Using Sanctions and Rewards to Promote Cooperation in a Field Experiment

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Cooperation consists of taking a decision that reduces one’s own payoff, while increasing total aggregate payoff.

Understanding how to create cooperation is a longstanding focus of research in the social sciences.

What institutions can be employed to create cooperation?

In this talk, I will describe a field experiment in which achieving cooperation is very challenging.

I will describe treatments in which peer punishment and reward are permitted.

Laboratory evidence (with student subjects) indicates that self-governance is effective in promoting cooperation in the laboratory, and we will see if the same is the case in our field environment.
Conventional Setting: A Typical Experimental Laboratory
The setting for our experiments ‘De Biestse Oevers’, in Biest-Houtakker (NL)

This is a privately-owned trout-fishing facility located near Tilburg, in the Netherlands. The sports-fishermen fishing at the complex comprise our subject pool.
Location of the fishing site
Typical customer is Dutch, male and over 50 years old.

Normally costs 12.50 Euros for a half-day (4 hours) of fishing.

For each person who fishes, four trout are thrown into the pond, but an individual can catch as many as he is able to.

Any fish caught must be taken away from the site.
We adapt the following game, which is frequently studied in the laboratory:

There is a group of n agents, each of whom has an endowment (of money).

Each agent simultaneously chooses a portion of the endowment to contribute to a group account, and keeps the rest for himself.

- Every cent contributed to the group account earns each member of the group x cents (x is called the MPCR, the marginal per-capita return).
- Set $x < 1$ and $xn > 1$
- One version of the mechanism specifies that the contributor does not get back any portion of what he contributes (requires $x(n-1) > 1$).

Dominant strategy for individual is to keep everything for himself.

Social optimum is for all agents to contribute the entire endowment.

Amount contributed is interpreted as a measure of cooperation.
Some cooperation at the outset that declines over time.
The experimental design for our field experiment

- Four treatments
- Two factors:
  - Social dilemma exists or not
  - High (October) or low (June) season

<table>
<thead>
<tr>
<th>No Social Dilemma</th>
<th>Low Season</th>
<th>High Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>FieldPIL</td>
<td>(4 gps)</td>
<td>FieldPIH</td>
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<tr>
<td></td>
<td>(8 gps)</td>
<td>FieldPIH</td>
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<tr>
<td>FieldPGL</td>
<td>(7 gps)</td>
<td>FieldPGH</td>
</tr>
<tr>
<td></td>
<td>(8 gps)</td>
<td>FieldPGH</td>
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The treatments

- In the **Field Public Goods** treatments, a social dilemma and the possibility of cooperation is created.
- Group earnings can be increased if individuals reduce the amount of fish they catch.
- In the **Field Private Incentive** treatments, no such possibility exists.

- In the **High Season**, the water is colder. The fish are biting more and it is easier to catch fish than in the low season.
- This means it is costlier to cooperate in the High season. The opportunity costs of not fishing are higher, since the expected catch is higher if one attempts to catch fish.
Each session consists of 6 periods of 40 minutes each.
16 participants per session, divided into groups of 4, partner matching.
Locations at the pond are randomly assigned, and are changed every two periods.
At the beginning of the session, two trout per participant are put into pond, plus an additional six trout.
Activity within a period

- Each fisherman is allowed to catch up to two fish in each period.
- Each fish caught must be kept.
- After his two-fish quota is caught, a fisherman must wait until the next period.
- After a period ends, the experimenter replenishes the fish caught.
- The above describes the complete activity in the FieldPI treatments.
Setting for the sessions

Grey Dutch sky

Subjects

Jan Stoop

A student who was helping us
The Field PG treatment

- Similar to the Field Private Incentive treatment except:
- For each fish below two that an individual catches in a period, each of the other three members of his group receives 2 Euro.
- If an individual catches no fish in a period, he yields \( [2 \text{ fish}] \times [3 \text{ people}] \times [2 \text{ Euro}] = 12 \text{ Euro} \) to his group.
- Over 6 periods, this is 72 Euro. If no group member catches any fish, each player receives 72 Euro for the session.
Issue #1: Do we have a social dilemma?

Evidence that we do:

- A social dilemma exists if participants prefer 72 Euro to fishing all afternoon and going home with 12 fish.
- €72 would pay for 5 afternoons of fishing and leave € 9.50 left over. The subjects are typically regular fishermen so we presume that they can make this trade-off.
- €72 would pay for 12 trout at local shops and leave at least €36 left over.

We conducted some sessions in which we gave fishermen the choice between € 72 and the right to catch two fish every 40 minutes for 4 hours. 31 of 46 chose the money.

We then ran four sessions exclusively with those individuals who preferred the money.
How to measure cooperation?

The problem is that not everyone can catch two fish per 40 minutes even if they want to (because of exogenous factors: ability, weather conditions)

Use FieldPI treatment as a baseline to measure the level of cooperation in FieldPG.

