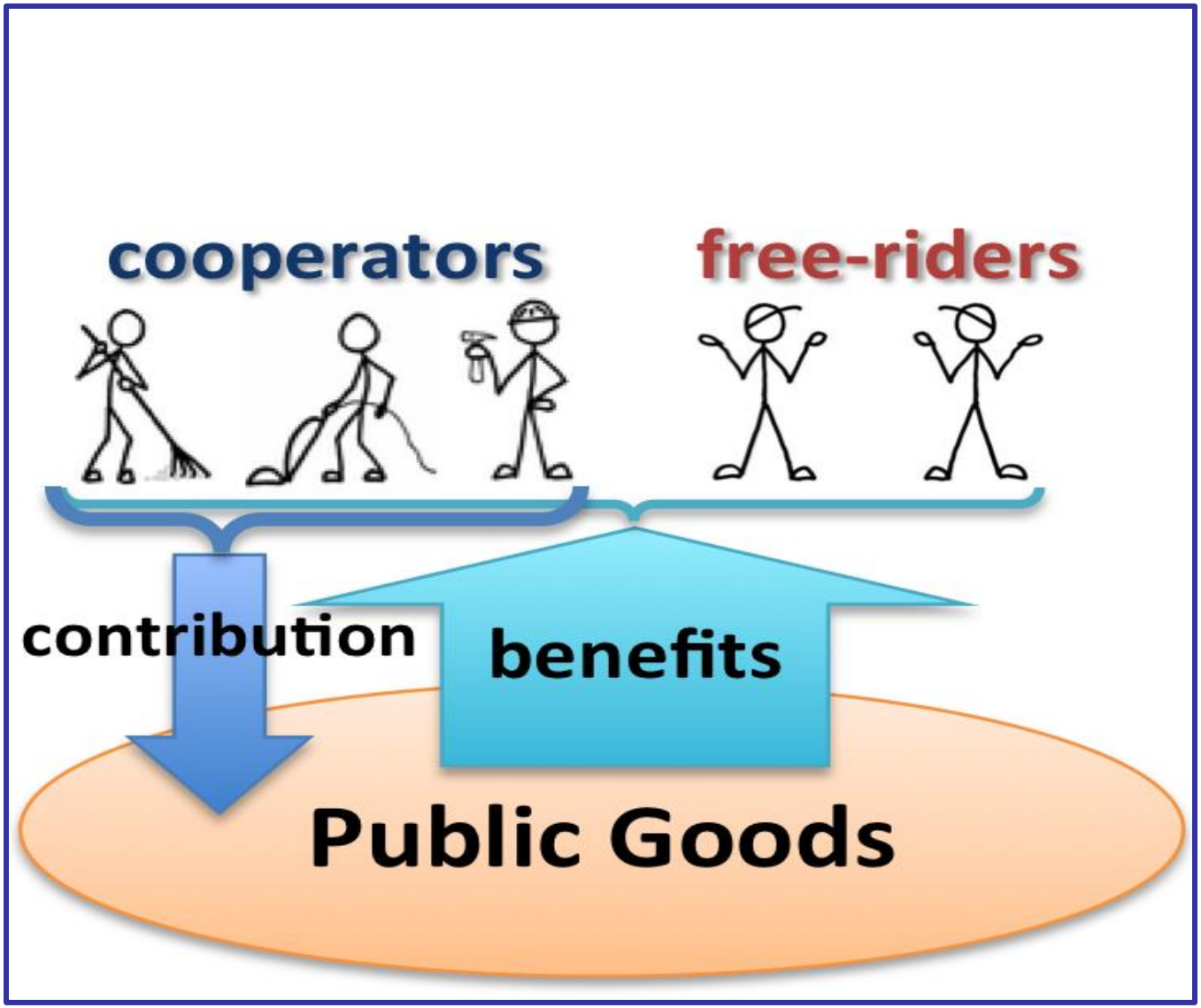
Public Goods: Theory and Experimental Evidence



Public Goods: Theory and Experimental Evidence

Structure of Lecture:

What does the existence of Public Goods imply for the individualistic behavior? A quick refresher on the incentive to *free-ride*.

Is the experimental evidence in line with our theoretical priors?

What is the effect of the so-called “altruistic punishment”?

What is the effect of the so-called “anti-social punishment”?

Public Goods: Theory and Experimental Evidence

The lecture is based on the following teaching material:

Fehr, E., Gächter, S., (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90, 4 980-994

Fehr, E., Gächter, S., (2002). Altruistic punishment in humans. *Nature* 415,137–140.

Herrmann, B., Thöni, C., Gächter, S., (2008). Antisocial punishment across societies. *Science* 319, 1362-67.

Public Goods: Theory

The **linear voluntary contribution mechanism** is the most widely employed mechanism in order to investigate public goods

We assume ***N* different player.** Each player decides his/her contribution to a common money box (i.e., the public good) and keeps the rest of his/her income for private consumption.

If ***Y*** is the total amount of money of player i (the initial endowment)

Each player *i* decides his/her contribution $g_i \in [0, \Upsilon]$.and his /her utility is as follows:

$$U_i = \Upsilon - g_i + a(g_i + \sum_{j \neq i}^{N} g_j)$$

Public Goods: Theory

What is the marginal utility of agent i from his/her contribution gi;

$$\frac{\partial U_i}{\partial gi} = -1 + a$$

Parameter $\boldsymbol{a}$ **reflects the** marginal per capita return of the public goods contributions (in our class example α equals 0.156 that is 1,25:8)

- When $\boldsymbol{\alpha > 1}$ **then** $\boldsymbol{\partial U_i / \partial g_i > 0} \rightarrow$ and each agent i decides $g_i = \Upsilon$ *to the common money box*

- When $\boldsymbol{\alpha < 1}$ **τότε** $\boldsymbol{\partial U_i / \partial g_i < 0} \rightarrow$ and each agent i decides $g_i = 0$ *to the common money box*

Public Goods: Theory

But what is the socially optimal choice?

By assuming a Benthamite Welfare Function

$$\mathrm{W} = \sum_{i=1}^{N} U_i = N \cdot \Upsilon - \sum_{i=1}^{N} g_i + N \cdot a(gi + \sum_{j \neq i}^{N} g_j)$$

$$\frac{\partial W}{\partial g_i} = -1 + N \cdot a$$

When $\alpha > 1/N$ then $\partial W / \partial g_i > 0 \rightarrow$ and the socially optimum is to contribute $g_i = \Upsilon$ to the common money box (public good).

Below are the result from our class experiment

1st Round

	ID1	ID2	ID3	ID4	ID5	ID6	ID7	ID8
gi	0	1	1	3	3	0	2	2.5
G	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
winners/ loosers	1.95	0.95	0.95	-1.05	-1.05	1.95	-0.05	-0.55
5euro+G	6.95	5.95	5.95	3.95	3.95	6.95	4.95	4.45

Total amount in the money box= 13*1,25= 15,6: 8=> So G=1,95

Social Optimum G= 40*1,25=50 :8=6,25

Below are the result from our class experiment

2nd Round

	ID1	ID2	ID3	ID4	ID5	ID6	ID7	ID8
gi	0	0	0	0	0	0	1.5	2.5
G	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
winners/ loosers	0.63	0.63	0.63	0.63	0.63	0.63	-0.88	-1.88
5euro+G	5.63	5.63	5.63	5.63	5.63	5.63	4.13	3.13

