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CHAPTER 13

Cooperative Punishment and Religion's Role in the Evolution of Prosocial Altruism (Version 6)

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1.0 Introduction

Historically, human social behavior has been studied by sociologists. However, in the past several decades biologists, who had been studying the social behavior of non-human animals for centuries, began to look at human social behavior as well. Their initial reception into this field was hostile due to the concern expressed by many sociologists that biology was going to cannibalize sociology and that human social behavior was going to be conceptualized as being completely genetically determined. This fear, which was ill conceived, was never realized. Whereas genes have been shown to contribute to human behavior in terms of *congenital* (present at birth) predispositions, virtually no human behavior is completely genetically determined. Yet two important concepts emerged which help explain many aspects of human social behavior.

One is *kin selection*, as devised by William Hamilton,[1] means that the frequency of a gene in a population will be influenced not only by the effect the gene has on a particular individual's survival but also on the survival individuals who are close relatives (kin). There are more of one's genes in one's close relatives than there are in oneself. As a result, even if genes "act" selfishly,[2] there are still more of them in one's relatives than in oneself, which results in human behavior being influenced by kin selection in ways that predispose people to do things which benefits one's close relatives even at a cost to self. Kin selected acts are therefore, not really *altruistic*, as genes are just benefiting themselves in the various bodies of relatives in which they reside.

A more general definition of *altruistic behavior*, according to Robert Trivers, is "a behavior that benefits another organism, not closely related, while being apparently detrimental to the organism performing the behavior, benefit and detriment being defined in terms of *inclusive fitness*."[3] The term "inclusive fitness" is just another way of addressing the result or outcome of kin selection in which the reproductive benefit is calculated across all close relatives.

Here we want to apply these concepts to human social behavior, specifically to the issue of the relationship between the individual and the social group. We define *prosocial* behavior on the part of an individual as behavior that benefits the social group. Volunteering to do community service is an example. *Altruistic* behavior is behavior that costs the doer and benefits the other. Putting these two terms together, *prosocial altruism*, which is the word used in the title of this chapter, is behavior in which the "other" is the social group in which the doer is a member.

The evolution of prosocial altruism (i.e. behavior of an individual that favors the group at a cost to the actor) has been commonly approached as an instance of *the public goods problem.* This problem is how to manage goods or resources that belong to and are used by everybody in the social group and yet where the individual user has no incentive to spend his or her resources to supply or replenish the goods. There is also *the free-riders problem.* This problem is where everybody has to contribute some resources for a common group enterprise, but were some free ride, benefiting from the communal goods without participating in the expenses of contributing goods. This predicament is often referred to as *the social dilemma,* [4] [5] [6] and is the modern version of the centuries old quest for philosophical and political ideas that may lead to a better society.[7]

The essential problem in a social dilemma is that each group member is tempted to act socially and be a member of the group in order to reap the fruits of the social welfare resulting from the concurrent prosocial efforts of other group members. However, individual group members are more strongly tempted to spare the altruistic costs of prosocial behavior while still enjoying those fruits. As a result, the predictable outcome is the disappearance, or nonappearance, of prosocial behavior among individuals in a social group. There is a presumption in this last statement, which is that the predisposition to behave in a prosocial altruistic way, versus a free-loading way, has genetic determinants. Although humans have flexibility in their behavior, there are genes, which when possessed, predispose someone to take more than they give back to their social group.[8] We know that being an unfair reciprocator is one of the hallmarks of Antisocial Personality Disorder and that this disorder does have genetic determinants.[9] That finding does not mean that genes completely determine if one behaves antisocially. Rather, there are genes, which when congenitally possessed, tend to bias behavior in this direction. In the rest of this chapter we will discuss selfish behavior and prosocial altruism as that which needs to be understood rather than addressing the genes which may predispose to these behaviors. However, in order for what we say to make sense, one has to presume that there are congenitally acquired genes which predispose individuals to prosocial altruistic and free-riding behaviors.