Two measures used:

- (1) Output: in terms of fish caught per period, we look at differences between the two treatments within each season.
- (2) Input: in terms of effort, average number of times per minute an individual casts his rod into the water.
Results: average number of fish caught per group, all treatments (lower catch indicates more cooperation)
In this experiment, there is no cooperation at all, in contrast to the laboratory.
Experiment 2: Bridging the Gap between Lab and Field

Is there a laboratory effect?
Is there a subject pool effect?
Do differences in the game have an effect?
Participants were placed in groups of four under Partner matching.
Played 6 periods of a Public Good game.
Conducted by hand (pen and paper).
Contextualized framing: used terms such as “fish”, “catch”, and “pond”
MPCR equal to .5. No private return from cooperation.
They could choose to catch 0, 1, or 2, fish each period.

Three treatments: StuLab, FisherLab, Fisherpond
The StuLab treatment

- In StuLab, students play a Public Good game in the Lab.
- Only Dutch students were allowed to participate, in order to control for culture.
- In StuLab, each fish caught yielded a private return of 1 Euro. Each fish not caught yielded 50 cents to all other players.
- 8 groups
The StuLab treatment

Standard-looking experimental lab

Would love to have large grant for new lab
In the FisherLab treatment, we convert the restaurant of the fishing complex into an “experimental lab” and run the same experiment like in StuLab, but with the fishermen.

Under FisherLab, payoffs were four times as high as in StuLab.

8 groups

In addition to their earnings in the experiment, we paid for their fishing for the afternoon.
The FisherLab treatment

Where experimenter goes after session
In the FisherPond treatment, we administer the same paper and pencil experiment to individuals while they are fishing. We approached them and asked if they wanted to participate in a research study, and then made sure that they were far enough away from other participants so they would not communicate. We explained the instructions to them at a central location. Under FisherPond, payoffs were four times as high as in StuLab. 7 groups
The FisherPond treatment

Daan van Soest
Cooperation level (average group contributions) in the StuLab, Fisherlab, and FisherPond treatments
In all three treatments, cooperation is positive in early periods and declines over time.

Fishermen cooperate more than students
  • Subject pool is not the (sole) source of lack of cooperation in FieldPG

The Lab setting reduces cooperation relative to the field setting
  • The field setting itself is not the (sole) source of the lack of cooperation in FieldPG.

The difference must be caused by some difference in the two games themselves.
There are several differences between the FisherPond and the FieldPG treatments (timing, stakes, etc…).

One salient difference is that the units of measurement of group benefits and private benefits differ.

- They are the same in FisherPond, FisherLab, and StuLab (both money),
- They are different in FieldPG (money for group benefits and fishing for private benefit).

This may be why we observe no cooperation in FieldPG, if for example, people do not perceive a social dilemma to exist or resent being paid not to fish. Self-serving biases could be at work.
Experiment 3: Punishment, Reward, and Cooperation

Does allowing peer punishment increase cooperation in our field setting?
Does allowing peer rewarding increase cooperation?

In this experiment, both cooperation and non-cooperation are in terms of fishing time.
Suppose that after contribution decisions are made:
- Individuals are informed about all others’ contributions
- They then have the opportunity to pay from their own earnings reduce the earnings of any other players.
- Results show that people are willing to punish and that the availability of punishment increases cooperation (Yamagishii, 1986; Ostrom et al., 1990; Fehr and Gaechter, 2000).
- After a few periods, it also increases earnings.
In the lab, allowing peer punishment is very effective in creating and maintaining cooperation.
Rewards tend to be less effective than punishment (Sefton et al., 2007).
They are more effective the cheaper they are to assign (Rand et al, 2009; Sutter et al., 2010)
Our experiment allows individuals to punish and reward others with fishing time.
In all treatments, fishermen participate in groups of 4, in sessions of four periods.

- The first three periods last 30 minutes each. Each participant can catch up to two fish in these periods.
- The last period lasts 150 minutes, and players can catch an unlimited number of fish in this period. Furthermore, in this period, they also receive 3 Euro for each fish they catch.
- Each fish caught in the first three periods reduces the time each other group member can fish in the last period, by 10 minutes.
The three treatments

- **Baseline Treatment:** The above describes the game.

- **Reward Treatment:** At the end of each of the first three periods,
  - any individual can give up 5 minutes of his period 4 time and increase the period 4 fishing time of another player by 15 minutes.

- **Punishment Treatment:** At the end of each of the first three periods,
  - any individual can give up 5 minutes of his period 4 time and decrease the period 4 fishing time of another player by 15 minutes.
Result: There is no evidence of cooperation in any treatment.