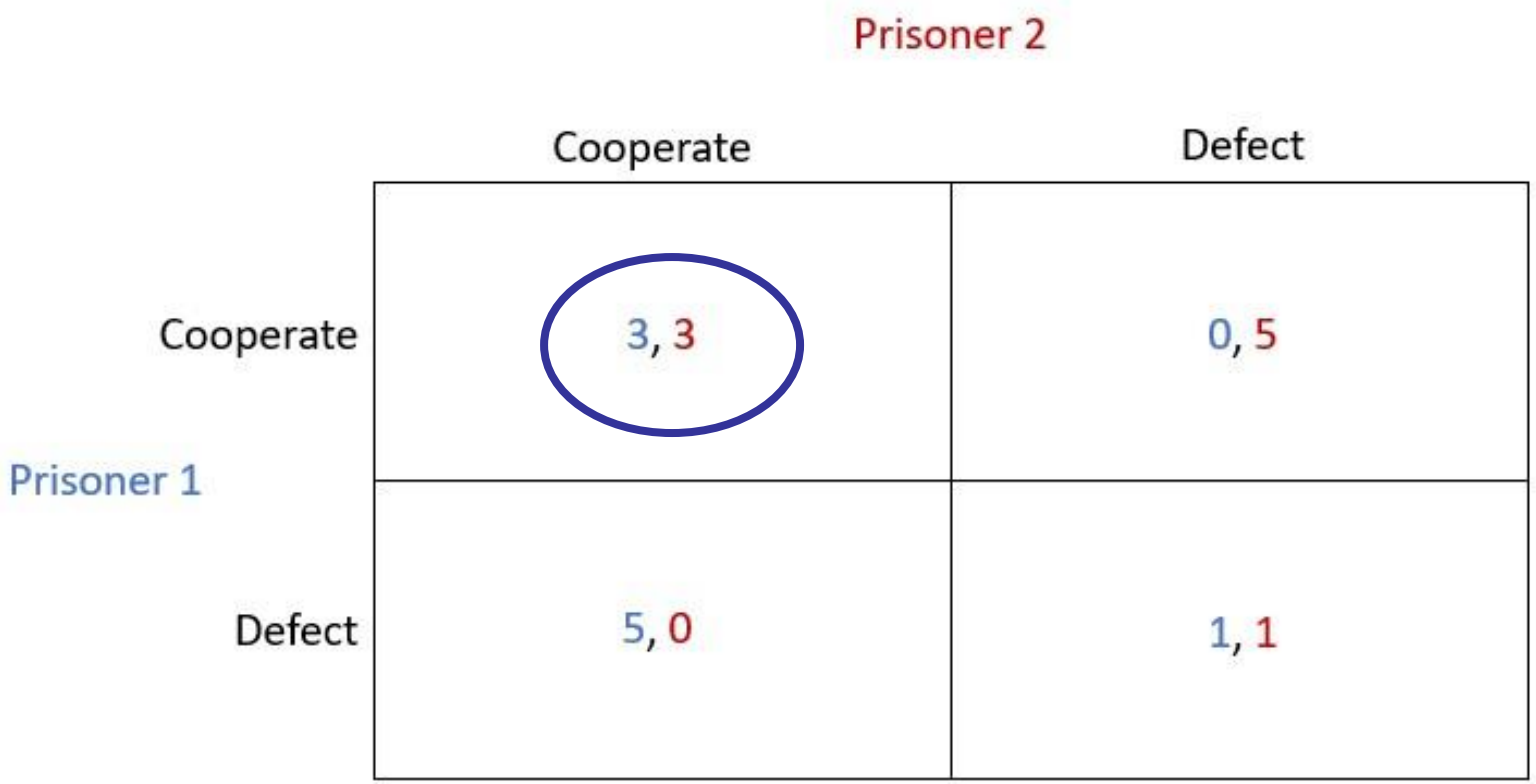
Total amount in the money box= 4*1,25= 5: 8=> So G=0.63

Social Optimum G= 40*1,25=50 :8=6,25

In essence our analysis concludes to a structure of incentives which is similar with the standard prisoner's dilemma

		Prisoner 2	
		Cooperate	Defect
Prisoner 1	Cooperate	3, 3	0, 5
	Defect	5, 0	1, 1

In essence our analysis concludes to a structure of incentives which is similar with the standard prisoner's dilemma



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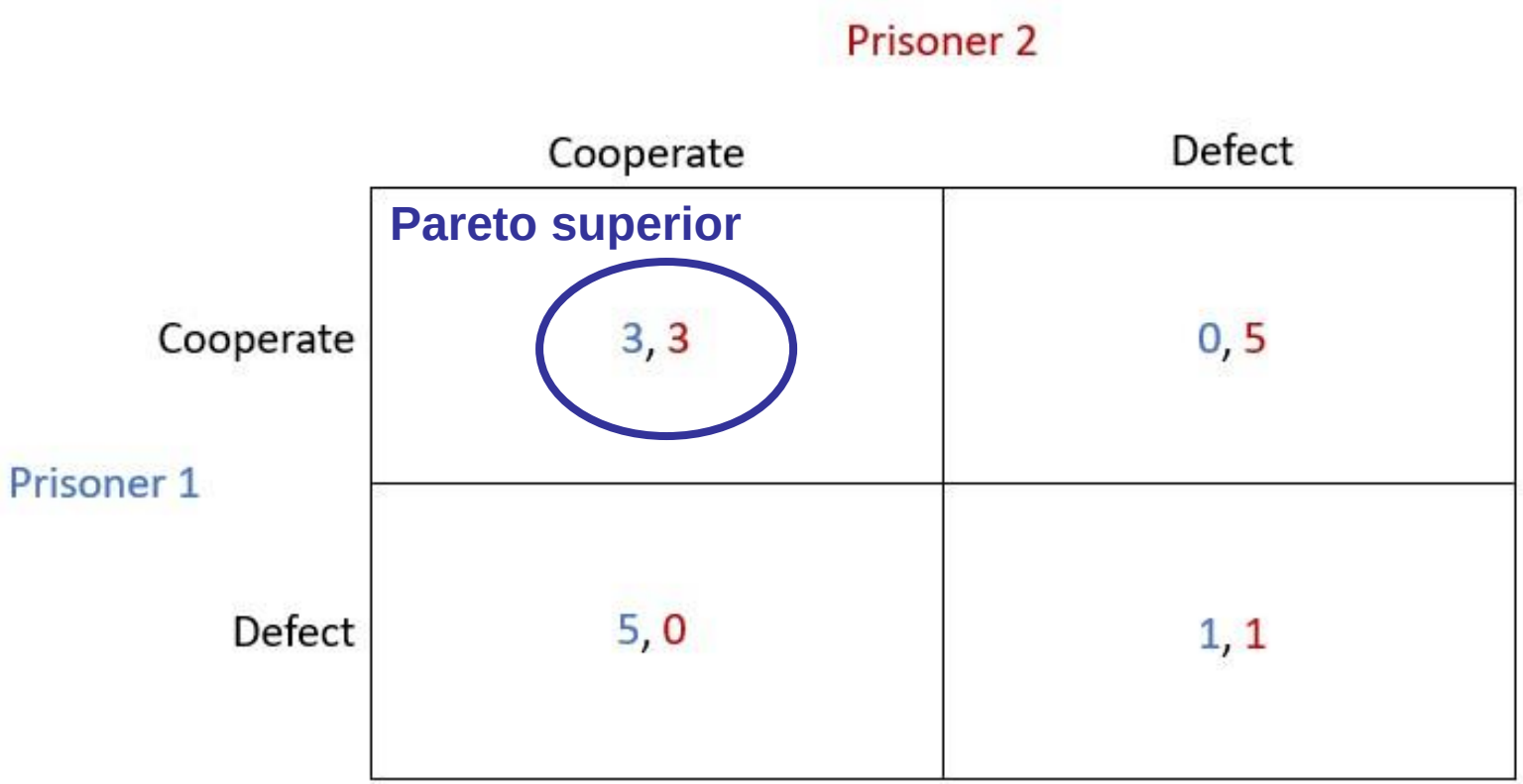

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		Prisoner 2: Cooperate	Prisoner 2: Defect
Prisoner 1	Cooperate	3, 3	0, 5
	Defect	5, 0	1, 1

In essence our analysis concludes to a structure of incentives which is similar with the standard prisoner's dilemma

		Prisoner 2	
		Cooperate	Defect
Prisoner 1	Cooperate	3, 3	0, 5
	Defect	5, 0	**Nash Equilibrium** 1, 1

International Public Goods

Public goods and especially international public goods (i.e., goods with international spillovers) are everywhere

Table 1. The desirable allocation of policy responsibilities

	Policy domains	Externalities	Pref. asymmetry	Devolution
1	International trade	High	Low	EU/Global
2	Common market	High	Low	EU/Global
3	Money and fiscal	Med./High	?	National/EU
4	Education, research and culture	Low	High	Local/National
5	Environment	Med./High	High	National/EU/Global
6	Business relations (Sectoral)	Low	High	National
7	Business relations (Non-sectoral)	High	?	EU/Global
8	International relations	Med./High	Low	National/EU
9	Citizen and social protection	Mixed	High	Local/National

International Public Goods

In the presence of international public goods, there is always an incentive to centralize the policy decision making (as to internalize the externalities/ international spillovers).

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9	Citizen and social protection	Mixed	High	Local/National

Experimental Evidence

Experimental evidence suggests that the subjects contribute almost always a small amount of money in the common money box (public good). In other words, the subjects do not fully free ride.