Different features in this competition between selfish behavior and prosocial altruism might tilt the balance towards prosocial behavior.[10] The most important feature has as to do with degree of relatedness. It is expressed in what is called *Hamiton´s rule.* This rule states that prosocial behavior is favored by genetic relatedness and states that what looks like altruism is much more likely to occur between related individuals than between non related ones. That is, the behavior will favor the passage to the next generations of the genes eliciting it, as they are likely to occur in closely related individuals. The rule is that a costly action should be performed if: $C < R \times B$. In this simple inequality C is the cost in fitness to the actor, R the genetic relatedness between the actor and the recipient (between 0 and 1) and B

is the fitness benefit to the recipient. Fitness benefit is measured in the reproductive success of the actor. Hamilton's rule is the basis of kin selection theory. It is used to explain the majority of social behaviors in diverse species found in nature. Yet many prosocial behaviors and altruistic acts are performed among genetically unrelated individuals. This is especially true as humans social groups became larger throughout human evolution. Thus, Hamilton's rule cannot be used to explain all types of prosocial behaviors within human social groups.

Another feature that might tilt the balance in favor of prosocial behavior beside genetic relatedness is the *social synergy* achieved by social cooperation.[11] Social synergy means that the effectiveness and efficiency of action by a group is more than the sum of the individual actions of the group members. As an example, the cooperative group effort of a football team can advance a ball down the playing field in a more effective and efficient manner than if the individual members of the team each tried to do this individually not in a coordinated and planned way. As another example, the cooperative effort of the crew of a large sailing ship can get the ship to sail in the desired direction more effectively and efficiently than the sum of the individual actions of the different crew members if they were not coordinated. That is, social cooperation can be achieved and maintained even among unrelated individuals if the collective benefit of the prosocial behavior is very big, so as to eventually benefit also the altruist. Computer simulations[12] and empirical evidence, for example evidence from inter-species interaction in insects[13] suggest that when the synergy or benefits achieved by a given prosocial behavior is very large, social behavior is evolutionarily stable. In other words, when the benefits of being part of society are very high, compliance to social norms is easier.

Not always are the benefits to the individual of being part of a social group evident from the very beginning to the individual. When the individuals are neither related nor are the eventual long term benefits of sociality very large, prosocial behavior could be stabilized through punishment of the free-riders. When punishment of a free-rider is done by another individual group member, such punishment could incur an individual cost to the punishing individual. The cost could be in resources or time or by retribution to the individual or the individual's family from the person who is punished. Therefore, because there are individual costs involved, when an individual punishes a free-rider in the group, this is called *altruistic punishment.* The entire group benefits from punishing the free-rider but only the punishing individual bears the cost of being the punisher. Nevertheless, the occurrence of altruistic punishment, through which individuals punish other individuals for failing to act prosocially, increase the costs of free-riding for the free-rider. It thereby improves the option of individuals in the group engaging in prosocial behavior.[14] [15] The problem is that because altruistic punishment is also costly to the individual who is doing the punishment, rational individuals would, again, be more inclined to let others assume the costs of punishing the free-rider individually, while still enjoying the fruits of prosocial behavior by being a member of the social group.

If human ancestral groups were, on the contrary, able to display *co-operative punishment*, and sustain the capacity for cooperative punishment for long periods of time, they would be curbing the biological fitness of *congenital free-riders*, while raising the biological fitness of *congenital altruists.*[16] A "congenital" free-rider or altruist is someone who has the genetic predisposition to be a non-fair or fair reciprocator in reference to their social group.[17] By cooperative punishment we mean punishment that is carried out by rule or law or order of the social group, even though individuals in the social group may be actually giving the punishment as agents of the social group. Birds, for example commonly engage in a communal behavior called mobbing,[18] which serves to defend themselves or their offspring from predators. An analogous example of cooperative punishment in humans in modern societies is incarceration in prison for persons found guilty of serious crimes; or paying specialists (i.e. policemen) to punish efficiently.[19] In other words, cooperative versus individual altruistic punishment creates the perfect environment for the biological evolution of prosocial altruism.[20] As we will develop in this chapter, religion could have played and may still play such a role as the substrate for dispensing cooperative punishment. We also will present what we believe are good reasons, at least from a biological perspective, why some religion can do this in some circumstances better than a form of secular governance.

