

## Analysis of the Influence of the Penalty on the Cooperative Behavior Based on Netlogo Computer Simulation

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### Abstract

At present, cooperative behavior is mainly in three aspects: theoretical research, computer simulation and empirical analysis. The basic research paradigm including the game method and peer evaluation method. This paper research based on multi agent is designed and implemented a cooperative bank system based on Netlogo platform, in the system to study whether the effects of punishment on cooperative behavior. Through the Netlogo simulation model and analysis of the operation, if there is no social punishment selfish people will be more likely to survive. In order to make the environment conducive to cooperation, this paper establishes the penalty system.

**Key words:** Cooperative behavior; Computer simulation; Netlogo; Penalty system

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### INTRODUCTION

Cooperative behavior is common to the animal kingdom and human society. Cooperation, as an architect of the evolutionary process, is the key factor of language

production (Nowak & Highfield, 2011). It is the greatest success of human society, and human society is built up on the idea of helping each other (Nowak, 2006). In the Darwinian perspective, natural selection does not favor and partners. The emergence and development of human civilization relies on large-scale cooperation, so cooperative behavior to be produced and continue to grow and develop has become one of the important issues in the field of natural science and social science, many scholars also this research. During the 1990s, cooperation has become representative issues of decision-making psychology. Cooperation is to study on two or more than two people or groups to achieve long-term common purpose, in resources, knowledge and ability to share in order to increase the well-being of each participant of an interactive mode (Spekman et al., 1998).

At present, there are three main research directions of cooperative behavior at home and abroad. (a) General theoretical analysis. Including collaborative modeling feature, cooperation stability and cooperative information research. (b) Computer simulation. Such as Axelrod and Hamilton based on the game theory simulation, proposed cooperation and evolution, which is the current mainstream research framework. (c) Empirical analysis. The reciprocity theory of Trivers that cooperative behavior are similar to the investment, the purpose is to get the corresponding return to the foreseeable future (Trivers, 1971). Zahavi (1975) showed that the expensive signal theory, cooperative behavior can be regarded as a kind of signal, letting the sender to show their type in order to improve the social status of Wu et al. (2011) found that participants were more likely to reject disadvantageous inequality and equality of preferential. According to the viewpoint of Weber et al. (1997), the factors that influence cooperative behavior can be divided into two categories: internal factors and situational factors. The internal factors can be divided into two parts of the personality factors and cognitive factors, specifically, including self-

efficacy sense of values, emotional states, cognitive development level, social cognition and cooperative feedback and communication. Situational factors include the difficulty of the task, interpersonal relationship, information communication and incentive structure. According to this classification, this paper is a situational factors of cooperative behavior influence research (Weber, Kopelman, & Messick, 2004).

The simulation system can realize the cooperation behavior simulation with Swarm, Repast, MASON and Netlogo. Before the three platforms are very powerful, can achieve any model, but more complex and not provide auxiliary tools, so the non-professional computer users are difficult to use. By comparison, Netlogo has its own unique advantages: It can not only realize the basic simulation all kinds of complicated social phenomenon, but also can provide a friendly interface to ensure easy to learn and easy to use. It uses the most advanced all in the simulation platform of Logo language programming language, natural language is very close to humans, researchers can thus help without too much computer programming quickly masters the skills so as to realize the idea of. The computer simulation is constructed by computer model imitating the real situation. The research is not easy to direct observation of the characteristics and prediction of the future computer simulation two Classic applications. Compared to the simple scenario of the traditional methods, the simulation system can simulate the real situation, but also can avoid the influence of subjective factors. The research results from the cooperative behavior of computer simulation including cooperation mechanism generation, cooperative structure, process, cooperation, cooperation in large scale autonomous system, the evolution of cooperation, negotiation, alliance, cooperation, support cooperation in multi-agent deception and trust as well as the computer artificial intelligence, software, electronic commerce and so on. The simulation system can realize the cooperation behavior simulation with Swarm, Repast, MASON and Netlogo (Pillot & Morvan, 2014). Before the three platforms are very powerful, can achieve any model, but more complex and not the auxiliary tool, so non-professional computer users are difficult to apply. In comparison, Netlogo has its own unique advantages: It can not only achieve a variety of basic complex Simulations of social phenomena, and can provide friendly interface to ensure learnability and ease of use. It uses the all simulation platform in the most advanced programming language Netlogo language, very close to the natural language of human beings, so it can't help too much computer programming based researchers quickly mastered skills so as to realize the idea.