Also, their behavior appears to be **endogenous to the behavior of the other players.**

So, the big question is why the agents do not fully free ride (…at least not from the beginning)

Experimental Evidence

So, the big question is why the agents do not fully free ride (at least from the beginning)

[1] Direct reciprocity [Axelrod and Hamilton,1981; Axelrod,1984]

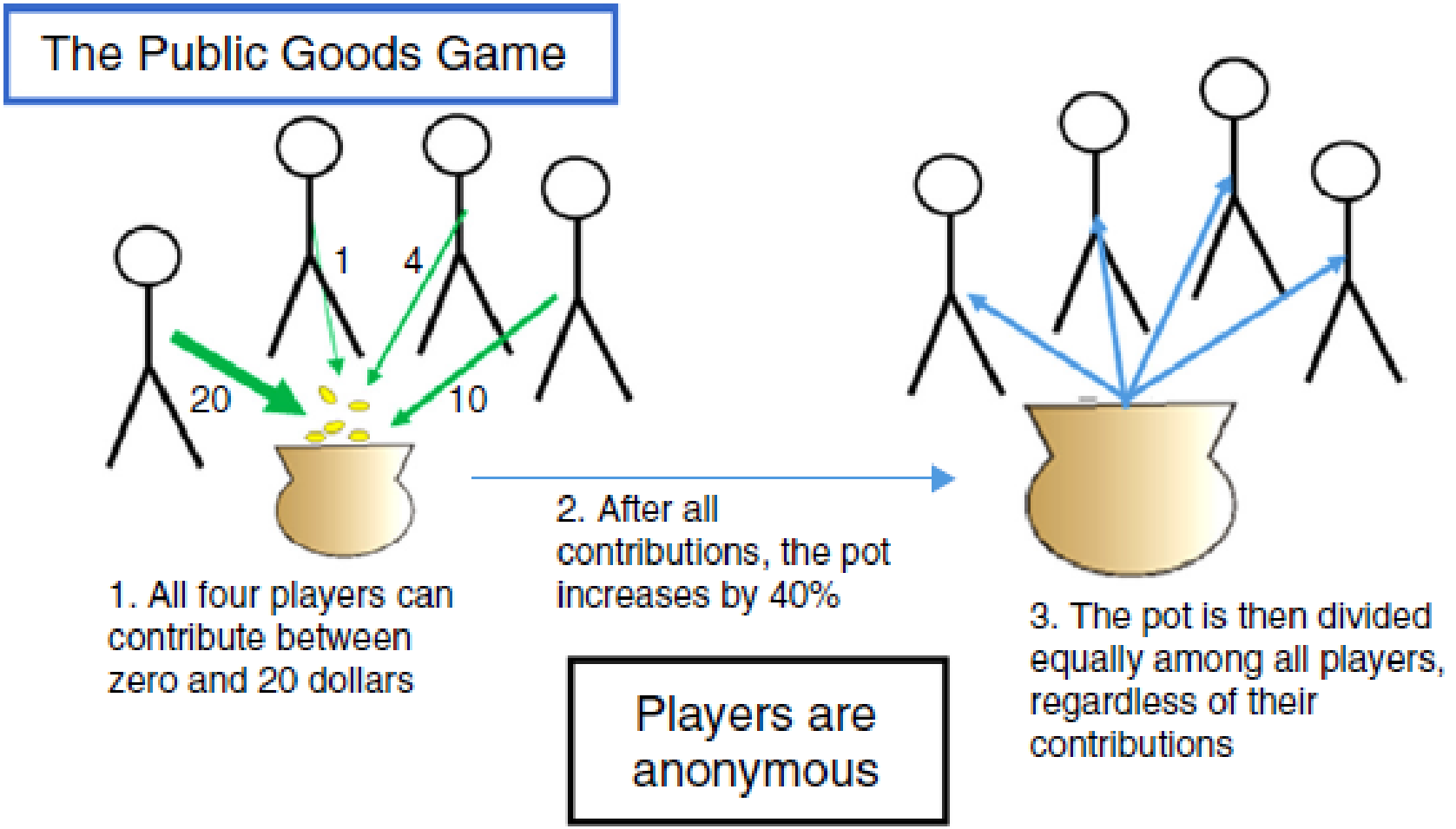
- "tit-for-tat" may lead to cooperation but also to death spirals

[2] Indirect reciprocity [Nowak and Sigmund,1998]

- The agents may decide to build a reputation capital. (in multiple period settings)

[3] Costly signalling [Gintis et al., 2001]

Fehr, E., Gächter, S., (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90, 4 980-994



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Treatment A

***Partners**: 10 groups of the same n=4 individuals which interact for 10 periods

***Strangers**: 10 random groups of n=4 individuals which interact for 10 periods

Treatment B:

***Without Punishment**: The agents decide solely their own contribution to the common money box (i.e., public good)

***With Punishment:** The agents decide their own contribution, in turn they are informed about the contributions of the others, and then they decide whether to punish (or not) some other players by paying an extra individual cost.

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How the punishment mechanism works?

- Each agent *j can give* p_j^i points of punishment to agent *i*

- Each punishment point p_j^i reduces 10% the welfare of agent i during the previous round U_i^1

- If agent *i* decides to punish the others, he/she has to pay a total cost for punishments $\sum_{j \neq i} c\left(p_i^j\right)$, So the utility of each agent is now as follows:

$$U_i = U_i^1\left(1 - 0{,}1P^i\right) - \sum_{j \neq i} c\left(p_i^j\right)$$

Fehr, E., Gächter, S., (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90, 4 980-994

How the punishment mechanism works?

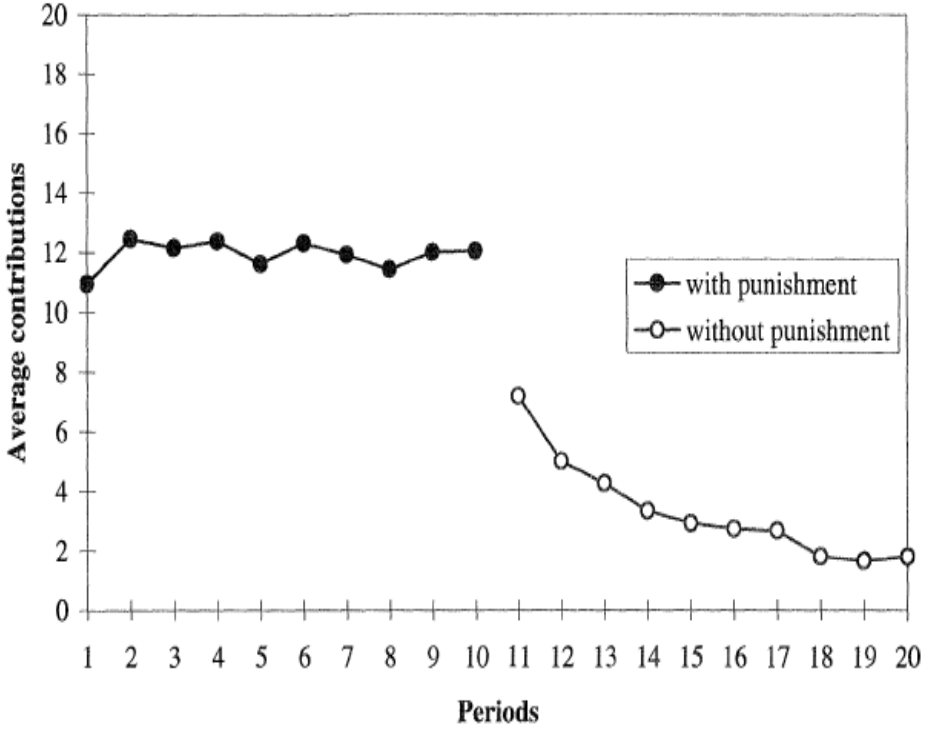
- From a theoretical point of view, the option of punishment should not affect private agents' incentives. **This is because punishment is by itself a public good!**

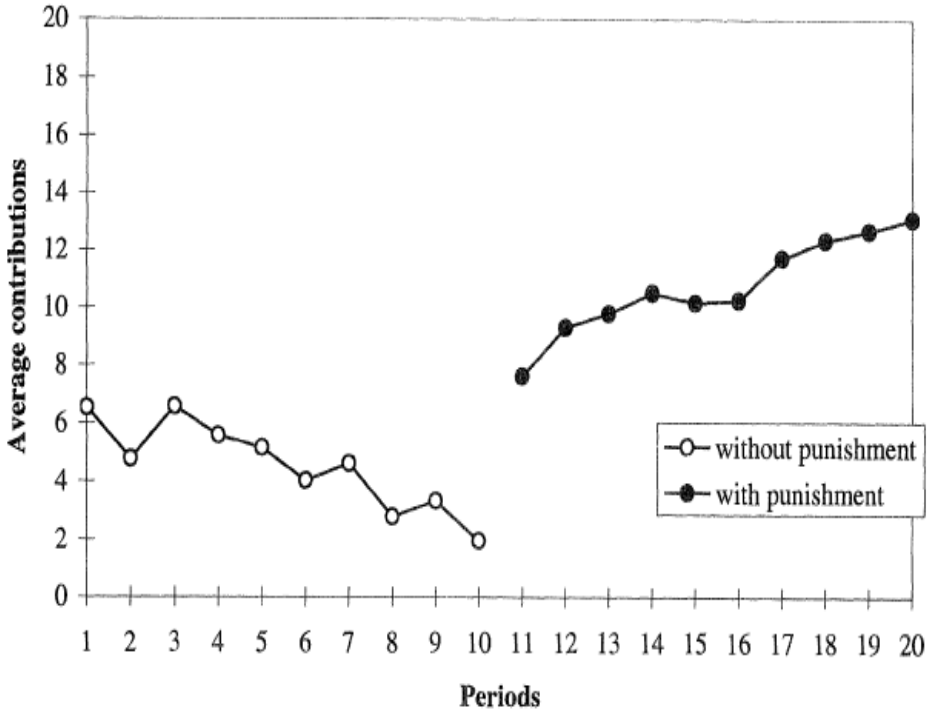
- It implies costs (and so it reduces the private welfare of the agent that decides to punish) without providing any money benefit.