The next question is how can one go about showing scientifically that this could be the case - that cooperative punishment could have played a role in the emergence of prosocial altruism in human social groups of unrelated individuals? It is not possible to go back in time when human social groups were getting larger than small hunter-gather bands and becoming composed of unrelated individuals. That change may have occurred on a large scale sometime around 10,000 or so years ago when agriculture and animal husbandry began to replace the hunter-gather band. Humans could then live in larger groups of unrelated individuals by having domesticated animals and growing cereal grains and rice outside of and around the population centers. There are only two ways of showing what the role of cooperative punishment may have been in the evolution of prosocial altruism. One way is by what are called computer simulations. The other way is by setting up a game scenario in modern humans which looks at the degree to which people engage in prosocial altruism versus selfish free-riding as a function of their religious affiliation or non-affiliation. That way is covered in the next chapter. In this chapter we will address the question by computer simulations.

2.0 Computer Simulations

To show scientifically that cooperative punishment *could* facilitate the evolution of prosocial altruism in human populations of unrelated individuals we have modeled through computer simulation the evolution of a virtual population of 500 hunter-gatherers by means of a computer program called *Sociodynamica,*[21] previously used to model economic aspects of altruistic co-operation,[22] altruistic punishment,[23] and the role of shame in stabilizing co-operation.[24]

All 500 individuals in the virtual population agree to contribute part of their hunting and gathering efforts in order to form every economic period a common pile of food that would ensure the diversity of nutrients they need. Such diverse nutrients could hardly be obtained individually, which creates the social synergy previously discussed. In the simulation each individual collects 3 food units in each economic period. The prosocial individuals (s=1) contribute with 1 unit of food to the common food pile each period. The resulting common food pile is periodically distributed evenly among all group members, independently of their individual contribution. A fixed expense for each individual is survival, which is simulated here by a cost of 0.5 food units each period. When the accumulated wealth of an individual is larger than 2 units, it will use its excess wealth for self-reproduction, at a cost of 2 units per clone. A lifetime of an individual consists of only 10 periods, and random death is constantly introduced to keep the population steady at 500. Every new clone will be identical genetically to its parent except for an occasional mutation which occurs in average at a rate so that it affects 10% of all new genes.

We set up the simulation so that at first, half of the actors are congenital prosocial altruists in the sense that they always honor their commitments of contributing 1 food units to the common food pile, while the other half of the actors are congenital free-riders that never do so. The free-riders keep all of their food for themselves. Later on, gene frequencies in the simulation will vary according to reproductive success of each type of agent, which in turn affects the size of the common pile gathered each period. The gene frequencies change because of the congenital aspect of being either a prosocial altruist or a selfish free-rider. Figure 1 reflects at each moment in time the percentage of prosocial genes within the population over a period of 50 periods in three different social scenarios—No Punishment, Altruistic Punishment, and Co-operative Punishment. Note that because the lifetime of the individual is only 10 periods, 50 periods represents several generations. The simulation could just as well have been made making the average lifetime of an individual 50 periods and looking at changes in gene frequencies in the population over 250 periods.

The following three different situations or social scenarios were explored with our simulations

- **No Punishment (NP)**. It is initially agreed that the collecting system will rely entirely on people's good will, with no monitoring and enforcement of the social contract.
- **Altruistic Punishment (AP).** To tackle the free-riders problem, group members are allowed to enforce the social contract by punishing individually those who fail to contribute, which involves a detraction of food units. Since free-riders will presumably resist being punished, altruistic punishers will also incur certain costs.
- **Co-operative Punishment (CP).** Here, group members apply punishment co-operatively, meaning that the costs of punishing free-riders are not assumed by a few freelance punishers, but distributed among all society members (operationally implemented by detracting the aggregate costs of punishment from the common pile).

The summary of the different variables used in the simulations is given in Table 1

[INTRODUCE TABLE 1 ABOUT HERE.]

