

Factors Underlying Cooperation During Covid-19 Pandemic

Analysis on Game Theory

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ABSTRACT

Starting in 2020, one of the most serious epidemics occurs in human history. The sudden arrival of the covid-19 takes many lives away. There is no doubt that the most critical issue is how to get more people to cooperate on epidemic prevention. The study topic is about the factors underlying cooperation during the covid-19 pandemic by using the game theory to analyze. In the paper, the author sums up recent studies about how communication, reputation, payoff structure can affect cooperation and provide some advice for prevention methods based on the discussions. According to the research results, communication, reputation, and payoff structure can affect whether people will choose to cooperate inside a group. Besides, making information more transparent and attainable, emphasizing the importance of reputation, increasing reputation reports on individuals and companies, and designing a proper payoff structure can be ways to contain the epidemic.

Keywords: *Pandemic, Cooperation, Communication, Reputation, Payoff*

1. INTRODUCTION

In 2020, a sudden virus has seriously affected people's lives. This virus is covid-19. People infected with the virus will have mild to severe symptoms. In many countries, the coronavirus has caused abundant deaths. During the epidemic, preventing human-to-human transmission of the virus is a crucial issue. There are two main methods: vaccination and home quarantine. Nguyen's theory advocates that we can regard the epidemic as a prisoner's dilemma situation [1].

Parts of the general public reject vaccination because of concerns about the safety and side effects of vaccines. This is the implicit cost of taking the vaccination. People who choose not to be vaccinated will be free riders, benefiting from people who decide to accept the vaccine. If everyone chooses to cooperate, being vaccinated, the pandemic will ease quickly, and the world will return to normal soon.

Besides, home quarantine and keeping social distance are efficient ways to control the epidemic. However, individuals are sometimes reluctant to pay the costs of home quarantine and keeping distance from

others, and this can greatly limit the effectiveness as a control measure [2].

In the face of the pandemic, a global terrorist disaster, why would anyone choose to defect? Why are they not cooperating with others? Is there any way to increase the probability that they choose to cooperate?

In this article, the author will deeply analyze the three factors that affect cooperation: communication, reputation and payoff structure by summarizing some past research and analysis. Based on the explanations and explorations, the author will offer some possible methods that can help relieve the pressure of the epidemic and increase the vaccination rate and home quarantine rate.

2. COMMUNICATION

Since 1950, people start to realize that communication can greatly enhance cooperation in social dilemmas. The experiment from Daniel Balliet utilizes a meta-analysis and tracks down a hugely positive outcome of communication on participation in social dilemmas ($d = 1.01$) [3]. When people encounter social dilemma, it is hard for them to make decisions, which will make them anxious and uncomfortable. They

realize that by exchanging ideas and opinions with others, they can make their decision-making process simple and effective, and at the same time alleviate anxiety. The result indicates communication plays an indispensable role in determining people's decision-making processes when facing a social dilemma. As modern civilized society progresses into the future, there will be more and more difficulties encountered, and the communication between people will definitely increase accordingly. Communication will play a big role in overcoming difficulties, because it will bring many benefits.

Communication helps people coordinate their actions. Hypothetical and experimental examinations have reliably proved that collective behavior in different tasks can be improved by permitting communication [4]. Communication requires team members to commit to working together [5]. When facing a decision, having a conversation offers people chances to exchange information, which will let the information become more transparent for everyone. Transparent information supports people to possess deep understandings underlying their decisions. People will realize the payoff of the decisions. Therefore, it is more likely for them to make a rational choice.

Moreover, there is greater pressure for people to conform to the norms of teamwork. Behavior is not always driven by people's inner motivation; in fact, social factors also play a part in the decision [6]. To consider others' thoughts, people, communicating with others in a group, will make a decision that meets the needs of the group. In other words, when everyone chooses to cooperate, the collective will become better. This hypothesis is also valid in a specific situation such as an epidemic.