- **So, according to the theory agents should not contribute to the money box and –at the same time- should not punish any other player.** $g_i = 0$ remains the dominant strategy.

Fehr, E., Gächter, S., (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90, 4 980-994

- 10 periods, E=20, n=4, α=0,4
- Groups of strangers



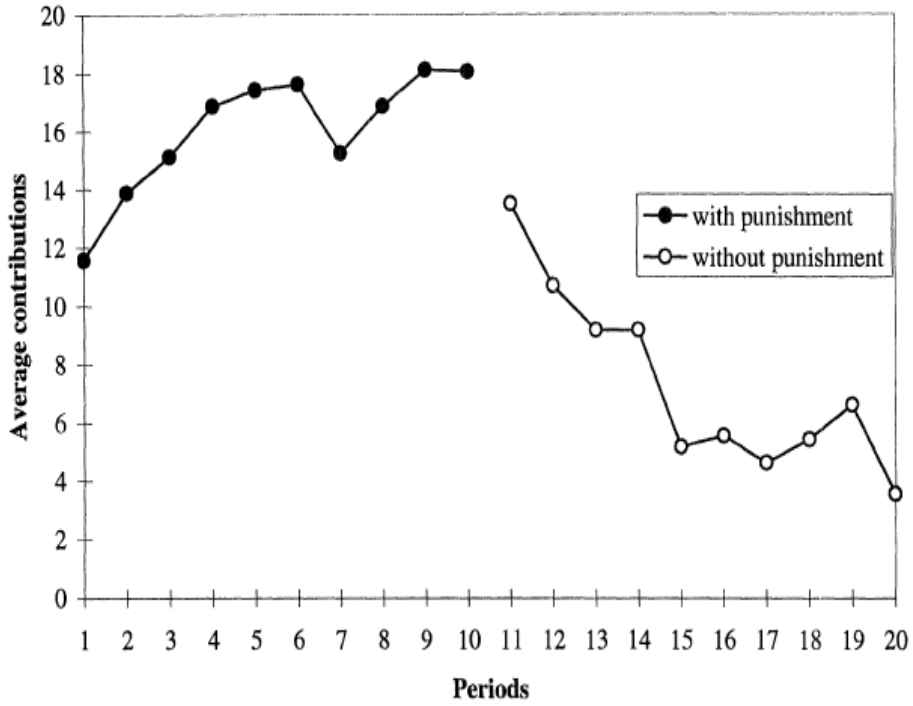


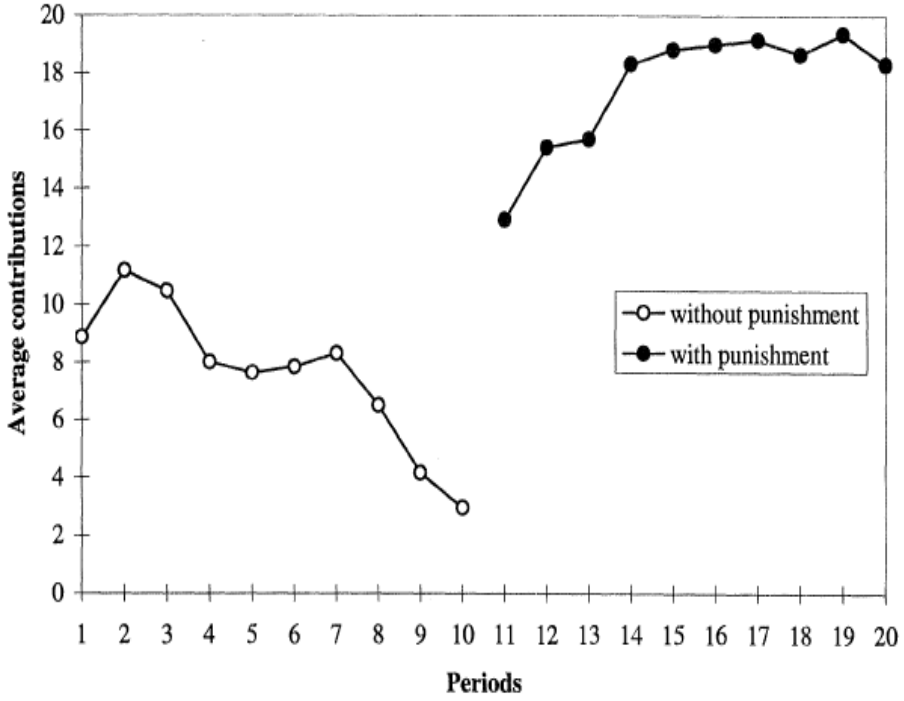
without punishment

with punishment

Fehr, E., Gächter, S., (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90, 4 980-994

- 10 periods, E=20, n=4, α=0,4
- Groups of Partners





without punishment

with punishment

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TABLE 3—MEAN CONTRIBUTIONS IN THE STRANGER-TREATMENT

	Mean contribution in all periods		Mean contribution in the final periods	
Sessions	Without punishment opportunity	With punishment opportunity	Without punishment opportunity	With punishment opportunity
1	2.7	10.9	1.3	9.8
	(5.2)	(6.1)	(4.3)	(6.8)
2	4.0	12.9	2.3	14.3
	(5.7)	(6.4)	(4.3)	(5.0)
3	4.5	10.7	2.0	13.1
	(6.0)	(4.9)	(3.8)	(4.0)
Mean	3.7	11.5	1.9	12.3
	(5.7)	(5.9)	(4.1)	(5.6)

Notes: Numbers in parentheses are standard deviations. Participants of Sessions 1 and 2 first played the treatment with punishment opportunities and then the one without such opportunities. Participants of Session 3 played in the reverse order.

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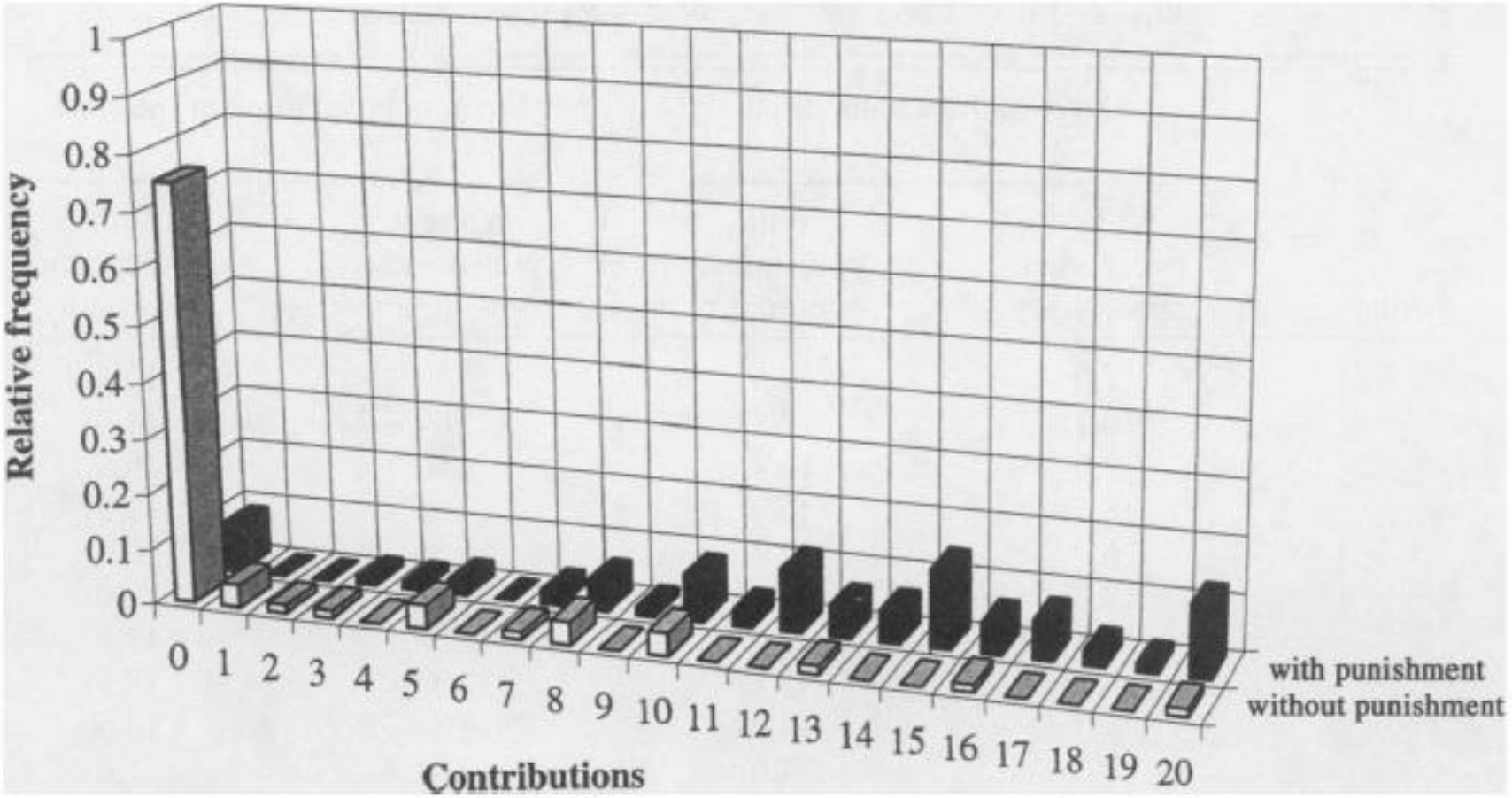

