Public Good Games

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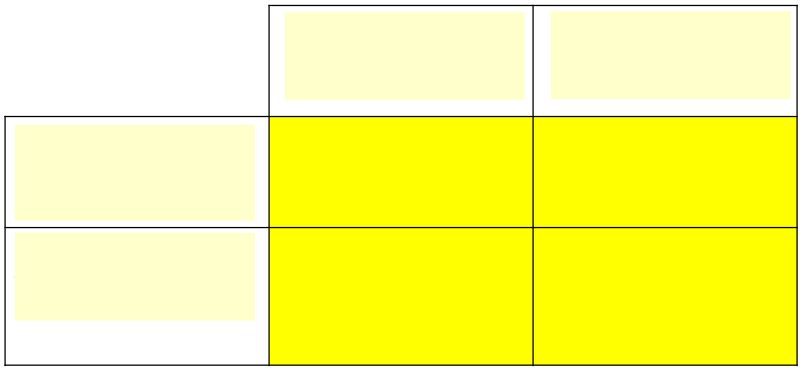
About Efficiency



* “Market works well” means
- No externalities
- No monopoly/market power
- No public goods
- No asymmetric information about the product’s quality

** Loss in total economic surplus is called “Deadweight Loss”

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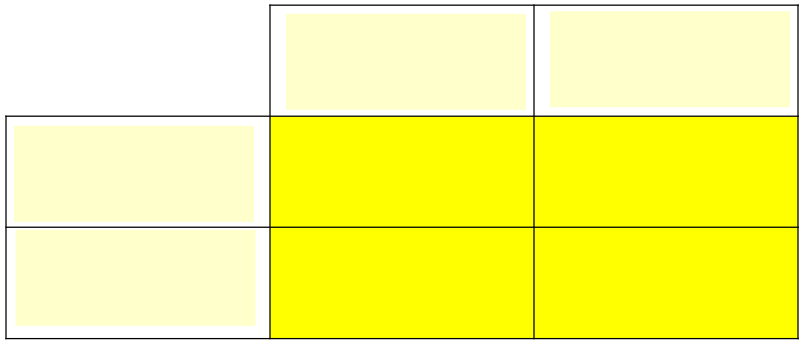
Features of goods:



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Supply: Three public good games

- - Summation PG game
  - Best-shot PG game
  - Weakest-link PG game
- Contributions: x_1, x_2, x_3, x_4.
  Payoffs: p_1, p_2, p_3, p_4.
- (Nash) Equilibrium: no individual

- Social optimum defined here

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Summation public good game

- $p_n = (10 - x_n) +$ $* (x_1 + x_2 + x_3 + x_4)$
- was chosen to make this a dilemma:

  Any number between would work.
- Equilibrium: →
- Socially optimal outcome: →

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Summation public good game

- Socially optimal outcome is not equilibrium since everybody has an incentive to change if the others do not:
  $(10,10,10,0)$ →
- (Also: $(0,0,0,10)$ →

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Prisoners' Dilemma

- A summation public good game is a form of "Prisoners' Dilemma":
- Many (environmental) situations can be seen as Prisoners' Dilemmas.

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Prisoners' Dilemma

- About the name:

		Carl: Confess	Carl: Don't Confess
Rudy	Confess		
	Don't Confess		

- "Socially" best outcome (from Rudy's and Carl's perspective): both don't confess.
- Equilibrium: Both confess.

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Best-shot public good game

- $p_n = (10 - x_n) + 2 * \max(x_1, x_2, x_3, x_4)$
- 4 equilibria: → ,…
  →
- All four are also socially optimal outcomes: for example
  $(8,0,0,0)$ → and
  $(10,0,0,4)$ →
- Note:

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Best-shot public good game

- So this is a game:

  (but still better off than he/she would be if nobody contributed)
- Many (environmental) clean-up situations can be modeled this way.
- Sometimes called “Game of Chicken”.

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Game of Chicken

- About the name:

		Carl	
		Drive Straight	Swerve
Rudy	Drive straight		
	Swerve		

- Socially best outcomes and equilibria: one swerves, the other one drives straight.
- Equivalent to one person contributing to PG.

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Weakest-link public good game

- $p_n = (10 - x_n) + 2 * \min(x_1, x_2, x_3, x_4)$
- 1 equilibrium that is also socially optimal: →
- 10 other equilibria that are all suboptimal:
- Note:

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Weakest-link public good game

- Another game (but different than the previous one):

  Many (environmental) pollution avoidance situations can be modeled this way.
- Sometimes called “trust game,” “assurance game” or “stag hunt” game.