During the covid-19 epidemic, people's behaviors are crucial for preventing the spread of the virus. Based on the model, communication among the group promotes cooperation in social dilemmas [7]. Under effective group communication, people will be more and more accurate in their judgment of the correctness of information, so that in the chaos and panic of the epidemic, they will quickly stabilize, and have a understanding of the benefits of vaccine and home quarantine. Furthermore, through communication with other people, people will realize the importance of taking safeguard procedures and try to be well. This is, in the pandemic, the reason that communication can benefit the situation.

3. REPUTATION

Have you ever experienced a situation that you heard student A betray student B; then you never talk to student A because you are afraid that student A will betray you someday. This is an example of the effect of

reputation in real life. You do not talk to student A only because you think he is not a reliable person.

In the prison dilemma game, it is often the best choice for both parties to choose cooperation at the same time. However, how to gain the trust of the other becomes particularly crucial. According to research done by Junhui Wu in 2016, people prefer to cooperate with people who have a positive reputation in their social environment [8]. People prefer to cooperate with reliable and trustworthy people. In other words, each player's decisions in each round of the game have the potential to influence their position in others' minds, their possibility to cooperate with others in the future, and thus their total earnings in the end.

For a long-term stable collective, reputation is closely related to the concept of indirect reciprocity. In short, indirect reciprocity is: I help you and another person will help me [9]. For example, if there are three people, they are A, B, and C. When A encounters difficulties, B helps A, and this behavior is known to C. So when B encountered difficulties, C helped B, even if C did not get help from B. It helps to explain why people donate to others who cannot directly return the favor [10].

During the pandemic, reputation contributes to cooperation to a large extent, especially for both individuals and corporations.

For the individual, they live in a fixed group. This means that their decisions during a pandemic will have a great impact on their future life, especially future cooperation with other residents. Under a severe covid-19 situation, people in the same community are being treated as a whole. Based on the different people's constitutions, coping strategies in a different community, travel bans and mandatory quarantine will be applied [11]. In China, at the most severe stage of the epidemic, if a resident is diagnosed with Covid-19, the entire community will be completely closed. In other words, the result of a person not being vaccinated or going to a high-risk area may make life much more difficult for hundreds of people. These serious influences are all because some people choose defect in cooperation. Since everyone wants their reputation to become better, they may be more concerned about their decisions, thus avoiding the above problems. They are more likely to receive the vaccine and avoid going to high-risk areas, like everyone else. This is the contribution that reputation will make to the mitigation of the epidemic from an individual perspective.

For a corporation, reputation also plays a very important role. The influence of reputation on the company is mainly reflected in the customer's view of the company. If a company chooses donations and supplies medical equipment during the epidemic, people are likely to remember its name and create a good

impression. As of February 3, 2020, 1521 companies have donated a total of 16.84 billion RMB to support the coronavirus epidemic. Up to now, this number has become larger and larger, and more and more companies choose to donate to the affected places for their reputation.

Wuhan, China is a very telling example. Starting from January 2020, the city's urban buses, subways, ferries, and long-distance passenger transportation will be suspended; citizens are not recommended to leave Wuhan without special reasons, and the airport and railway station's passages from Hanoi are temporarily closed. Wuhan closed the city until the epidemic eased. Many experts and scholars believe that "closing the city" will reduce the chance of the epidemic spreading, saying that this measure is very appropriate and crucial. Many Wuhan citizen states that staying in Wuhan is the responsibility to all people in China.

Therefore, more people choose to cooperate during the epidemic because of the existence of reputation, which contributes to the solving of a covid-19 pandemic.

4. PAYOFF STRUCTURE

In game theory, payoff structure has always been a very important part. The long-standing belief is that in most cases, people tend to expand their benefits. Thus, the payoff structure will affect the future willingness to cooperate. Proper punishment and rewards are crucial conditions for punishment.

The reward can impact their motivations to cooperate. People's behaviors generally are more likely to be exhibited when rewarded more. In contrast, according to the research of Cooperative Behavior in the Prisoner's Dilemma Game, the motivation of defect would be due primarily to the significantly lower amount of cooperation for subjects assigned to the low potential reward [12].