FIGURE 2. DISTRIBUTION OF CONTRIBUTIONS IN THE FINAL PERIODS OF THE STRANGER-TREATMENT WITH AND WITHOUT PUNISHMENT

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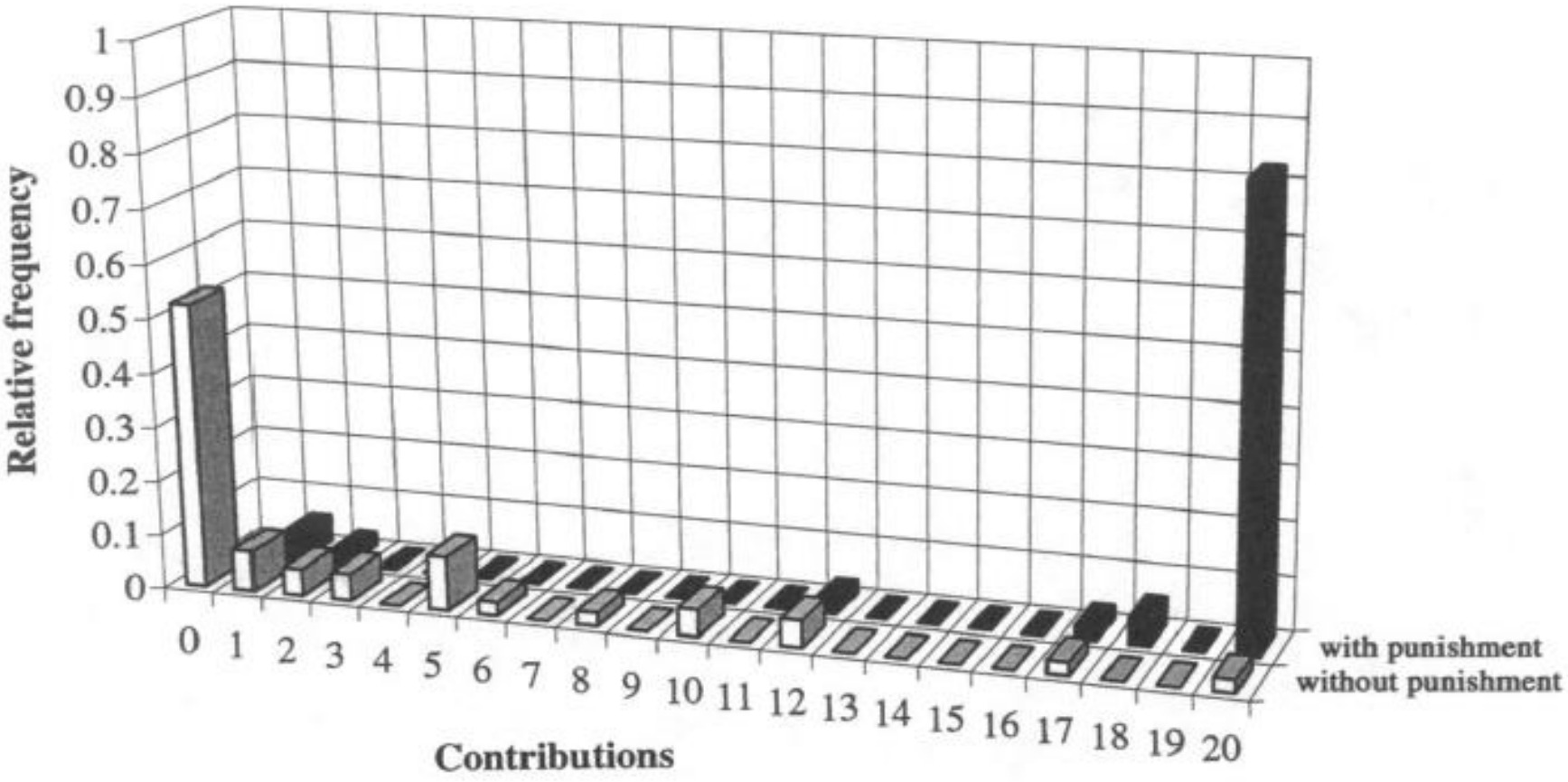

FIGURE 4. DISTRIBUTION OF CONTRIBUTIONS IN THE FINAL PERIODS OF THE PARTNER-TREATMENT WITH AND WITHOUT PUNISHMENT

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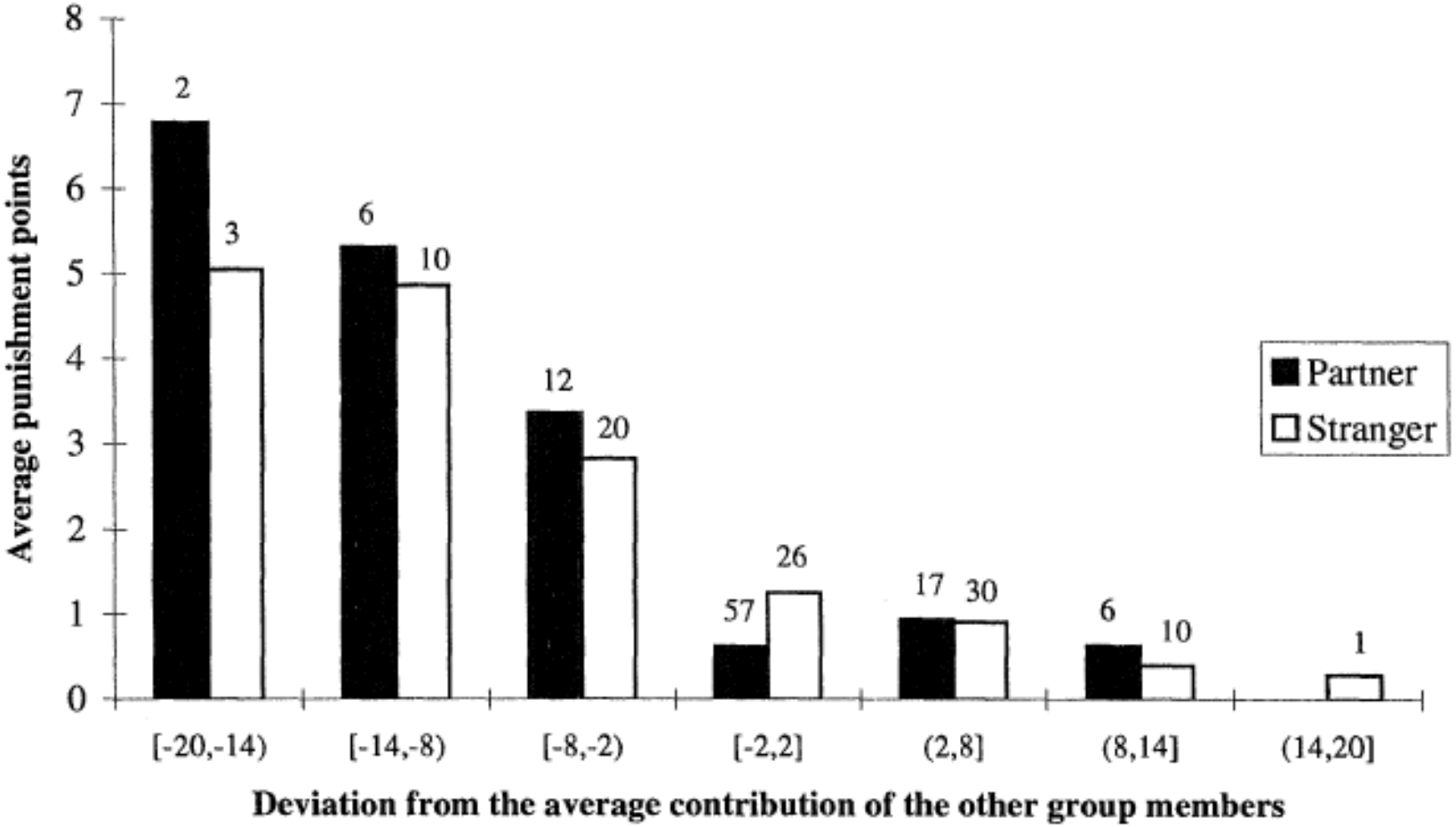


FIGURE 5. RECEIVED PUNISHMENT POINTS FOR DEVIATIONS FROM OTHERS' AVERAGE CONTRIBUTION

Fehr, E., Gächter, S., (2002). Altruistic punishment in humans. *Nature* 415,137–140.

