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# Evolutionary Game Modeling and Analysis of Competitive Dissemination between Disinformation and Knowledge on Social Media

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**Extended Abstract****Evolutionary Game Modeling and Analysis of Competitive Dissemination between Disinformation and Knowledge on Social Media***Yishu Wu<sup>1,2</sup>, Dandan Wang<sup>1,2,3</sup>, Feicheng Ma<sup>1,2,3\*</sup>*<sup>1</sup> School of Information Management, Wuhan University, Wuhan 430072, China<sup>2</sup> Center for Studies of Information Resources, Wuhan University, Wuhan 430072, China<sup>3</sup> Big Data Institute, Wuhan University, Wuhan 430072, China

**Abstract:** The dissemination of disinformation has become a thorny issue in the era of social media, and knowledge can play a crucial role in tackling this problem. However, currently more research interest lies in the disinformation dissemination model, but ignores the interaction between disinformation and knowledge in the diffusion process. In order to explore the evolutionary path and stable strategy for the competitive dissemination between disinformation and knowledge on social media, an evolutionary game model based on social capital theory is proposed in this paper. By model solving and numerical simulation, the initial dissemination willingness, the disinformation infection probability, the knowledge infection probability, and the knowledge penetration probability are demonstrated to be important factors affecting the game equilibrium in the competitive dissemination process of disinformation and knowledge. Moreover, some countermeasures and suggestions for the governance of disinformation are put forward. The present study reveals the dynamic mechanism of social media users disseminating disinformation and knowledge, and is expected to promote the formation of a cleaner cyberspace.

Keywords: Disinformation dissemination, Knowledge dissemination, Evolutionary game, Competitive information

**1. INTRODUCTION**

With the development of social media, people can receive and release any information they want at any time, resulting in the exponential growth of disinformation on social media. According to the definition of Huang et al. <sup>[1]</sup>, disinformation is defined as inaccurate information and knowledge is defined as accurate information. Disinformation and knowledge are different discourses on the same theme, which coexist and compete with each other in a certain period of time, and thus can be regarded as ‘competitive information’. Although some theoretical results about disinformation dissemination model have been obtained, there is still a lack of understanding of the interaction between disinformation and knowledge and how to promote social media users to disseminate knowledge and resist disinformation. In this study, we develop a competitive dissemination model of disinformation and knowledge based on the evolutionary game theory, to explore the evolutionary path and stable strategy of the competitive dissemination of disinformation and knowledge on social media.

**2. MODELING**

Social capital is defined as the sum of assets or resources embedded in the relationship network among individuals. In order to facilitate the model construction and solution, we propose several assumptions about the players, the strategy space, the benefits, the cost of users disseminating information, and the probability of users

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choosing to disseminate or not. Table 1 shows the notations of the payoff matrix which is used throughout the paper.

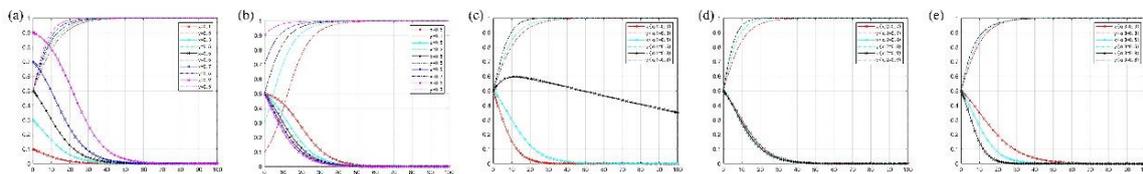
**Table1. List of symbols.**

Variable	Descriptions	Variable	Descriptions
DUs	disinformation-believed users	$\alpha_2 (0 \leq \alpha_2 \leq 1)$	the probability that UUs is transformed into KUs
KUs	knowledge-believed users	$\alpha_3 (0 \leq \alpha_3 \leq 1)$	the probability that DUs is transformed into KUs
UUs	the unknown users	$\alpha_1 (0 \leq \alpha_1 \leq 1)$	the probability that UUs is transformed into DUs
C1	the risks brought by spreading disinformation	$x (0 \leq x \leq 1)$	The probability of DUs choosing 'disseminate'
C2	the persuasion cost of spreading knowledge	$y (0 \leq y \leq 1)$	The probability of KUs choosing 'disseminate'