Due to the detailed division of labor, the level of demand continues to improve, people self-sufficiency

was gradually weakened, more people need different roles to individual people are increasing for their attention gradually increased, so the conflict between private interests and public interests of the convex. of a society to exist, the productive forces must be continuously improve the productivity, which will inevitably lead to the continuous of the social division of labor, and the interdependence between people and people, behavior factors material instead of affective behavior factors, in which with a private growth potential. So the productivity and social cooperation seems to be contradictory, which in turn leads to a that led to increasing productivity vicious spiral, social cooperation, and social cooperation will eventually harm the society. Because of their own quality related cost and efforts of team members, high-quality group Team member's effort would cost less than the low quality of the members of the cost, so the enthusiasm of high-quality staff cooperation will be higher such as technical director of the project than the general technical workers cooperation enthusiasm this is in addition to its position, the more important is the technical responsible person have rich technical experience, and familiarity technical knowledge and general technical workers need more time to learn to master, so the technical responsible person to provide the cost of cooperation than low skilled workers, are more willing to help and cooperation so as to improve the quality staff and altruistic preferences lower quality of staff costs will help to the project team cooperation for the others (Ruan et al., 2012).

The multi-agent simulation is used in this paper, using the Netlogo simulation software to study whether cooperation efforts needed to cost is high, the enthusiasm for the team members is also lower. Explore no penalty for cooperation and selfish people's survival, the survival condition of adding a penalty after cooperation and selfish, draw the simulation results, and the realistic problems to make certain guiding activity analysis.

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## 1. MODEL CONSTRUCTION AND SIMULATION ANALYSIS

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### 1.1 Model Assumptions and Construction

This paper will use a prisoner's dilemma game to explain the evolution of cooperation behavior. In evolutionary game theory are two kinds of situations,  $y$  of cooperation and  $n$  of non-cooperative. Cooperation will pay a cost  $C$ , and to all the people (in addition to themselves) to bring the  $B$  income (in this paper we will always assume  $B > C$ , i.e., the cooperation of the benefits outweighs the costs, otherwise a cooperation does not make sense). And non-cooperative haven't to pay any cost, also do not give each other to have any benefit. Payoff matrix as follows is shown in the table below:

**Table 1**  
**Whether the Partnership Income Matrix Table**

	<i>Y</i>	<i>N</i>
<i>Y</i>	$b-c, b-c$	$-c, b$
<i>N</i>	$b, -c$	$0, 0$

Using Netlogo simulation in the system, and we will work together on cost as the cow eats left grass, cooperation is the cost of dairy cows to a certain extent will not eat the grass, revenue is leaving the grass will bring to the whole population of happiness. Non-cooperative will not have to cost, because they will eat up their grass, nor the population benefits.

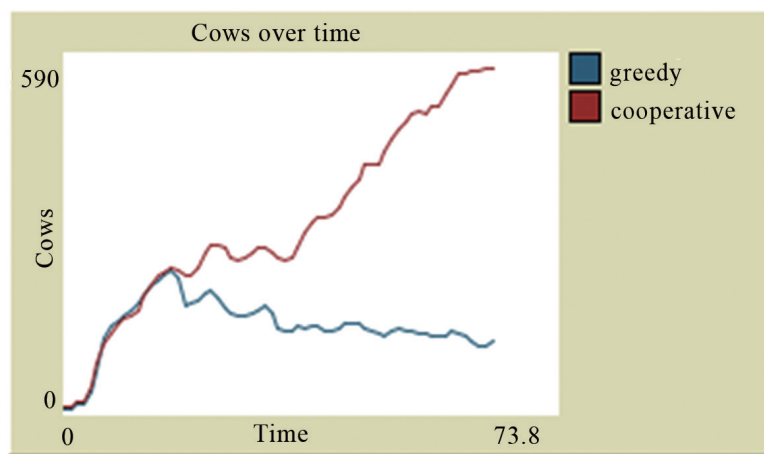
In this study the turtle images of cattle, grass green tiles. Tiles (grass) on a pink and blue two cattle, respectively adopt a cooperative strategy team and take the strategy of selfish players, and referred to as cooperation and selfishness. They belong to an organization that takes the limited resources in order to achieve survival and advancement of grass (reproduction) goal. Assuming that more grass cattle are more likely to breed, in this sense, get more resources are more likely to be promoted. This study through the computer simulation of Netlogo, with the passage of time, under different conditions to take these two strategies the group competes with each other. What will the results of each cow place called “tiles”, a symbol of unit resource. Each round each cow can eat the tiles you are standing on the grass. For once the non-cooperative on a tile, they will eat all the grass in the area. In the growth partners (grass), but the use of resources to a certain extent will have to stop, because once the length of the grass is lower than the specified height (regeneration threshold). Grass growth speed will slow