3.0 Results

The simulations showed that the successful enforcement of social norms, required as a precondition for the evolution of prosocial altruism, is highly dependent on keeping punishment costs low, on the one hand, and punishment effectiveness high, on the other, thereby increasing the cost-effectiveness of punishment (K/C). This can be clearly seen from Figure 1.

[INTRODUCE FIGURE 1 ABOUT HERE]

In Figure 1, the NP curve reflects the situation of a zero percent effectiveness in punishment (*E=0*). The AP curve, for its part, remains always below the CP line. The CP curve shows that the social system begins to work when the cost/benefit ratio is below a threshold of 0.5.

In Figure 2 we show the amount of agents that show prosocial behavior at equilibrium for systems with different punishment efficiencies (*E*). The Figure shows that prosocial behavior can be sustained if more than *half* of infractions are punished (that is, $E>60$),

[INTRODUCE FIGURE 2 ABOUT HERE.]

The findings can be summarized by saying that the cost of punishment to the punisher times the probability of having to pay the cost of punishment by the punisher is less than the cost of punishment paid by the free rider times the probability of the free rider having to pay the cost. For those readers who like to think about such relationships symbolically the following inequality summarizes our findings analytically:

$$C * p_c < K * p_k$$

where **C** is the punishment cost, **K** the cost of the punishment paid by the free-rider if caught, and $\mathbf{p_c}$ and $\mathbf{p_k}$ are the probability of having to pay the cost **C** or the cost **K** respectively. (The "*" stands for multiplication.)

What the above analytic inequality shows is that social behavior is evolutionarily stable if the cost of punishment times the probability of having to pay a cost for punishing is much less than the cost the punished individual has to pay times the likelihood that he is caught and has to pay a fine. Recent experimental evidence from economic games confirms that the K/C ratio and p_k are fundamental in triggering altruistic punishment.[25]

4.0 Discussion

Our results show that co-operative punishment has a critical quality of dividing the costs of punishment among society members, and has the potential to enhance the cost-effectiveness of punishment significantly, by both reducing its costs and increasing its effectiveness.

Co-operative punishment achieves eventually a reduction in the costs of punishment as a consequence of the synergy that typically results from co-operation.[26] Strong resistance may be expected when one individual tries to punish another individually, leading potentially to considerable damage to the punisher. But when various individuals punish someone co-operatively, resistance may be expected to fall dramatically. When a large group of individuals decide to engage in punishment, a simple sign of their willingness may be sufficient to convince the violator to follow the rules, which means that the costs of punishment would be virtually reduced to zero.

Another benefit of co-operative punishment is that it may increase the effectiveness of punishment as a result of the combined capacities of all society members in monitoring individual behavior, making it possible to detect infractions in a way that non-cooperative freelance punishers could not.

Certainly, co-operative punishment involves additional costs in terms of the observations, evaluations, and discussions required to reach agreement and in maintaining a cohesive flux of information. In constituted societies punishment costs may actually lay for the most part in these necessary proceedings rather than in execution of punishment itself. We believe, however, that in the end all these factors add up to the cost-effectiveness of co-operative punishment, reinforcing its power to exert a consistent selective pressure leading to the evolution of prosocial altruism.

Forming a group or maintaining a religion, of course, has a cost, which might be quite high. Historically, not al religions necessarily aimed at improving harmony among humans.[27] Some religions might develop important social functions, such as promoting prosocial behavior[28] and thus guarantee their long term survival but others might not and eventually go extinct.[29] But once a group exists, excluding a member from the group (banning, isolating, excommunicating, shaming, lower its reputation etc.) is a very cheep way of applying a large punishment (K) at a low additional cost to punishers (C). Moral punishment is a very ancient human practice and may be common in many social institutions, including most religions. Based on the simulation results, we propose then that the prosocial effect of religions is mainly through cooperative punishment.

Our simulations showed the importance of the K/C ratio in achieving evolutionarily stable prosocial behavior. The K/C ratio is the cost of the fine extracted to the punisher divided by the prosocial contribution made by the agent. A way to maximize inequality $C<K$ is to make $C = 0$, $K = \infty$ (and $p_k = 1$). This is achieved by religions where God is the one who

punishes[30] so that C for humans =0, and where the punishment is hell for eternity ($K = \infty$). Superhuman Gods, of course, find free-riders with p=1.