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Stag Hunt Game

- About the name:

		Carl	
		Hunts stag	Hunts hare
Rudy	Hunts stag		
	Hunts hare		

- Equilibria: both hunting stag or both hunting hare.
- Hunting stag is better equilibrium.

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- In all of these situations some need for government intervention/help.
- Clearly in prisoners' dilemma, but also for helping coordination in two other situations.
- It is important to understand incentive structures of certain situations to be able to device policies.
- Two additional topics:

  - "conditional cooperation" (in summation PG)

  - how are markets with externalities related to (summation) public goods?

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Conditional cooperation

- In summation PG game: What would you do if you knew contributions of others?

If others give on average	Then I give …
0	?
1	?
…	
10	?

- Economic theory:
- Results from experiments: about all the time, but

  → Conditional cooperators

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Fischbacher, Fehr and Gächter (EL 2001)

$$\pi_i = 20 - g_i + 0.4\sum_{j=1}^{4} g_j.$$

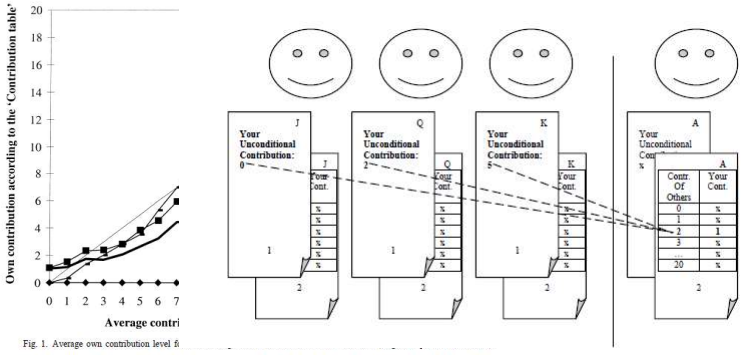

Fig. 1. Average own contribution level fi

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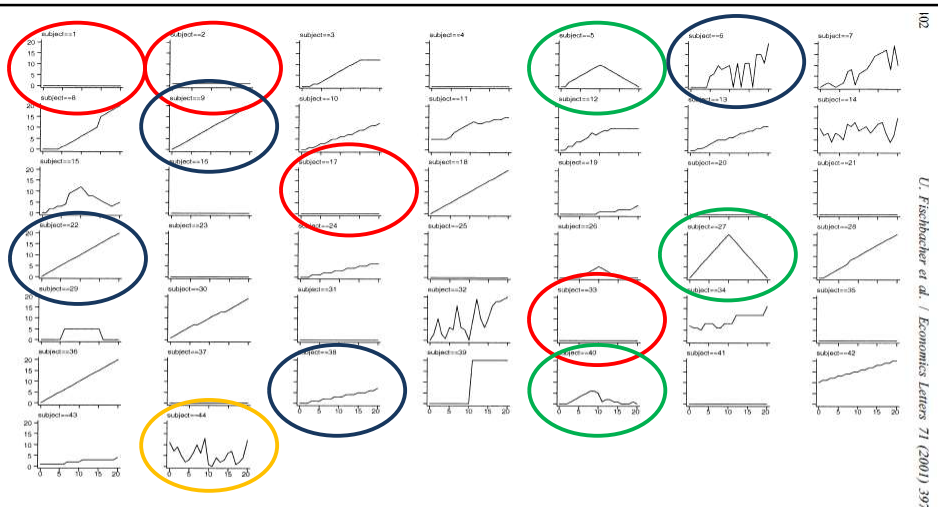

Contribution other group members
Contribution schedules per subject

Note: Subjects were classified as follows: *Free-riders:* Subjects no. 1, 4, 16, 17, 20, 21, 23, 25, 31, 33, 35, 37, 41;
Conditional Cooperators (Spearman's $\rho > 0$ at p-value < 0.001): Subjects no. 3, 6, 7, 8, 9, 10, 11, 12, 13, 18, 19, 22, 24, 28, 30, 32, 34, 36, 38, 39, 42, 43;
"Hump-Shaped": Subjects no. 5, 15, 26, 27, 29, 40;
Other patterns: Subjects no. 2 (unconditional cooperation of 1 token), 14, 44 (random patterns).

Fig. 2. The contribution schedules of all subjects.