down significantly. Simply speaking, partners will do the welfare of the individual, to leave more resources for the group (food), on the contrary, for the grass to eat roots, regardless of life and death. The whole group definition of operational models for cooperation and restrain their grazing behavior to stop regeneration, threshold. So every time the grass can be a cooperative behavior or competitive behavior. To simplify the problem, assume that partners have been cooperative behavior, contention has been taken for behavior.

### 1.2 Simulation and Results

Define the partner *Y* as cooperative-cows, the non-cooperative *N* for greedy-cows when the probability of the occurrence of the joint authors is 0.5, as shown in Figure 1, the 13\*13 of the grid in the loop simulation of the world.

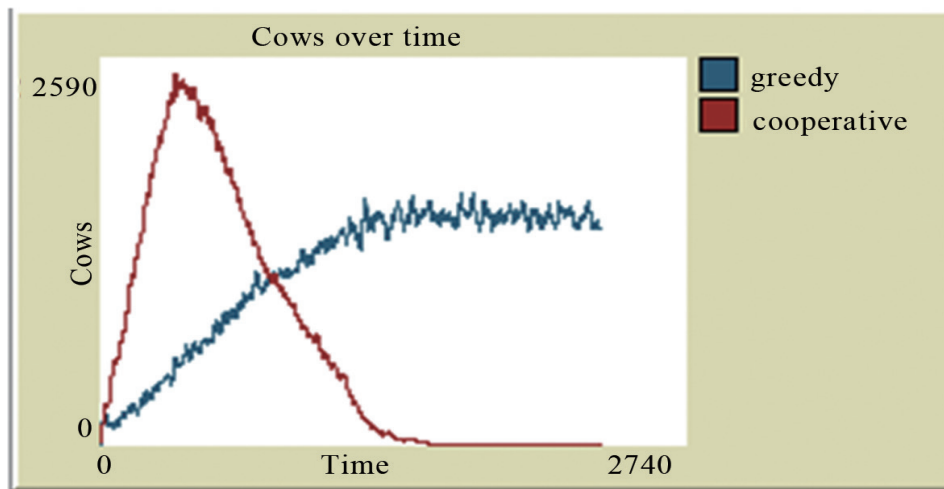
We can be seen from Figure 1 to two subjects as much, because the probability of our setting is the cooperation of the fifty percent, because the moving speed of population is not high, at first we can find partners will be more conducive to the development of the society, because partners are increasing. Through the simulation, you will find a special on the situation, that is the beginning of cooperation there will be more than the number of selfish, and increased rapidly to a peak then began to decline. Through repeated experiments found that, beginning the initial stage (as Figure 1), selfish groups and cooperation will have a short “entanglement” process, and cooperation the number has risen sharply. But this process is precisely the experimental area set by netlogo began to be occupied or development stage, namely resources for people to supply does not reach a saturation stage. This paper calls the stage is simulation start phase.