Emotions as a proximate mechanism

In Ferh and Gachter (AER, 2000) we saw that given the pattern of punishment the investment behavior of subjects seems quite rational. To avoid punishment, subjects invested in accordance with the group norm.

But we the question is why subjects punish free riders when this is costly?

- With regard to the proximate source of the punishment, negative emotions may provide an explanation.
- Free riding may cause strong negative emotions among the cooperators and these emotions, in turn, may trigger their willingness to punish the free riders

Fehr, E., Gächter, S., (2002). Altruistic punishment in humans. *Nature* 415,137–140.

If this conjecture is correct, **we should observe particular emotional patterns in response to free riding.**

To elicit these patterns, the participants were confronted with the following two hypothetical investment scenarios after the final period of the second treatment (the numbers in brackets relate to the second scenario):

Fehr, E., Gächter, S., (2002). Altruistic punishment in humans. *Nature* 415,137–140.

Question 1

"You decide to invest 16 [5] francs to the project. The second group member invests 14 [3] and the third 18 [7] francs. Suppose the fourth member invests 2 francs to the project. You now accidentally meet this member. Please indicate your feeling towards this person."

Scenario 1 → *47% (very angry, scale: 6-7) και 37% (moderate angry, scale: 4-5)*

Scenario 2 → *18% (very angry, scale: 6-7) και 80.5% (moderate angry, scale: 4-5)*

Fehr, E., Gächter, S., (2002). Altruistic punishment in humans. *Nature* 415,137–140.

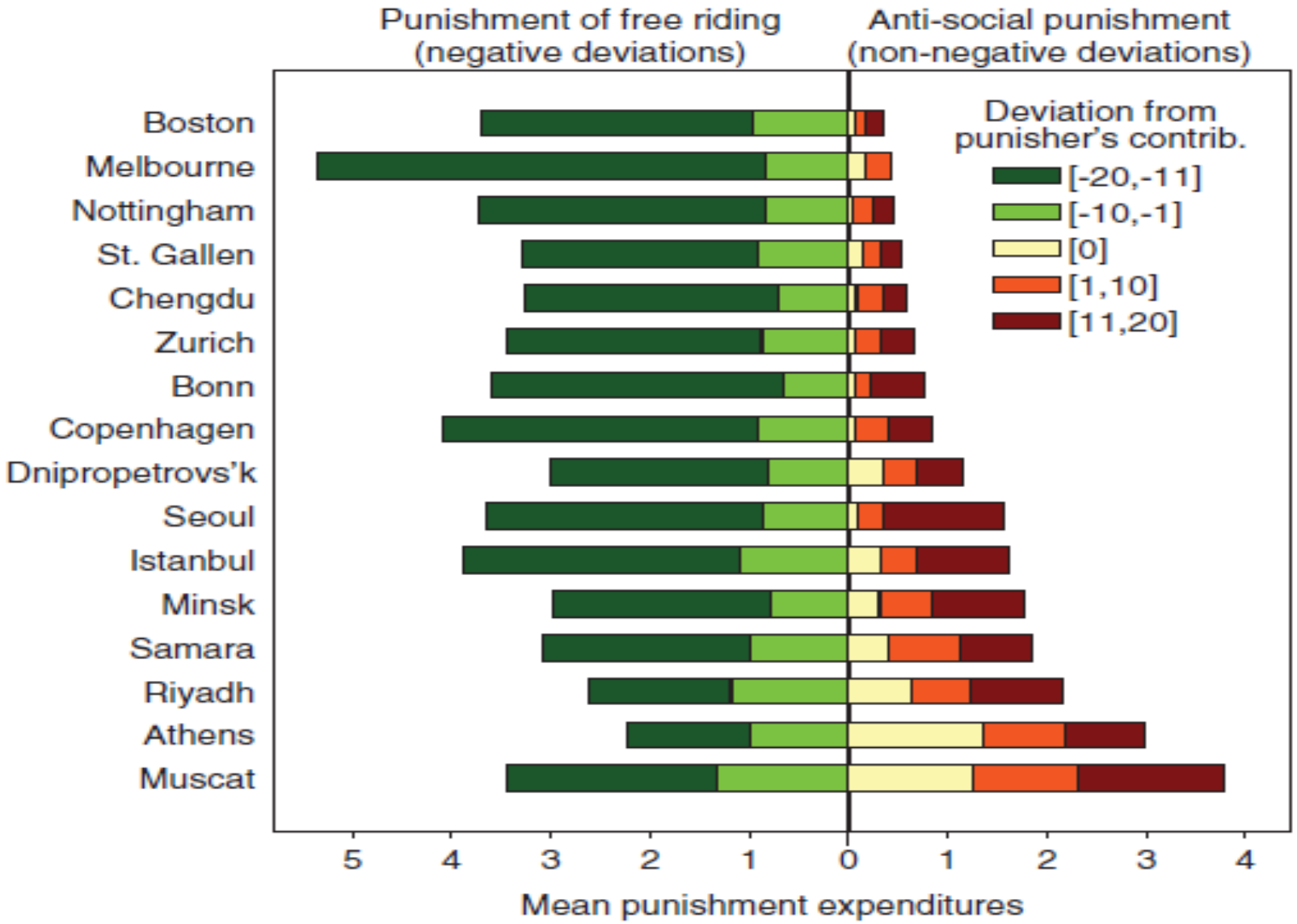
Question 2

“Imagine that the other three group members invest 14, 16 and 18 [3, 5 and 7] francs to the project. You invest 2 francs to the project and the others know this. You now accidentally meet one of the other members. Please indicate the feelings you expect from this member towards you."

Scenario 3 → *74.5% (very angry, scale: 6-7) και 22.5% (moderate angry, scale: 4-5)*

Scenario 4 → *17.8% (very angry, scale: 6-7) και 80% (moderate angry, scale: 4-5)*

Herrmann, B., Thöni, C., Gächter, S., (2008). Antisocial punishment across societies. *Science* 319, 1362-67.



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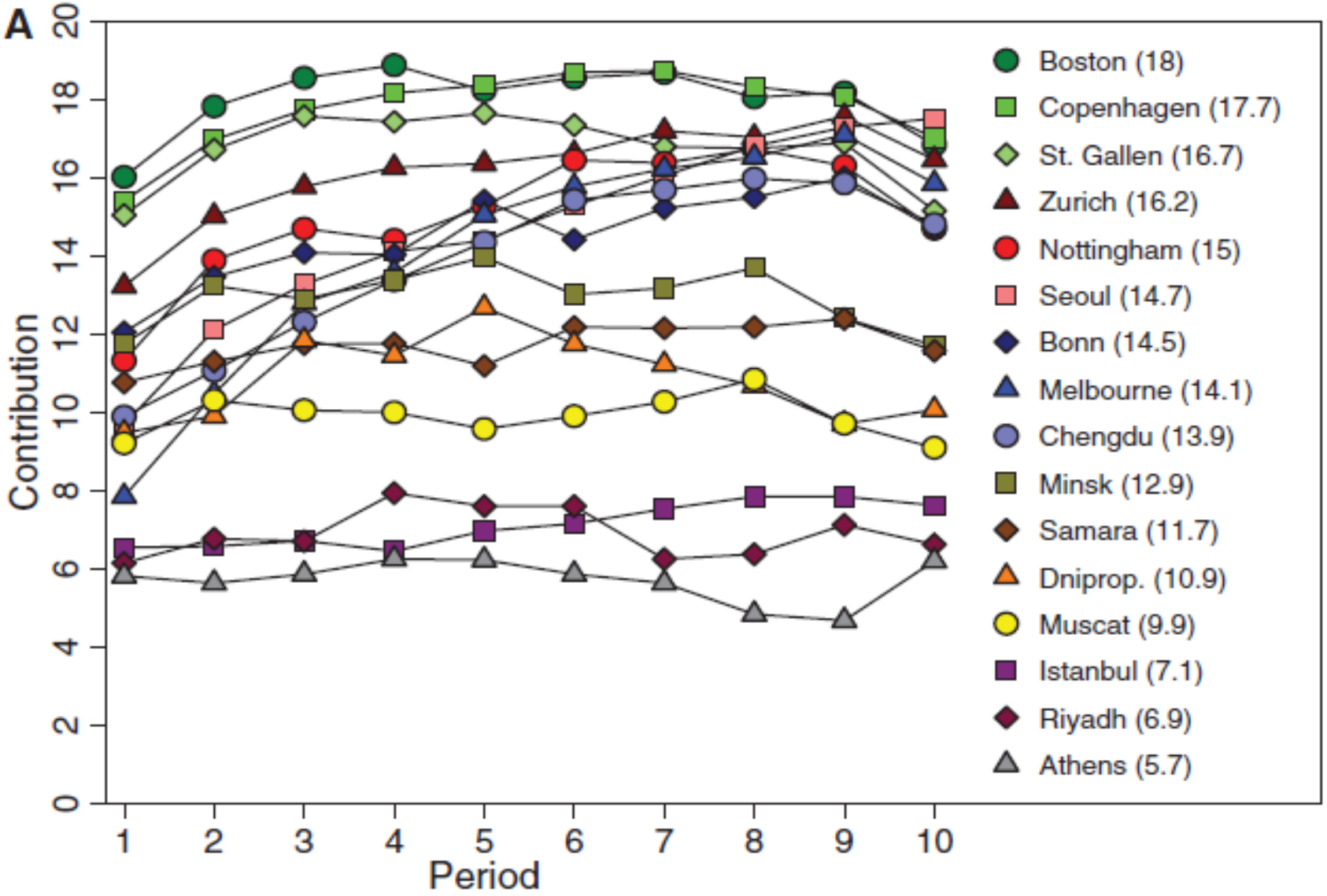