U. Fischbacher et al. / Economics Letters 71 (2001) 397–404

Cherry, Kallbekken, Kroll and McEvoy (2011)

- 2x2 design. Treatment variables:
- Externality
- Institution is either a game ("how much do you give to a public account"?), or
- a ("how much do you buy in this market"?)

$$\pi_i = e_i - ax_i + bx_i + c\sum_{k \neq i} x_k$$

- With positive externalities: e_i=10, a=1, b=0.4, c=0.4
- With negative externalities: e_i=16, a=1, b=1.6, c=-0.4
- Only difference between games:
- But basically same equilibrium: zero contributions with positive externalities or buy everything with negative externalities.

Cherry, Kallbekken, Kroll and McEvoy (2011)

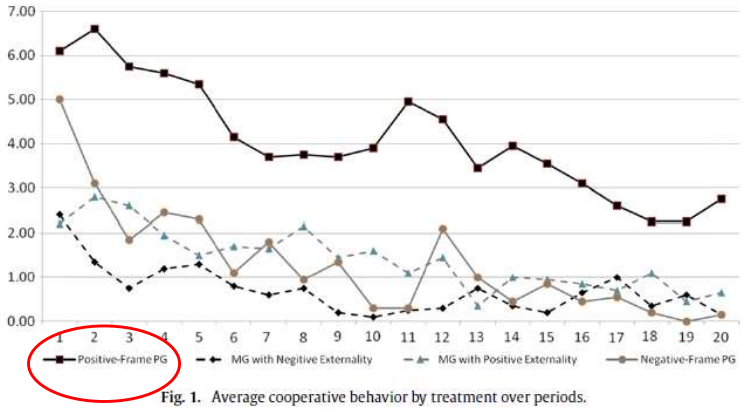

Fig. 1. Average cooperative behavior by treatment over periods.

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Fehr and Leibbrandt (2011)

- Do laboratory measures of other-regarding and time preferences predict fishermen's behavior in the field?
- Here combination of PG and time preference lab-in-field experiments and actual field data.
- Subjects: Fishermen and shrimpers around a lake with CPR problem.
- Data on "different fishing instruments that allow them to influence the proportion of the catch consisting of small shrimp/fish which have not yet reached fertility"

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A field study on cooperativeness and impatience in the Tragedy of the Commons

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ABSTRACT

This paper examines the role of cooperativeness and impatience in the exploitation of common pool resources (CPRs) by combining laboratory experiments with field data. We study fishermen whose main, and often only, source of income stems from the use of fishing grounds with open access. The exploitation of a CPR involves a negative interpersonal and inter-temporal externality because individuals who exploit the CPR reduce the current and the future yield both for others and for themselves. Economic theory – which assumes the existence of general across-situational traits – thus predicts that fishermen who exhibit more cooperative and less impatient behavior in the laboratory should be less likely to exploit the CPR, which our findings confirm. We thus corroborate the economic theory and extend the scope of other-regarding preference theories to crucial economic decisions with lasting consequences for the people involved. In addition, we establish cooperativeness and impatience as two distinct traits related to resource conservation in the field and validate laboratory preference measures.

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Fehr and Leibbrandt (2011)

- Differences between lab and field data:
- PG , CPR
- Field ongoing, lab one-shot
- Time in lab ; in field
- Intertemporal choices chocolate/mineral water vs. current/future yields

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Fehr and Leibbrandt (2011)

- Main resul g and time preference of individual behavior ir
- we observe mp fishermen e small shrimp – w maturity (i.e., "infer n the Appendix),
- and more c catch fish use fishnets with larger mesh sizes in which only bigger fish are caught (see Figs. B.2 and C.3 in the Appendix).

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Fehr and Leibbrandt (2011)

- Main result: laboratory measures of other-regarding and time preferences in both data sets important predictors of individual behavior in real-world CPRs.
- we observe that more cooperative and patient shrimp fishermen use shrimp traps with bigger holes where small shrimp – which have not yet reached reproductive maturity (i.e., "infertile" shrimp) – can escape (see Fig. A.1 in the Appendix),
- and more cooperative and patient fishermen who catch fish use fishnets with larger mesh sizes in which only bigger fish are caught (see Figs. B.2 and C.3 in the Appendix).

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Fehr and Leibbrandt (2011)

- Thus we provide evidence that other-regarding and time preferences are not so strongly context-dependent as to render the economic approach of explaining and predicting behavior in terms of relatively stable preferences meaningless.