**Figure 1**  
**Simulation Start Phase**

But when a certain period of time, the partners reached the peak, but due to the space constraints, the partners do not win the selfish, so the partners began to decline sharply. With the expansion of the selfish, the cooperation of the extinction, the survival of 0, and the selfish person does not stop growth to know

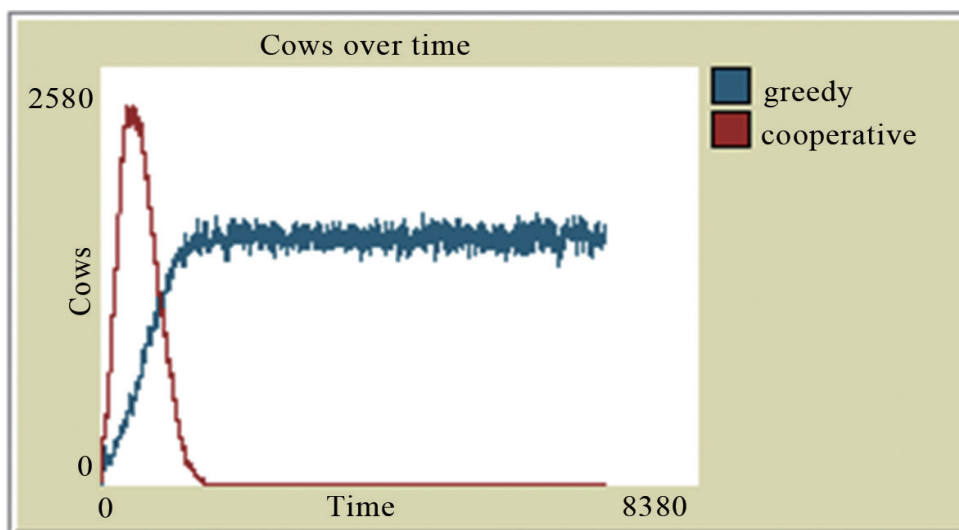
the limit of survival. Due to the grass will continue to increase, the number of selfish to some won't increase. We can also be seen, selfishness of the peak is less than cooperative. This shows that cooperation can make better development of society. As shown in Figure 2, the selfish reaches a steady state.



**Figure 2**  
The Simulation Reaches Steady State

For comparison, we will work together on the initial proportional to 70%, after reaching steady state, still the final collaborator will all die and leave the selfish steady state that in no punishment, it will naturally eliminate

partners. This is not conducive to the development of better society. And because we set the world is the same, so cooperation first peak and final selfish balance values were within the same range of fluctuations. As shown in Figure 3.



**Figure 3**  
The Proportion of Partners to Improve

## 2. COOPERATIVE SIMULATION WITH PENALTY

In business, in order to prevent losses because of partner cheating behaviors, companies need to partner signed agreement penalty for breach of contract. So this paper also considers the punishment can make the environment more conducive to cooperation.

With each other between individuals of the individual, and the modeling of the interaction between individual and system in the economic and social research, multi-agent simulation has several advantages: (a) it can be aimed at individual modeling, the definition of each

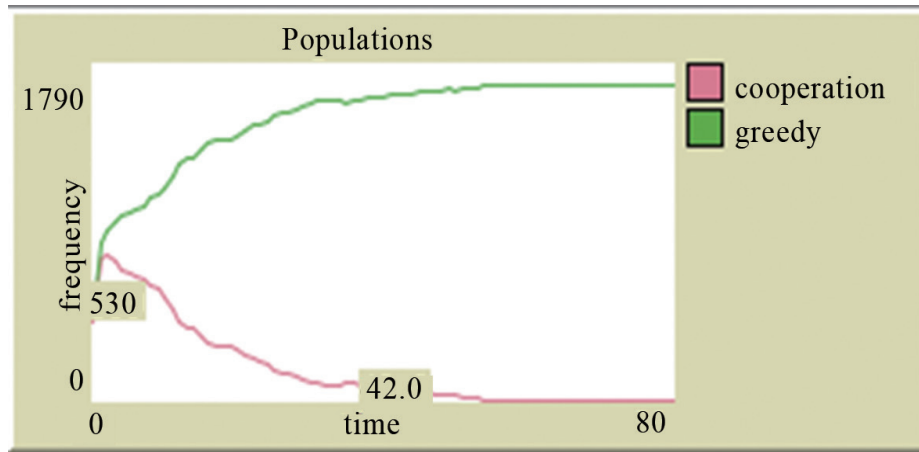
individual attributes and behavior rules; (b) it can be defined between the interaction rules; (c) it can study a large number of simple behavioral rules interact with each other to form complex phenomenon. And realistic social and economic system is consists of a large number of heterogeneous individuals, between individuals and the formation of diverse and complicated phenomenon. Therefore, multi-agent simulation technology is very suitable for large-scale social economic system modeling, by many research workers of all ages.