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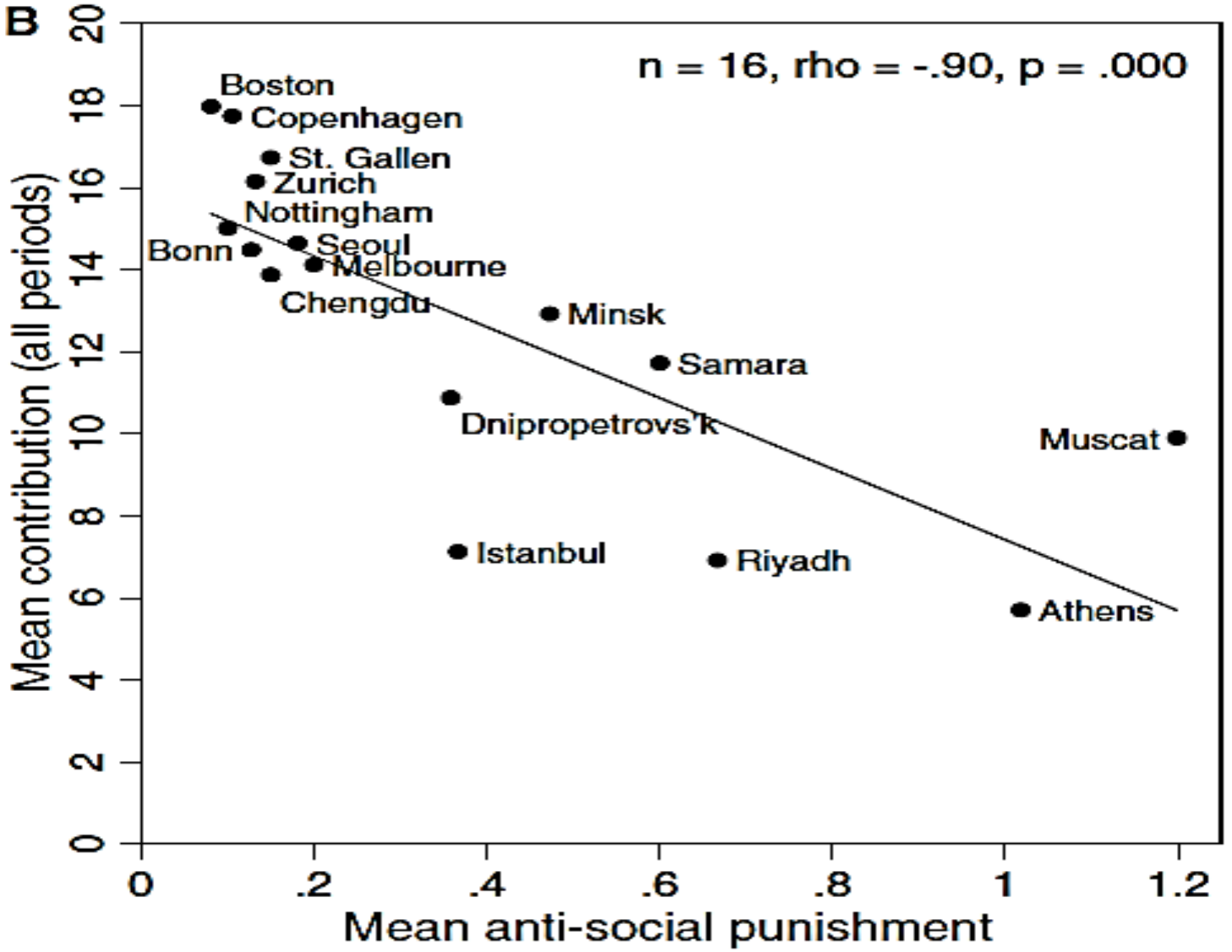