Through establishing the payoff matrix and analyzing the equilibrium points, we find the relationship among  $\alpha_1, \alpha_2, \alpha_3$  and the cost determine the final stable state. When the disseminating effect of knowledge is remarkable, the benefits of disseminating disinformation are less than the cost, while the benefits of disseminating knowledge are greater than the cost. At this moment, KUs will choose to disseminate knowledge while DUs will choose not to disseminate disinformation, and finally the social media will reach the ideal state, where there only exists knowledge.

### 3. RESULTS

In order to explain the competitive dissemination of disinformation and knowledge on social media more intuitively, Matlab R2018a is used to numerically simulate the evolution process of disinformation and knowledge, and analyze the influence of variables on the evolution path.



**Figure 1. The effect of different parameters**

It can be observed from Figure 1 that as the evolution time goes by,  $y$  keeps increasing to 1, and  $x$  gradually converges to 0, both of which exhibit a decreasing speed of change. Moreover, we find that the convergence process of  $y$  is always faster than that of disinformation dissemination. Comparing with Figure 1(c)- Figure 1(e), we can find that  $\alpha_1, \alpha_2, \alpha_3$  have a positive influence on  $y$ , and  $\alpha_1 > \alpha_3$ . Furthermore,  $\alpha_1, \alpha_2, \alpha_3$  have different effect on  $x$ . According to the simulation results, the importance is ranked as  $\alpha_1 > \alpha_3 > \alpha_2$ , where  $\alpha_1$  and  $\alpha_3$  have opposite influence on disinformation dissemination willingness.

Through theoretical analysis and numerical simulation, several crucial findings are elicited. First, the initial dissemination willingness of the knowledge-believed users and the knowledge penetration probability can effectively suppress the willingness of users to disseminate disinformation, while high disinformation infection probability will reinforce the dissemination of disinformation. This verifies the research of Ma et al.<sup>[2]</sup> that people attitude toward disinformation impact the disinformation propagation. Second, the knowledge infection probability has no obvious effect on disinformation dissemination, which do not agree with the conclusion that the more netizens with scientific knowledge, the smaller the spread scope of online rumor<sup>[3]</sup>.

#### 4. DISCUSSION

All of these findings are of great significance both in theory and practice. Theoretically, we regard knowledge as the competitive information of disinformation, and the interaction between knowledge and disinformation is researched, which can drive the unknown users contact knowledge, thus increasing the scope of knowledge disclosure<sup>[4]</sup>. Moreover, we introduce the evolutionary game theory to describe the competitive dissemination and analyze the impact of the initial dissemination willingness, the disinformation infection probability, the knowledge infection probability, and the knowledge penetration probability.

The study also provides abundant insights for practice regarding how to curb the dissemination of disinformation and promote the spread of knowledge. Firstly, the social media platform should reward users who disseminate knowledge through incentive measures like increasing their voice. Secondly, the platform should make use of the strength of experts, KOL and other people to distinguish and mark knowledge, refute the distorted information, and push it to more users through recommendation algorithm to curb the spread of malicious information on the network. Thirdly, users should improve their information literacy to identify disinformation, so as to reduce the disinformation infection probability.

Future research could further improve the assumptions, and substitute real data for verification to overcome the subjectivity of parameter setting. Besides, this paper only considers the game relationship between the disinformation-believed users and the knowledge-believed users, but in fact, the social media platforms sometimes condone the dissemination of disinformation in order to increase the exposure, which is also worthy of attention.

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