Also, punishment can affect people's motivation to cooperate. It is widely accepted that more punishment is good for people to form habits. However, based on recent research, excessive punishment of one behavior increased the occurrence of the selfish alternative [13]. Therefore, in order to encourage people to cooperate, the punishment exerted on individual should control in a proper extent, neither too much or too little.

The design of the payoff structure will greatly ease the development of the epidemic, especially for protection. In the community, if you come back from a high-risk area and actively isolate yourself at home, the community will help you buy daily necessities and take out the trash for you. If you choose to vaccinate, the community will give you some prizes. These are some reward methods. If you violate the epidemic prevention

rules, you will be fined or even publicly criticized. These are some punitive measures that can be applied.

Therefore, designing a suitable payoff structure will be very helpful to alleviate the epidemic.

5. CONCLUSION

In conclusion, the paper indicates that communication, reputation, and payoff structure will affect cooperation in a group. Besides, the author indicates several methods that can ease the pandemic: making information more transparent and attainable, emphasizing the importance of reputation, increasing reputation reports on individuals and companies, and designing a proper payoff structure.

Limitation of this research is as follows: The theory is merely based on previous and hypothetical data. There is a lack of current real data. Therefore, in the later period, the author will continue to pay attention to the development of the epidemic and collect enough data to support the conclusions of this paper.

REFERENCES

- [1] A. Nguyen. COVID-19 Dilemma: Signaling Effect on Cooperative Behavior. 2021 Honors Economics Posters. 14.
- [2] T.C. Reluga. Game theory of social distancing in response to an epidemic. *PLoS computational biology*, 2021, 6(5), e1000793.
- [3] D. Balliet. Communication and Cooperation in Social Dilemmas: A Meta-Analytic Review. *Journal of Conflict Resolution*, 2010, 54(1), 39–57.
- [4] W. Zhuang and M. Ismail, "Cooperation in wireless communication networks," in *IEEE Wireless Communications*, 2012, 19(2): 10-20, doi: 10.1109/MWC.2012.6189408.
- [5] E. Van Dijk, & C.K. De Dreu. Experimental games and social decision making. *Annual Review of Psychology*, 2021(72): 415-438.
- [6] P.J. Lewis, & M.P. Tully. Uncomfortable prescribing decisions in hospitals: the impact of teamwork. *Journal of the Royal Society of Medicine*, 2009, 102(11): 481–488. <https://doi.org/10.1258/jrsm.2009.090150>
- [7] N.L. Kerr, & C.M. Kaufman-Gilliland. Communication, commitment, and cooperation in social dilemma. *Journal of Personality and Social Psychology*, 1994, 66(3): 513–529.
- [8] J. Wu, D. Balliet, and P.A.M. Van Lange. Reputation, Gossip, and Human Cooperation. *Social and Personality Psychology Compass*, 2016(10): 350-364.

- [9] M. Nowak, K. Sigmund. Evolution of indirect reciprocity. *Nature*, 2005(437): 1291-1298.
- [10] C. Engel. Dictator games: a meta study. *Exp. Econ.* 2011(14):583–610
- [11] C. Kang, F. Meng Q. Feng et al. Implementation of quarantine in China during the outbreak of COVID-19. *Psychiatry Res.* 2020(289):113038. doi:10.1016/j.psychres.2020.113038
- [12] J.P. Sheposh, & P.S. Gallo. Asymmetry of Payoff Structure and Cooperative Behavior in the Prisoner's Dilemma Game. *Journal of Conflict Resolution*, 1973, 17(2), 321–333. <https://doi.org/10.1177/002200277301700208>
- [13] P.A. Bell, T.R. Petersen, and J.E. Hautaluoma. The Effect of Punishment Probability on Overconsumption and Stealing in a Simulated Commons1. *Journal of Applied Social Psychology*, 1989(19): 1483-1495. <https://doi.org/10.1111/j.1559-1816.1989.tb01460>.