We mainly focus on the evolution of cooperation in the path of penalty function in society, you must explicitly on the evolution process of modeling social

subject strategy choice. Individuals may adopt different strategies, some do not have some cooperation, some do not punish punishment. In each pair, one is altruistic side is also defined before us the cooperation; the other is a private initiative. Since the party have three action choices: cooperation, cooperation and punishment. If altruistic cooperation, he will cost C to B. If the passive side benefits of selfishness of non-cooperation, both sides at no cost and income. If the active side of punishment. He will spend the cost of M, the author brings loss to the

appropriate Q. this paper will survive cost is defined as punishment. Because of the degree of difficulty of survival cost decides survival. Mainly to study the survival difficulty will promote cooperation.

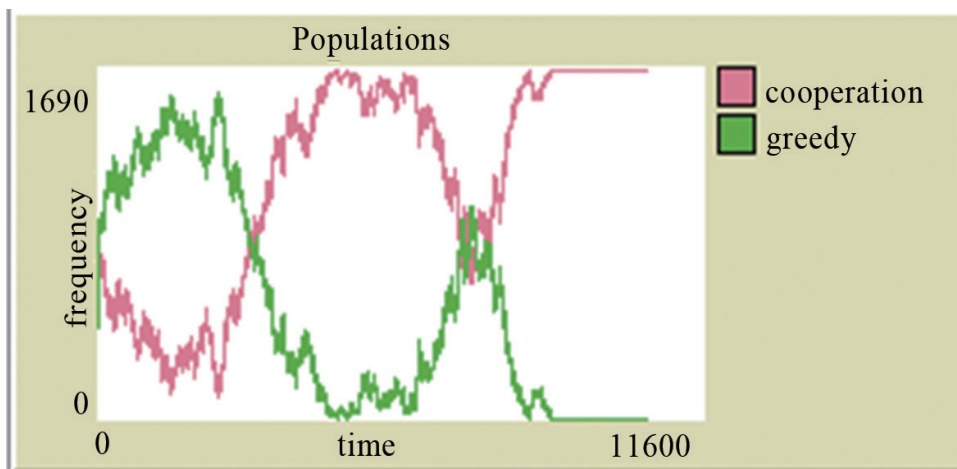
First of all, we will punish set for slight punishment, that is to say, the punishment for 30%, when we come to the conclusion that the cooperation will still be extinct after certain entanglement. Mild punishment is still unable to change the fact that natural selection of partners (Figure 4)



**Figure 4**  
**Simulation of Cooperative Behavior Under Mild Punishment**

We will punishment changed to 60%, then we can see the beginning is almost in balance state, cooperative and selfish entwined. Gradually the selfish person has the upper hand. But after a certain period of time.

The position of the selfish person is replaced by the cooperative. Although there is a reversal in the back of the selfish, but did not succeed. The end of all the death of the selfish, only the collaborators.



**Figure 5**  
**Simulation Results After Increasing Punishment**

## CONCLUSION

This paper takes Netlogo to simulate the situational factors of the last surviving relationship of cooperative behavior. Specifically, the task is divided into two

cases of punishment and no punishment, there may be an U curve between cooperative behavior and punishment, the punishment is low is not conducive to the cooperative behavior, but also relatively high under the act of punishment can promote cooperative behavior.



Punishment is also high survival difficult, so it can be considered acceptable living difficulties can contribute to the cooperation and competition. In the absence of any inhibition behavior intervention in the condition of selfish people easier promotion, no punishment system of cooperation in the survival cost disadvantage. Be the punishment for the condition of the high, will promote people to increase cooperation.

This paper can be extended to the cooperation between the enterprises depend on commercial credit environment, and supply chain in the core enterprise and general enterprise cooperation analysis. Starting from the point of view of social welfare, because cooperation created by the development of more powerful, apparently cooperation is more conducive to the development of society and common welfare. Therefore, the promotion of social cooperation of tax plans and moral reentrant legal solution can improve social welfare.

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