This means that the prosocial effect achieved by cooperative punishment might be an evolutionary driver for those religions which favor prosocial behavior, making them adaptive in evolutionary terms and favoring their maintenance. This effect however does not explain the evolutionary origins of religion.

An empirical way to falsify the propositions made here involve finding a way to quantify the costs of being punished or excluded from social groups and compare them with the costs of participation. If such cost can be quantified, it should then be feasible to measure the effect religions have on each of these costs. Intuitively it seems obvious that religion makes exclusion from a group much easier which in turn elevates the costs to free-riders, without increasing the cost of participation in the religion. Many a modern social structure seems to draw on this strength, exploited by all religions, to enhance their performance.

Recent work by Dominic Johnson and Oliver Kruger[31] seems to confirm that there exist a robust relationship between God's punishment and public goods. They tested the supernatural punishment hypothesis in 186 world cultures. This work was based on the fact that cooperation towards public goods relies on credible threats of punishment to deter cheats. However, punishing is costly, so it remains unclear who incurred the costs of enforcement in our evolutionary past. The theoretical work presented here suggests that human cooperation is promoted if people believe in supernatural punishment for moral transgressions. Using the data from 186 societies around the globe, Dominic Johnson showed that the likelihood of supernatural punishment—indexed by the importance of moralizing "high gods"— is associated with cooperation. These studies, however, do not consider the ratio between the cost of punishment (K) and the cost to punish (C). Further studies including these insights could prove to increase our understanding of the adaptive values of religions.

6.0 Summary

Punishment is often required to enforce prosocial behavior. Using the agent based computer simulation model Sociodynamica we show that the cost/benefit ratio of punishment is critical for its evolutionary establishment and maintenance. One way to reduce this ratio is to distribute the costs of punishment evenly among all group members such as in mobbing. This solution however is sensitive to the ability of the group to reach most free-riders for eventual punishment. The simulations show that if punishment costs can be distributed among group members and punishment reaches over 60% of the individuals, the establishment of prosocial behavior can be assured. We propose that religions allow the implementation of co-operative punishment among human societies, stabilizing prosocial behavior. Religions have a cost of establishment and maintenance, but once in existence they can implement supernatural punishment that achieves infinitely large punishment at zero cost to humans. Religions exploit co-operative punishments by banning non-compliers from their protective benefits and condemning them to eternal sufferings, maximizing punishment while minimizing the cost for punishment. The simulations show that any institution able to reduce the cost for punishment while increasing punishment is likely to become an evolutionarily adaptive strategy, but that only religions are able to maximize the cost-benefit ratio by promising hell for ever to non-compliers at no additional cost to the shaman or punisher.

Table 1: Variables defining the rules of the game in the simulations

Society	Defined by the use of the social contribution *C*. Societies simulated were: No Punishment (*NP*), Altruistic Punishment (*AP*) or Co-operative (Collective) Punishment (*CP*)
C	Contribution. Was paid as a proportion of the wealth accumulated by the agent. All agents with *s*=1 paid their contribution.
Y	Cost to the punisher. In the present simulations Y = C
K	Cost of the fine extracted to the punished agents
E	Efficiency in punishing free-riders (agents with *s* = 0). This efficiency is given as the percentage of free-riders punished. In the NP social scenario, E = 0.
P	Proportion of prosocial agents in the particular social scenario: 100 * Agents with *s*=1 / agent with *s*=0