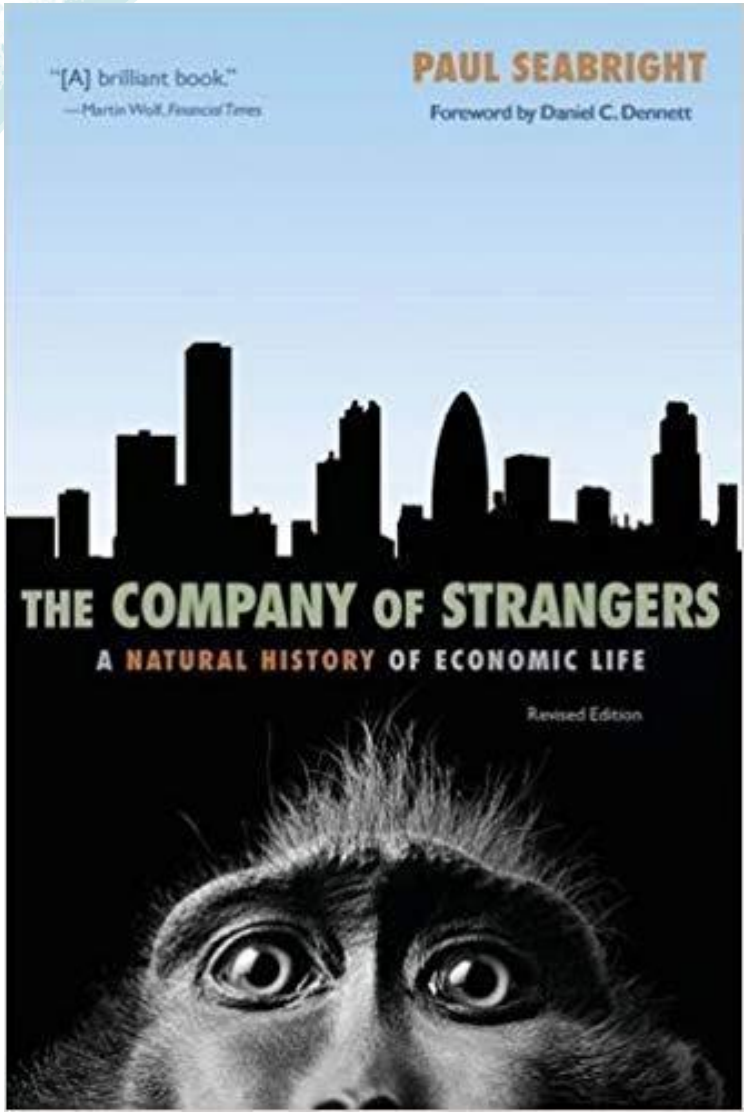
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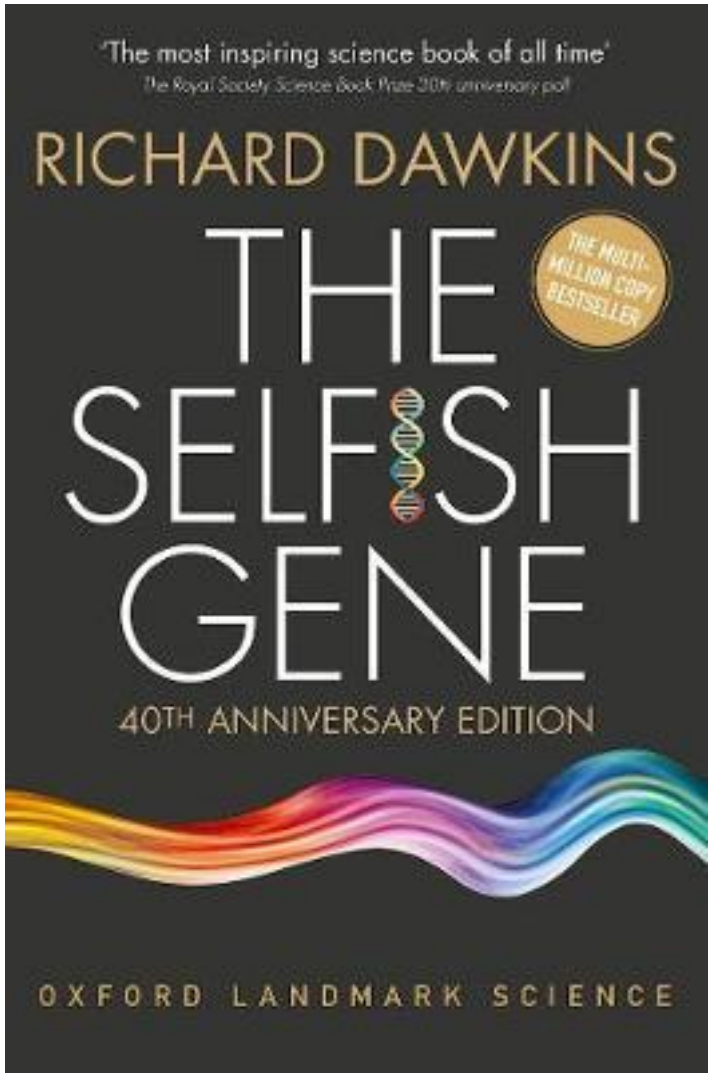
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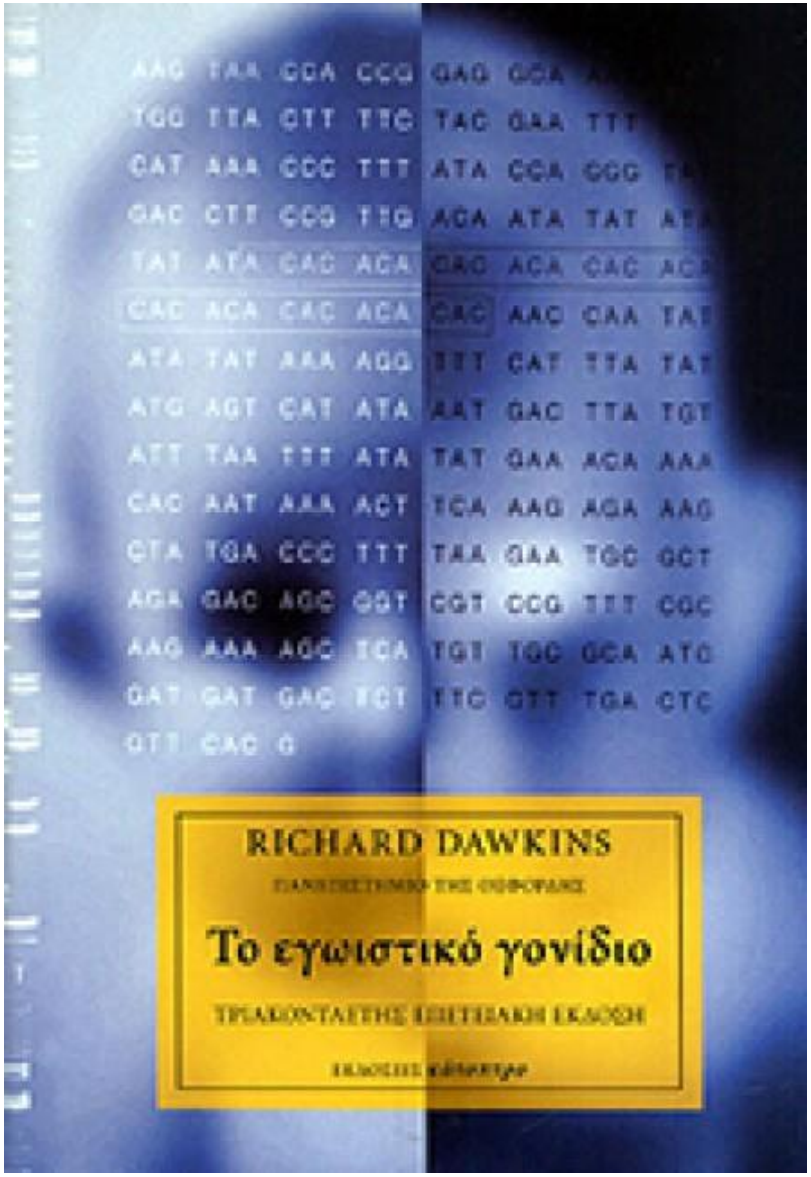
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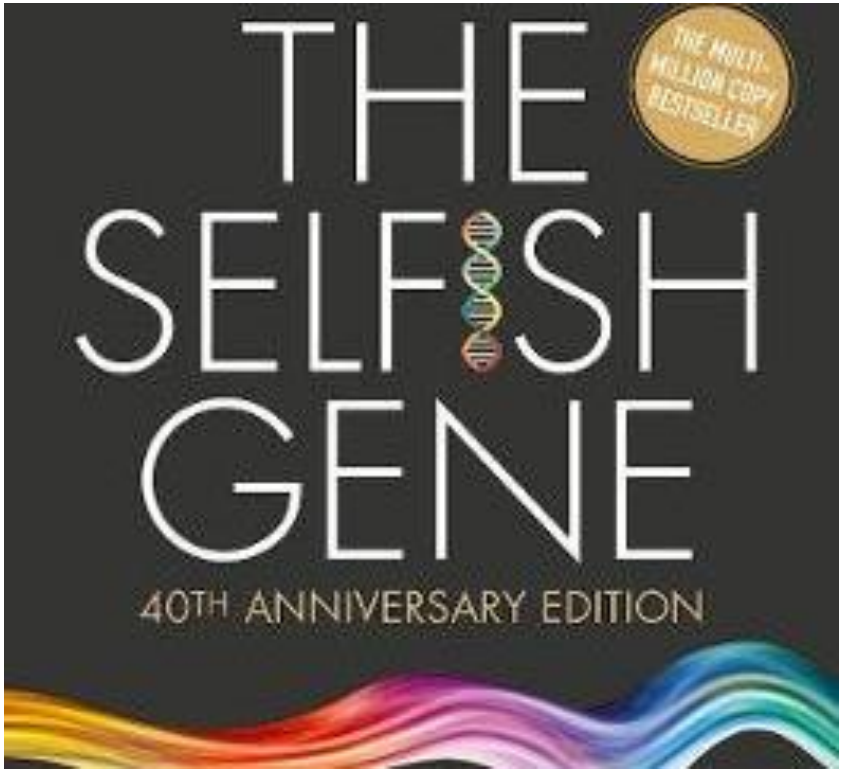
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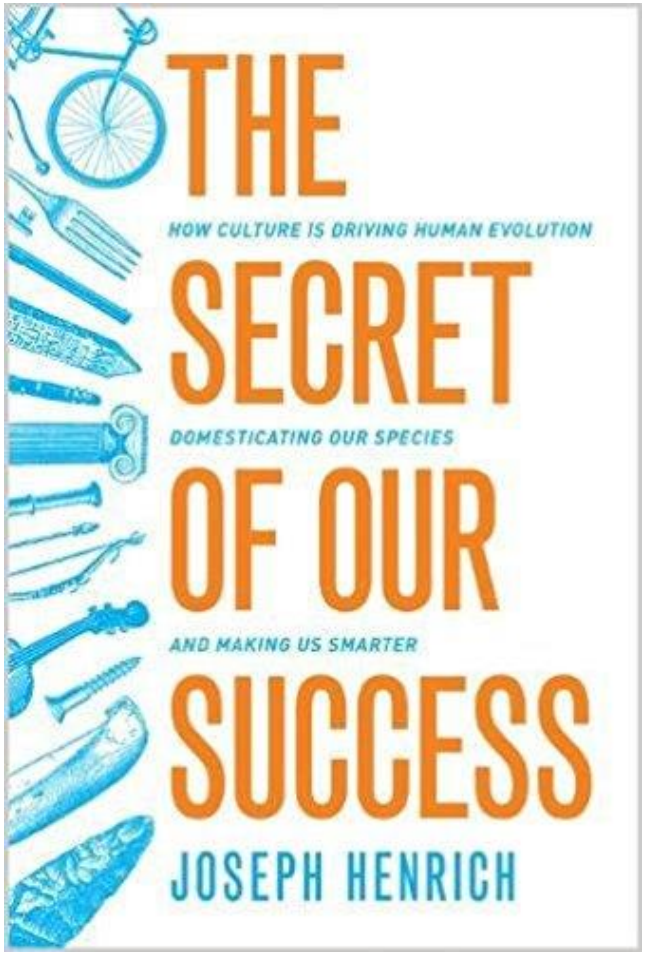
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AND MAKING US SMARTER
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JOSHUA GREENE

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