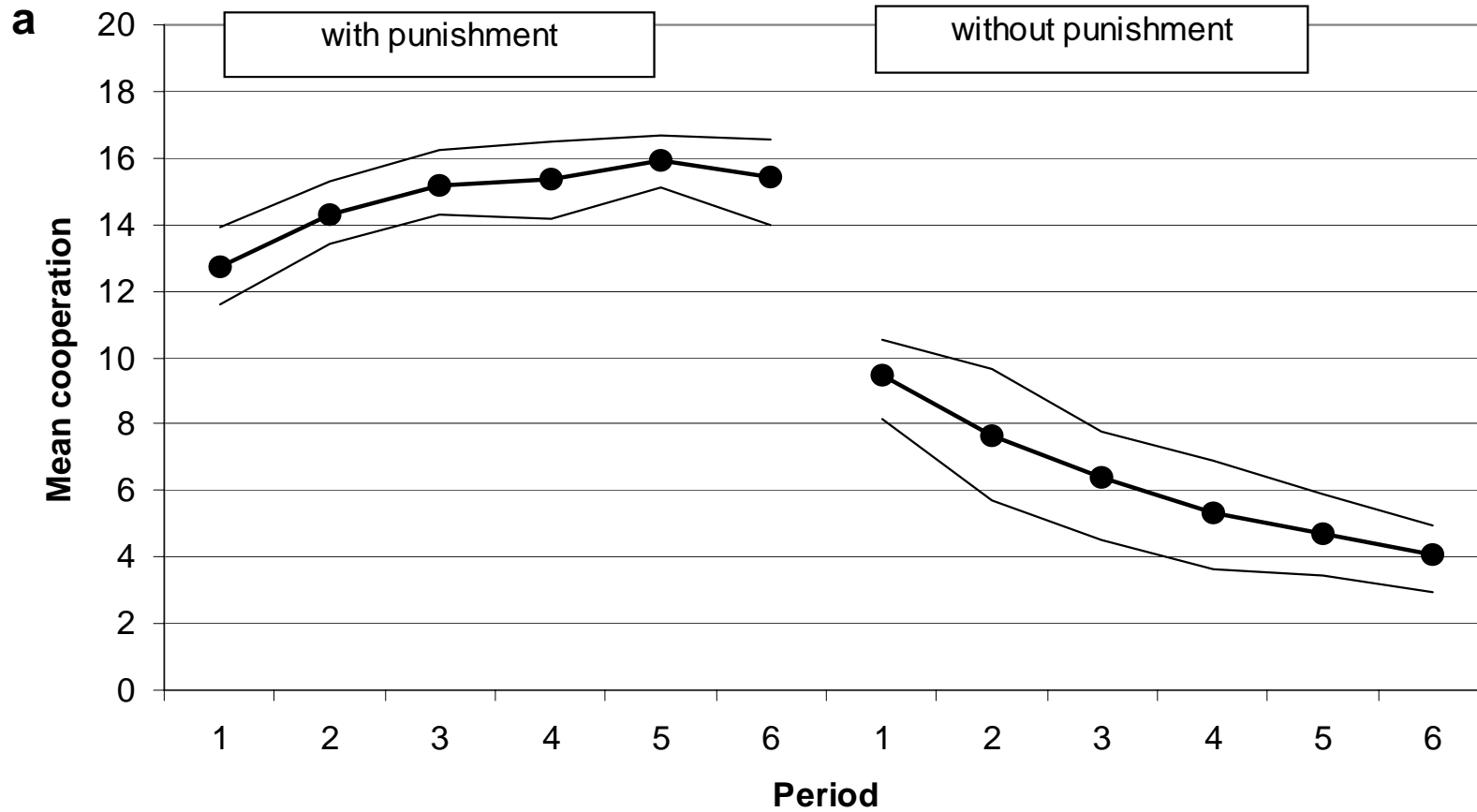
Punishment among Perfect Strangers



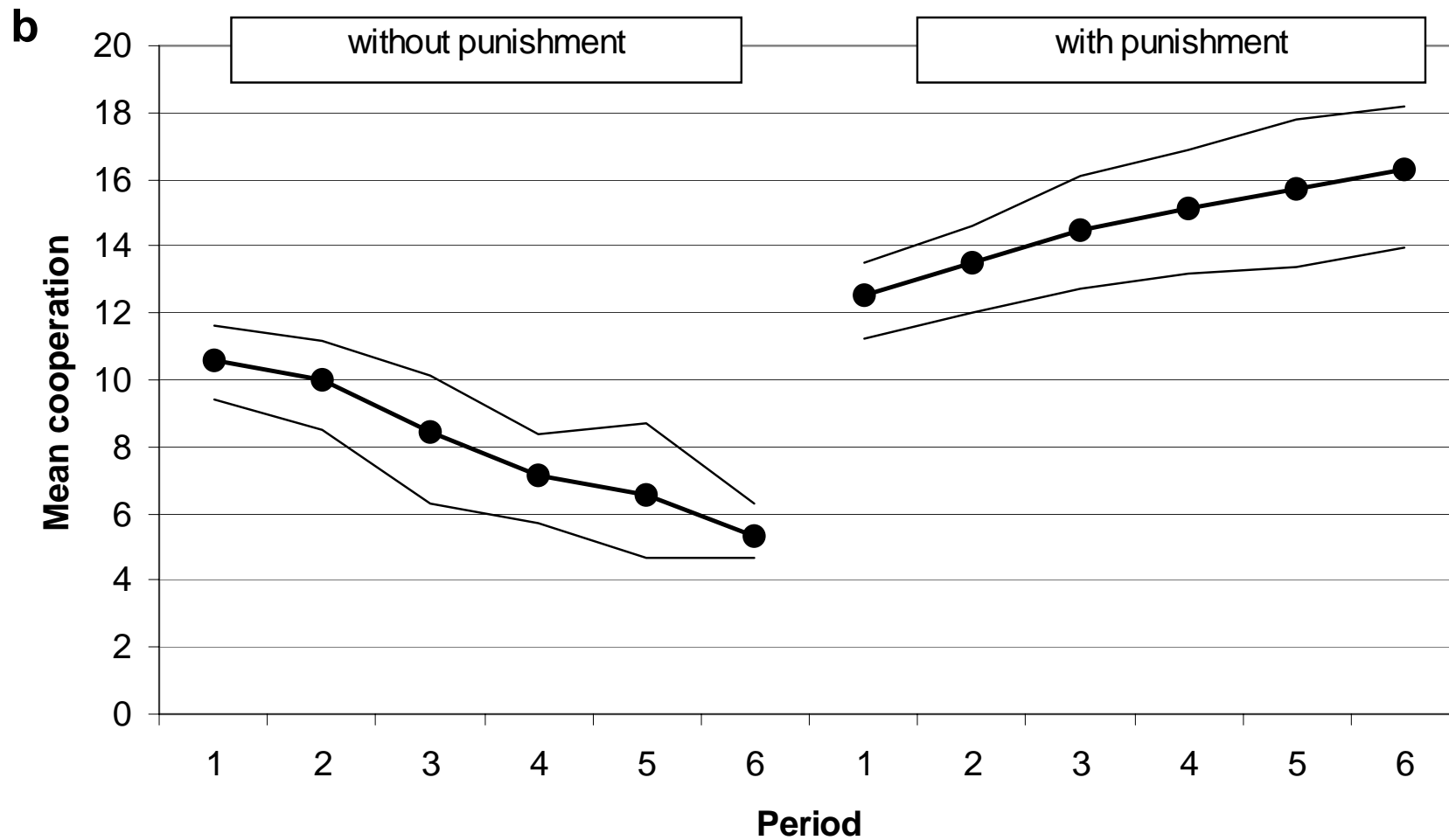
Source: Fehr&Gächter
Nature 2002

Ernst Fehr – Experimental & Behavioral Economics

Cooperation among Perfect Strangers

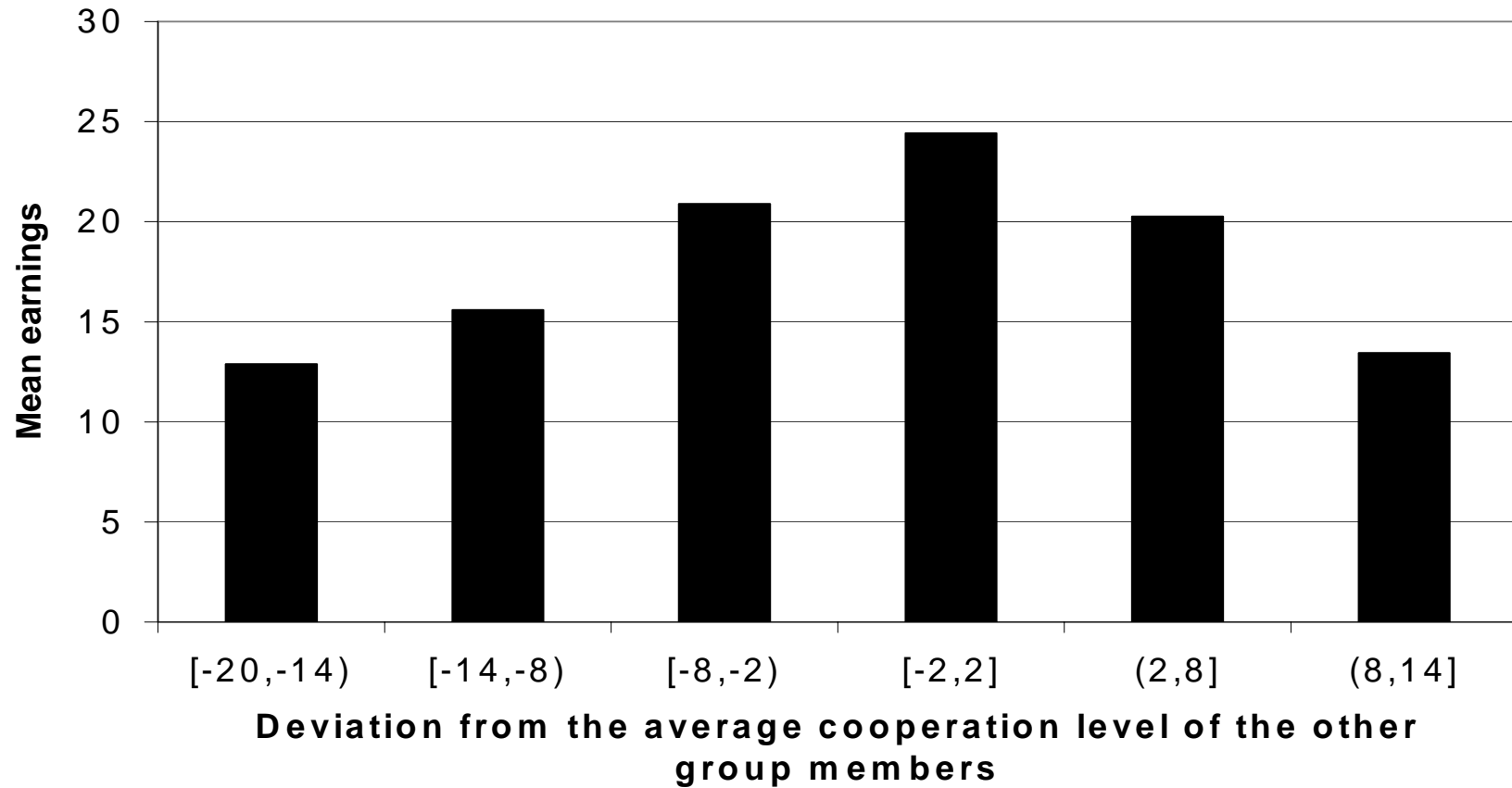


Source: Fehr&Gächter
Nature 2002



Source: Fehr&Gächter
Nature 2002

Punishment Incentives to Obey the Norm



Based on: Fehr&Gächter
Nature 2002

Conclusions

- Punishment opportunity allows enforcement of cooperative norms.
- Subjects whose contributions are below a relevant reference points are punished.
- By those who cooperate
- This also enhances cooperation in a perfect stranger design.

Results have been replicated in many other studies

- Sefton, Shupp & Walker (2002)
- Masclet, Noussair, Villeval & Tucker (AER 2003)
- Page, Putterman & Unel (2002)
- Carpenter & Matthews (2002)
- Falk, Fehr & Fischbacher (2001)
- Carpenter (2001)
- Bowles, Carpenter & Gintis (2001)

Cooperation and Punishment in Russia

(Gächter Herrmann 200x)

- Did past experience in the Soviet Union leave traces in cooperation and punishment behavior.
- Instrument: Cooperation and punishment experiment
- Subjects:
 - 126 Students (to provide a comparison with data from other student samples)
 - 183 non students from cities
 - 90 non students from the countryside

Kursk:



Inhabitants:

240,000

Average Income:

92 \$/month



Professions of Non Students

Profession	Subjects living in cities in %	Subjects living on the countryside in %
Employees in private sector	39.9	21.1
Managers	5.5	7.8
Workers	31.7	40.0
State employees	4.4	5.6
Farmers	0	3.3
Entrepreneurs	6.0	0
House wives	2.2	10.0
No information available	10.4	12.2

Design

- $n = 3$, one-shot Experiment.
- c_i obeys $0 \leq c_i \leq 20$
- Income at the first stage:

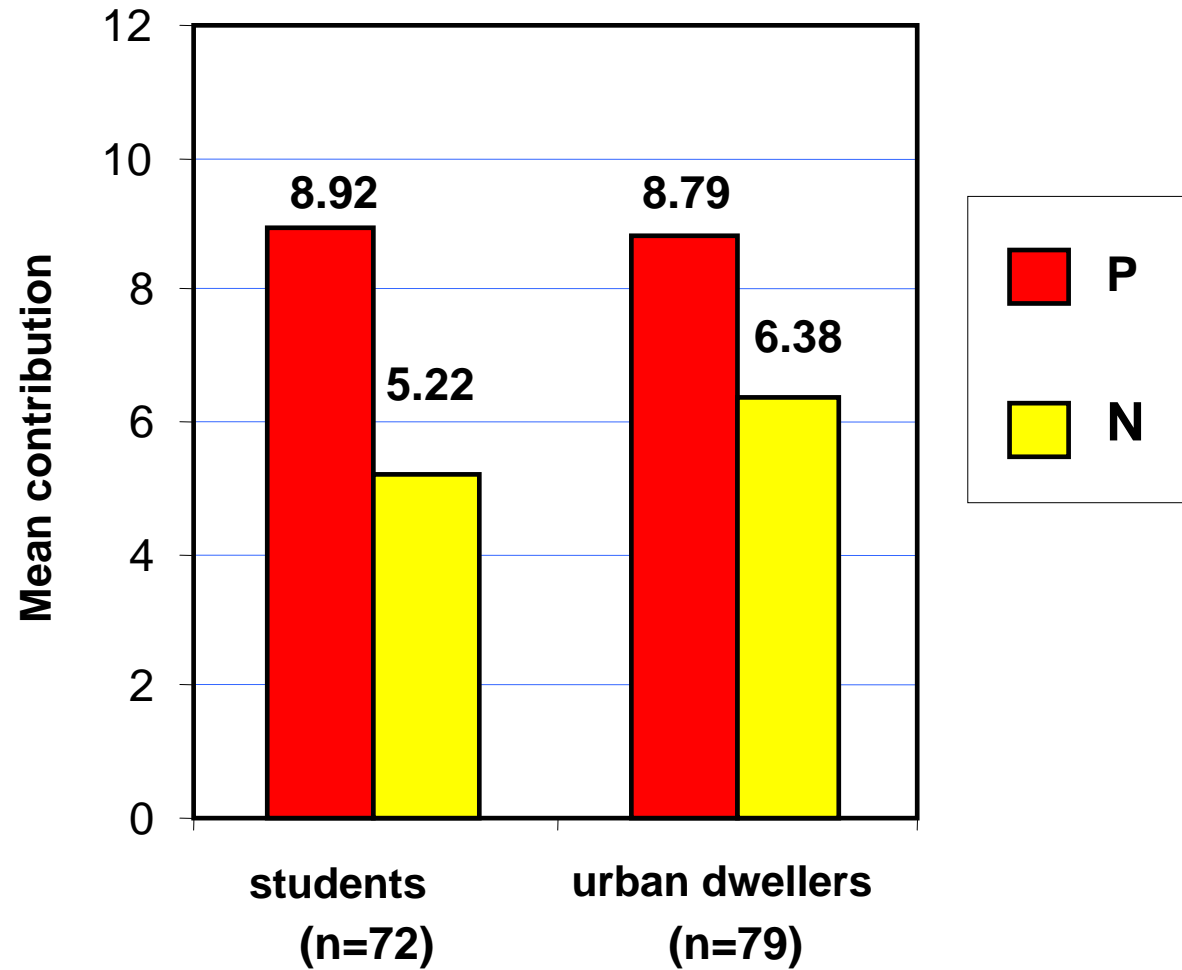
$$\pi_i^1 = 20 - c_i + 0.5 \sum_{j=1}^n c_j$$

- Income after punishment points p_{ji} and p_{ij} have been imposed:

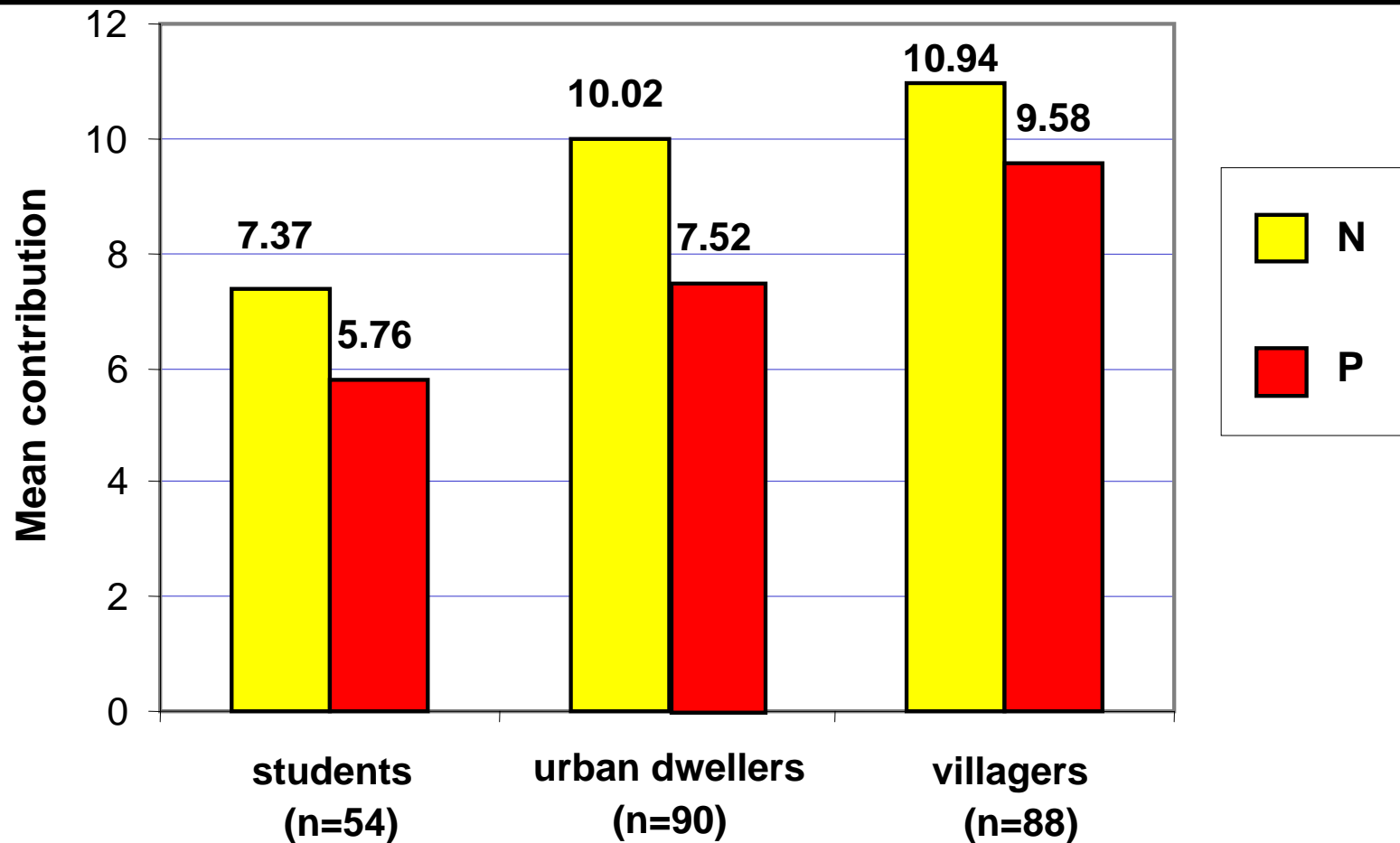
$$\pi_i = \pi_i^1 - \left(3 \sum_{j=1}^n p_{ji} + \sum_{j=1}^n p_{ij} \right)$$

- N-P Experiment (2 one-shots)
- P-N Experiment (2 one-shots)

