



Publishing the donation list incompletely promotes the emergence of cooperation in public goods game



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ABSTRACT

Since the donation list contains a lot of information, the cooperation may be promoted if the list can be skillfully applied. If the donation list is published completely, it will be considered as moral coercion. However, it is unfair to cooperators who contribute more money if organizers do not publish the list. Thus, how to publish the donation list properly is a subject worth studying. In our paper, we take reputation, behavior diversity and face culture into account at the same time to study the role of donation list in the public goods game. The results of numerical simulations show that the effect of publishing the list incompletely is better than that of publishing it completely or keeping it secret. Furthermore, there exists an optimum threshold to make the results best. And reasonable neighborhood relations are needed to promote cooperation. In addition, some personal attributes, such as the habit of data selection and mental capacity, have influences on cooperation.

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1. Introduction

China has experienced a long-term local society. And local society has nurtured the characteristic of village opera. In a village, the search for ideas and behaviors identity is very important. Therefore, sacrificial rites emerge as the times require. Village opera, as a local ritual, is an important component of rural ceremony. In many villages in Zhejiang province of China, the tradition of performing village opera has not changed. The fund required for the performance is raised by the villagers. Long before, a representative of the village would go door to door to collect money from civilians. What is more, individuals' donations are the same. But in recent years, it has evolved into the voluntary contribution to households. Meanwhile, how much to donate is entirely up to themselves. Then their names and donations will be displayed on a small blackboard and the LED screen on both sides of the stage if their contributions are more than a certain number. This leads to a deep reflection on us: could publish the list incompletely really promotes the cooperation of the public goods game (PGG)? How to skillfully use the donation lists to promote cooperation? Could this be widely used in public goods games? This is what we want to study in this paper.

In the modern times, the solving of the problems we are facing, such as environmental pollution, population expansion, financial crisis, is inseparable from cooperation [1–4]. So it is necessary to study how to promote the cooperation among selfish individuals. As a basic model to describe the coordination and cooperation of human society, the public goods game has become a hot research topic in the field of economics, politics, management science, anthropology and so on [5–13]. People can secretly choose how much to put into a public pool. Then their contributions are multiplied by an enhancement

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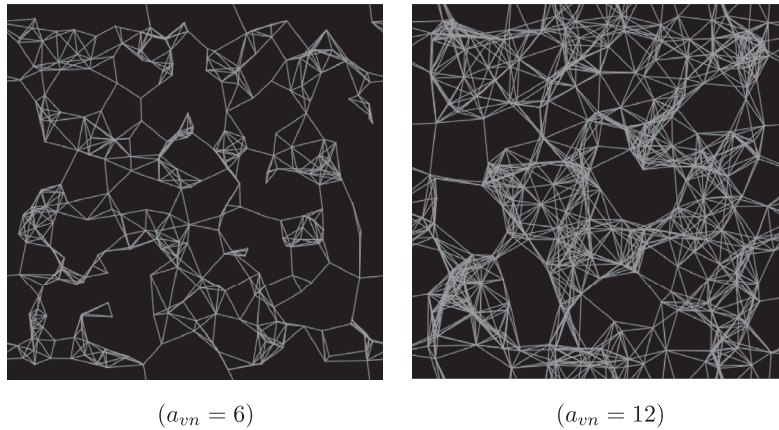


Fig. 1. Schematic presentation of network we used in this paper. Left: $a_{vn} = 6$. Right: $a_{vn} = 12$. Here population is set to be 300. As we can see in the figure above, some people may have many neighbors, and some people have few.

factor r , and equally distributed among all members. Since r is smaller than the group size, acting as a defector is always the best choice, no matter what others' strategy is [14]. This is why the free rider problem and the tragedy of the commons frequently occur [15,16]. Thus, the most difficult thing is that there always exist some defectors who want to get the same benefit of the cooperators at no cost [1,17,18]. To address this problem, several mechanisms were put forward, such as reward [19–21], reputation [22–25], indirect reciprocity [26,27], punishment [28–34], social diversity [1,35], voluntary participation [14,36–38] and so on.

Previously, those mechanisms were studied on regular lattices. What is more, most studies assume that the contributions of all cooperators are identical, often equals to 1. But with the development of research, new progress has been made in the research of PGG. Firstly, a great deal of work on the topology of the game has been done to study how cooperative behavior evolves in spatial PGG. Nowork and May have pointed out that the spatial structure is helpful for cooperation [8]. In fact, there does exist a big difference between the real social structure and regular lattices [22,39–41]. It is not reasonable to assume that everyone has the same number of neighbors. The real world is much less regular. So evolutionary games on scale-free network [39,42], or small-world [43,44] have been studied extensively. What is more, it has been proved that group-size can affect the evolution of cooperation in the spatial PGG [45]. Secondly, different people often have different conceptions, so they approach things differently [46,47]. That is, the investment is often distributed unequally in real life [48]. What is more, it has been proved that heterogeneous investments can promote cooperation in spatial PGG [39,49].

Combining the above-mentioned example and previous studies, we did some researches. As evidenced by many researches, reputation has a great influence on people's behaviors. Individuals not only care about their reputation but also try their best to maintain their reputation [50,51]. What is more, behavior diversity also should be considered to study the evolution of cooperation [52]. So in our paper, we assume the number of neighbors for each person is different. In addition, players can decide how much to donate according to their own ideas. Of course, they also can choose to be defectors. As one of the most influential social behaviors, gossip is universal [53,54]. The roles of some people who has different status or character cannot be ignored [55,56]. Hence, those who do not donate or donate relatively little money will be talked about by someone who enjoys talking about other people. This will make individuals feel that their reputation is destroyed. Note that different individual has different tolerance toward reputation. If individuals think their reputation has suffered enormously, this would mean a loss of face for them. Therefore, they may take actions to maintain their own face. But if the cost of making up their face is too high, players will give up. Perhaps you would say, why not publish the list completely? You know, this may give a feeling of moral coercion. But not publishing the list at all may lead to a result of confusion. So how to properly publish the list is worth studying. Luckily, we have come up with some interesting conclusions.

Next, we describe our model in Section 2. In Section 3, the numerical simulation results are discussed and analyzed in great detail. Last but not least, in Section 4, we draw conclusions based on our experimental data.

2. Model

Here, let us introduce our model briefly. The public goods game is staged on a network. Each person has a different number of neighbors (n_{ei}) and attends $n_{ei} + 1$ PGG groups. The per capita number of neighbors is equal to a_{vn} . We show two examples in Fig. 1 in order that readers can understand our model better. One node represents one player and edges are the interactions between players. Some players have many neighbors and some ones have few. There are two kinds of people in our model: cooperator (C) and defector (D). Cooperators make contributions according to their own ideas. That is, it is not mandatory for everyone to contribute in accordance with uniform standards. Defectors, who contribute nothing, also can enjoy the public goods. It is important to note that some of the cooperators are gossipmongers. Gossipmongers are used to talking about others and their private lives. In addition, players may have several bosom friends. We assume

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