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Fehr and Leibbrandt (2011)

- PG: Endowment of 10 MU, group of 3, private (social) return 0.5 (1.5).
- 15.8% do not contribute and 11.4% contribute only one MU.
- Approximately half of the participants contribute no more than three MUs (58 out of 114).
- 21.1% contribute five MUs and 18.4% contribute more than five MUs.

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Fehr and Leibbrandt (2011)

- Time preference:
- patient, impatient.
- Time preference and PG behavior uncorrelated.

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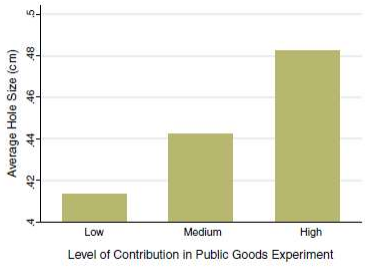

Fig. 2. Other-regarding preferences and hole size.

Table 1
Determinants of size of holes in shrimp traps (*OLS*).

Dependent variable	Average size of holes in shrimp trap in cm				
Model	1	2	3	4	5
Contribution in PGE (in MUs)	0.0105** (0.0041)		0.0094** (0.0038)	0.0103** (0.0041)	0.0088** (0.0040)
Impatience (praline dummy		−0.0504** (0.0230)		−0.0539** (0.0238)	−0.0467** (0.0217)
Belief in PGE			−0.0011 (0.0051)	0.0003 (0.0055)	−0.0001 (0.0053)
Preference for praline				−0.1962 (0.1425)	−0.1593 (0.1228)
Age			−0.0011 (0.0011)	−0.0003 (0.0012)	−0.0009 (0.0012)
Gender (male dummy)			0.0893*** (0.0232)	0.0663*** (0.0232)	0.0515 (0.0332)
Children			0.0121** (0.0056)	0.0137** (0.0062)	0.0109* (0.0058)
Centrality			−0.0001 (0.0003)	−0.0003 (0.0004)	−0.0005 (0.0004)
Years of schooling			−0.0034 (0.0039)	−0.0026 (0.0046)	−0.0004 (0.0045)
Years in occupation			−0.0008 (0.0010)	−0.0024** (0.0011)	−0.0022** (0.0011)
Field perception shrimpers			0.0195 (0.0195)	0.0437** (0.0203)	0.0490** (0.0206)
Field belief shrimpers			−0.0140 (0.0120)	−0.0286** (0.0134)	−0.0229* (0.0137)
Daily hours fishing			0.0050 (0.0065)	0.0091 (0.0060)	0.0039 (0.0062)
Quantity of shrimp traps			−0.0001** (0.0000)	−0.0001* (0.0000)	−0.0000 (0.0000)
Income			−0.0000 (0.0000)	−0.0001* (0.0000)	−0.0001 (0.0000)
Constant	0.4122*** (0.0174)	0.4061*** (0.0164)	0.3115*** (0.0850)	0.4432** (0.1700)	0.4435** (0.1705)
Village fixed effects?	no	no	no	no	yes
Observations	114	83	112	83	83
R^2	0.064	0.051	0.272	0.400	0.484

Notes: ***99% significance, **95% significance; *90% significance. Robust standard errors in parentheses.

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Fehr and Leibbrandt (2011)

- Overall positive and highly significant correlation between PG contributions and hole size.
- Average hole size for impatient fishermen: 0.406 cm
- Patient: 0.457 cm

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Fehr a

- Similar with fishnet a

Table 2
Determinants of mesh size of fishnet (*OLS*).

Dependent variable	Frequently used mesh size of fishnet in cm	
Model	1	2
Contribution in first period of PGE (in MUs)	0.133***	0.171*
	(0.049)	(0.095)
Impatience (mineral water dummy)	−0.366**	−0.641*
	(0.184)	(0.345)
Age	-0.000	
	(0.013)	
Gender (male dummy)	0.732*	
	(0.374)	
Children	0.023	
	(0.037)	
Years of schooling	−0.010	
	(0.033)	
Years in occupation	0.007	
	(0.010)	
Field belief fishermen	0.182**	0.503**
	(0.073)	(0.244)
Field perception fishermen	0.156***	0.352**
	(0.056)	(0.132)
Belief in first period of PGE	0.009	−0.144
	(0.059)	(0.141)
Weekly hours fishing	−0.006	
	(0.006)	
Constant	2.784***	2.023**
	(0.664)	(0.985)
Village fixed effects?	yes	no
Observations	121	35
R^2	0.334	0.227

Notes: ***99% significance, **95% significance; *90% significance. Robust standard errors in parentheses.

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