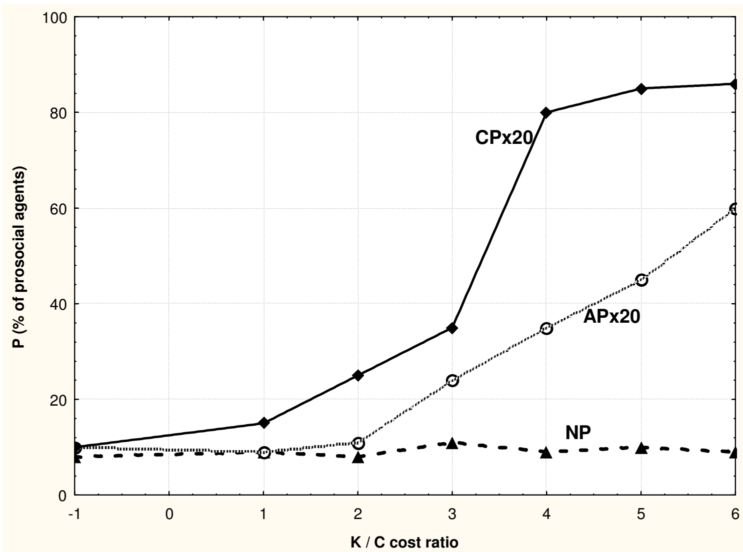

Figure 1: Average of P reached when simulating three different societies (NP, AP, CP) at different ratios of: the costs to the punished K and the cost to the punishers C. The efficiency of reaching free riders for punishment $E = 60\%$.

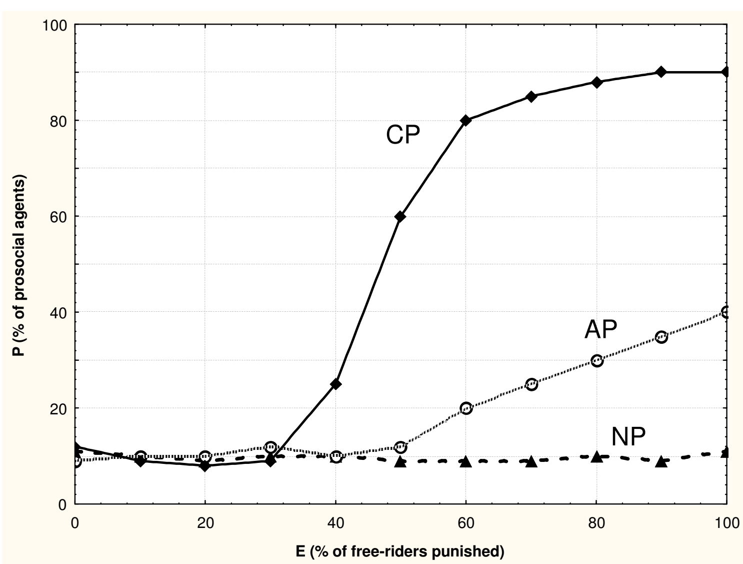

Figure 2: Average values for P derived from simulations in the three different scenarios (*NP, AP, CP*), where c=p=1 and p'=2. E varies from 0 to 100, as indicated in the horizontal axis. Data points represent the average of 200 simulations, each consisting of 200 time-steps.

5.0 **Appendix: Mathematical formulation of the model:**

The model emulates widely used experimental economics game in which each member of a group is provided an endowment, b that increases every time step in 3 units, that can be kept or invested in a public good. The combined investment in the public good is multiplied by a factor, s, and distributed equally to everyone in the group. The total payoff of each individual (the proportion of the endowment kept for oneself plus one's share of the public good) is related to fitness as excess food is used to produce offspring. In the present set of experiments, s = 1. Increasing "s" will increase the odds for cooperative strategies to invade the population (36). Thus, s=1 is a very stringent condition for cooperators to survive.

The accumulated wealth- fitness (W) of either cooperators (c) or free-riders (f) is:

$W_c = \Sigma_c\, b + s - c$

$W_f = \Sigma_f\, b + s - p$

Where:

b = amount of resources received trough feeding (constant)

c = cost of cooperation (constant)

p = cost of punishment * probability of being punished

The benefit received trough social cooperation (s) is defined as:

$s = (n_c * c * \alpha - \Sigma p') / (n_{c\,+}\, n_{f)}$

Where:

α = synergy achieved trough social cooperation

p' = cost to punish the captured free-riders

n_c = total number of cooperators

n_f = total number of free-riders

Endnotes

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