Contributions in P-N Sequence



Contributions in N-P Sequence



Socio-Economic Determinants of Cooperation

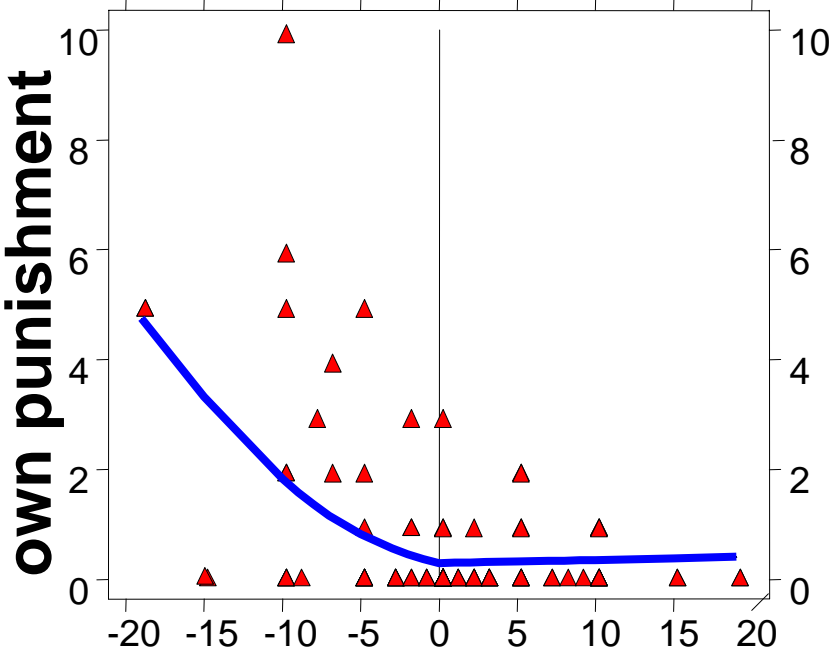
	Cooperation in N	Cooperation in P
2nd sequence	-4.47***	-2.08**
White collar	4.09**	1.96
Blue collar	2.64	-0.32
Other jobs	1.79	-0.08
Age	0.01	0.08
Female	0.37	-0.23
Religiosity	2.22**	1.67*
City size	-0.90**	-1.10***
Constant	8.31***	8.26***

$n=371$

*10%; ** 5%; *** 1%

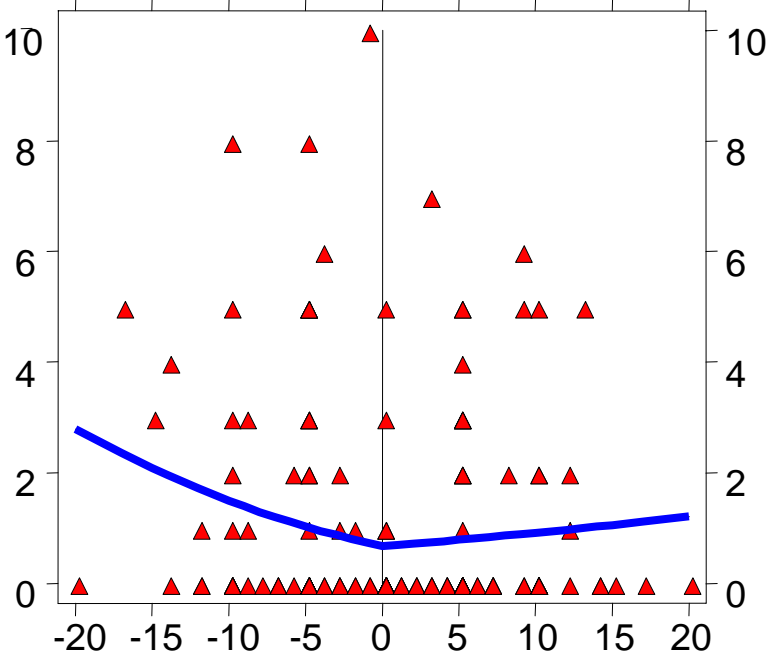
Punishment Behavior (N-P)

of students:



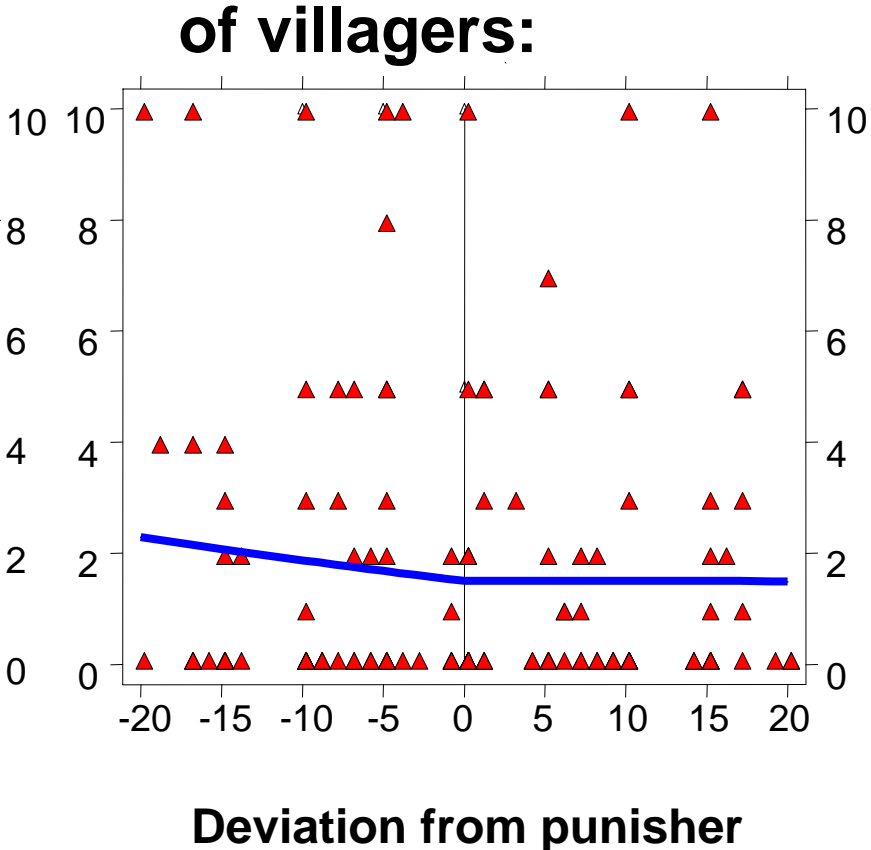
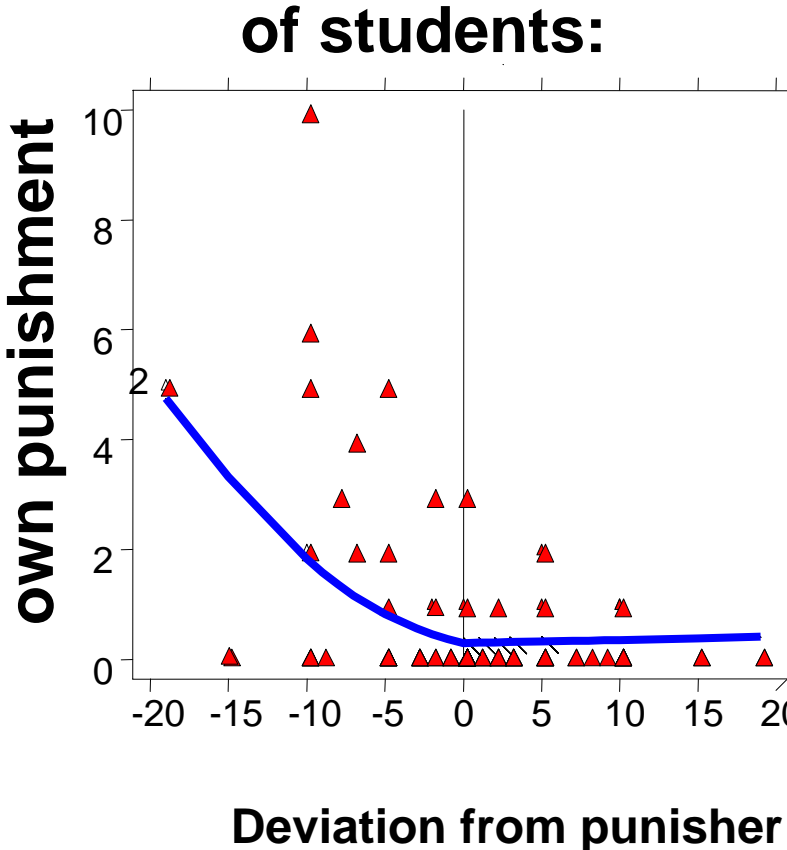
Deviation from punisher

of urban dwellers:



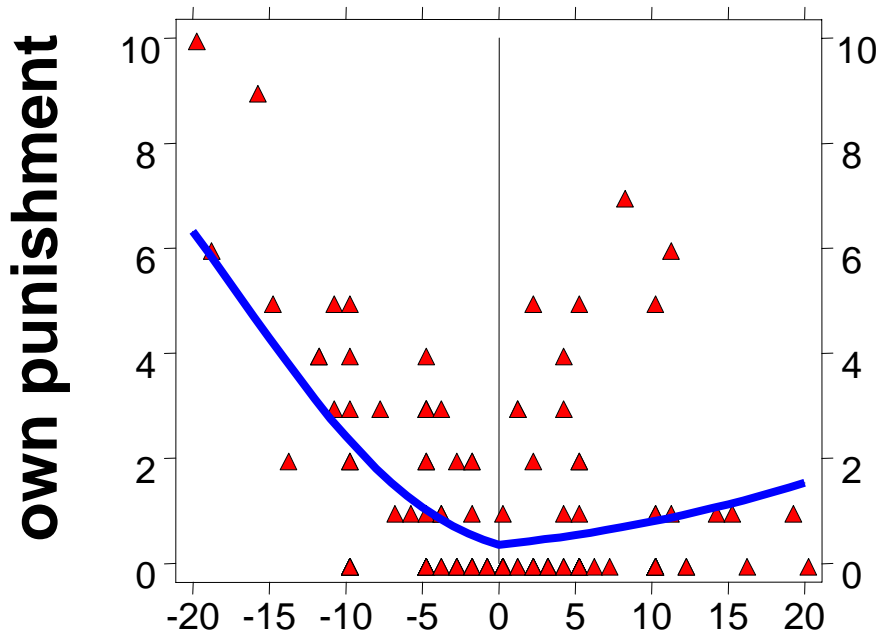
Deviation from punisher

Punishment Behavior (N-P)



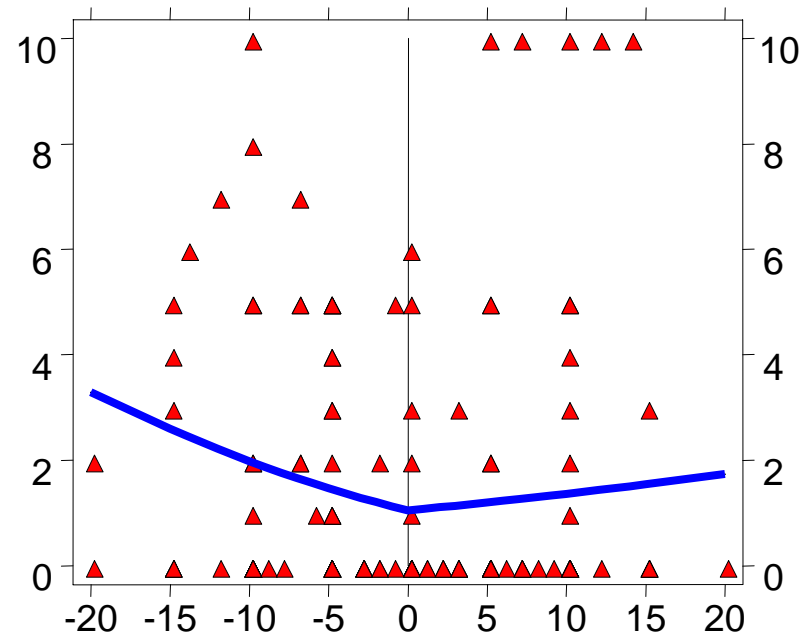
Punishment Behavior (P-N)

of students:



Deviation from punisher

of urban dwellers:



Deviation from punisher

Socio-economic Determinants of Punishment Behavior

	Coefficient	p-value
Negative deviation	-0.32***	0.000
Positive deviation	0.10	0.102
2nd sequence	-1.30*	0.085
White collar	-1.83*	0.057
Blue collar	0.75	0.436
Other jobs	2.09**	0.041
Age	0.08**	0.030
Female	0.37	0.608
Religiosity	1.04	0.118
City size	-0.12	0.688
Constant	-5.88***	0.000

$n=371$

*10%; ** 5%; *** 1%

Conclusions

- In western societies those who cooperate punish those who defect.
 - Enforces higher cooperation levels.
- In Russia there is a significant share of spiteful punishment, i.e. those who cooperated above average are punished.
 - Punishment opportunity does therefore not increase cooperation.
- Note: Punishment reduces the surplus; it is the **threat** of punishing free riders which, if effective, increases the surplus.