Catch: First three periods

Effort: First three periods

No evidence of reduction in effort after catching first fish

Catch and effort are lower in period 4 than in periods 1, 2, or 3.
Patterns in punishment and reward assignment

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Subjects who spend more than zero intervals</td>
<td>0.22</td>
<td>0.28</td>
<td>0.16</td>
</tr>
<tr>
<td>% Subjects who spend most intervals on those who catch most fish</td>
<td>0.86</td>
<td>0.89</td>
<td>1.00</td>
</tr>
<tr>
<td>% Subjects who divide intervals equally, conditional on spending</td>
<td>0</td>
<td>0.11</td>
<td>0</td>
</tr>
<tr>
<td>Reward</td>
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<tr>
<td>% Subjects who spend more than zero intervals</td>
<td>0.44</td>
<td>0.41</td>
<td>0.38</td>
</tr>
<tr>
<td>% Subjects who spend most intervals to those who catch fewest fish</td>
<td>0.36</td>
<td>0.23</td>
<td>0.42</td>
</tr>
<tr>
<td>% Subjects who divide tokes equally, conditional on spending</td>
<td>0.36</td>
<td>0.69</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Table 3 Mechanisms of punishment and reward in more detail.

More players give rewards than punishment.

Punishment is mainly directed at non-cooperators

Equal assignment of rewards to others is common
Reward assignments, by cooperation level of both parties

<table>
<thead>
<tr>
<th>Receiver’s catch of fish</th>
<th>0</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>0</td>
<td>52</td>
<td>16</td>
<td>0</td>
<td>68</td>
</tr>
<tr>
<td>[169]</td>
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<td></td>
<td></td>
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<tr>
<td>1</td>
<td>15</td>
<td>4</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>[38]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>[15]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>20</td>
<td>0</td>
<td>[18]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>[222]</td>
<td>[48]</td>
<td>[18]</td>
<td></td>
</tr>
</tbody>
</table>
Remarks on Punishment

- Punishment fails to create cooperation here.
  - Why? Maybe:
    - Insufficient number of periods? (Gaechter et al., 2008)
    - Dynamic /continuous game? (Janssen et al., 2011)
    - Imperfect monitoring of cooperation? (Ambrus and Greiner, 2010)
    - Lack of unambiguous norm to enforce. Cooperation is not necessarily the consensus norm. Catching as many fish as one can is also a plausible norm. In that case, behavior may not respond to punishment.

- People punish anyway.
  - Why? Maybe:
    - Instrumental (they mistakenly believe that punishment is going to increase cooperation)
    - Inequity aversion (Fehr and Schmidt., 1999)
    - Taste for reciprocal punishment (Fehr and Gaechter, 2000; De Quervain et al, 2004)
In our field experiments, there is no evidence of any cooperation at any time.

Cooperativeness is a characteristic of the game being played as well as of individuals.

There is a limit of the robustness of the behavior of the game that we typically study in the lab

- This is not because of a lab/field distinction per se, but because the changes in the game itself, generated different behavior.
- Conjecture: Can reproduce the same differences within the lab by modifying the game.

Our setting provides a challenging environment for institutions to promote cooperation.

Any advice about how to increase cooperation?
A dynamic social dilemma: The resource is depleted for the future if individuals fail to cooperate.
The fishermen are assigned to groups of four for a sequence of four one-hour periods.

Each group can catch a maximum quota of 8 fish in the first period.

Each individual can catch as much as he wants provided that the quota of his group is not exceeded.

The number of fish that the group is allowed to catch in each period depends on the number they caught in previous periods.

The number depends on a logistic function relating the increase in the number of fish that a group is allowed to catch in periods $t+1$ to the number of fish remaining at the end of period $t$.

The more fish caught in period $t$, the less the group has available to catch in $t+1$.

This design follows the structure of a canonical model of a renewable resource (Brown, 2000).
The number of fish added to the group’s quota in period $t$ as a function of the stock at the end of period $t - 1$.

**Figure 4** Experimental parametrization of the logistic growth function.
Social optimum
- Catch 4 units each period, and 8 units in the last period

Subgame perfect equilibrium
- Catch as many fish as possible in current period. The SPE path is 8 fish caught in period 1, and the stock is all depleted at that time.
Quiz was given at the beginning of the sessions to test understanding of the dynamic game.
At the end of each period, subjects were informed of total group catch in the period, and the amount the group was allowed to catch in the next period.
Individuals knew which other players were in their same group.
The stock of fish is replenished after each period so that the total number of fish in the pond remains the same at the beginning of each period. This was done so that it is always equally easy to catch a fish.
Because it is not always feasible for a group to catch the number of fish they intend, we use effort/casts-per-minute to measure cooperation.

If cooperation was occurring, the effort/casts-per-minute, should be a (increasing) function of the number of fish remaining.

That is, if agents are cooperating we should see less effort to catch fish the lower the current stock is.
Casts per minute as a function of the stock of fish
Casts per minute, averaged over all active groups

Black: Fielddyna
Red: FieldPG
Blue: FieldPI
There is no evidence of cooperation.

Casts per minute is the same as in the FieldPI treatment of experiment 1, in which there is no incentive to cooperate.

Casts per minute is the same no matter how large the current quota of the group.

Two of the groups deplete their entire stock early