Reversal of Influence: Decrease of Innovator's Influence under Information Diversification

(Extended Abstract)

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ABSTRACT

Recently, with the advance of information technologies, the amount of available information has increased exponentially. This has a great influence on individual acts because information is quite important for decision making and value judgment. In this paper, we propose a model of information diffusion considering information diversification and investigating its impact. In particular, we focus on the influence of innovators. Contrary to the results of preceding studies, our results reveal that a new phenomenon called "reversal of influence" emerges under information diversification.

Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence—*Multiagent systems*; J.4 [**Computer Applications**]: Social and Behavioral Sciences—*Sociology*

General Terms

Experimentation

Keywords

Emergence, Information Diffusion, Reversal of Influence

1. INTRODUCTION

Recently, with the advance of information technologies, the amount of available information has increased exponentially. Friedman[1] argues that closing the information gap across the world evens out differences in influence and the power of decision-making. That is to say, the influence is enhanced with the increase of the amount and kinds of information. Since the 1960s, it has been believed that this argument is applicable to not only organizations and countries but also to individuals.

However, there are some studies questioning those arguments. For instance, Gladwell[2] considered that correct decisions are occasionally made not by considerable thought of professionals but by their "first inspiration" (called adaptive unconscious). From this consideration, he argues that the increase of information does not always enhance the influence and power of decision-making.

The purpose of this study is to clarify and analyze the influence of individuals on information diffusion under information diversification. In this paper, we propose the information diffusion model, which can represent the diffusion of many kinds of information. Using this model, we investigated the phenomenon that occurs in a society with information diversification.

2. PROPOSED MODEL

We define that N individuals are agents $a_i (i = 1, 2, \cdots, N)$, and M kinds of information are $b_k (k = 1, 2, \cdots, M)$. Each agent has one or more kinds of information. In general, individuals have different amounts and kinds of information due to their motivation and interest in gathering information. In our model, agent a_i has information capacity c_i, which represents the amount of information a_i can have. During one time-step of a simulation run, two agents are selected randomly and information diffuses from one agent to the other. In the real process of information diffusion, people easily accept the opinions of experts; therefore, we define the probability p_{ij} of information diffusion from agent a_i to a_j as the following equation.

$$p_{ij} = \begin{cases} c_i/c_j & \textbf{if} \quad c_i < c_j \\ 1 & \textbf{otherwise} \end{cases} \tag{1}$$

Diffusing information is selected randomly from information owned by the source agent.

Next, to analyze the influence of agents on information diffusion, we define a measure of the influence. To calculate it, we consider the diffusion paths of information b_k when agent a_j has b_k. We define ω_k as the set of diffusion paths of b_k. In paths of b_k diffused to a_j, we define links connecting pairs of agents: the agent that transmitted information and the agent that received it directly. The distance d_{ij} is defined as the number of links between a_i and a_j. The influence σ_i

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Table 1: Configuration of agents.

	Number of agents	Information capacity
Innovator	2	100
Early adopter	14	10
Follower	84	1

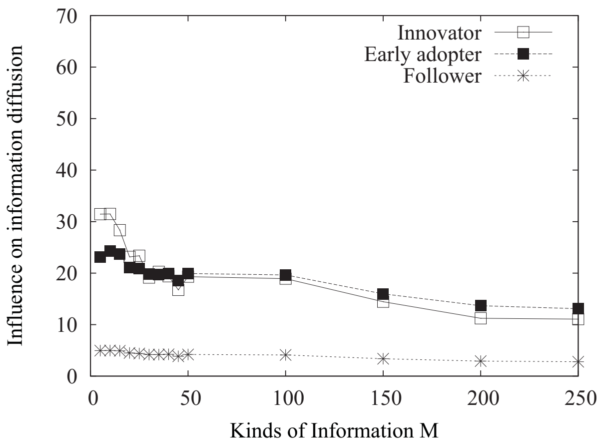

Figure 1: Changes in average influence.

of a_i on diffusion of b_k is defined as follows.

$$\sigma_i(b_k) = \sum_{j=1}^{N} \sum_{\omega_k} \left(\frac{1}{2}\right)^{d_{ij}-1} \tag{2}$$

The influence $\sigma_i(b_k)$ is increased when a_i diffuses b_k by itself, or agents that received b_k from a_i diffuse b_k to other agents, or both.

3. IMPACT OF INFORMATION DIVERSIFICATION

The purpose of this simulation is to analyze the effect of information diversification on the influence of innovators. We regard information diversification as the increase of kinds of information. In this simulation, based on the argument of Rogers[3], we divided agents into three categories: innovators, early adopters, and followers. Table 1 shows the number of agents and the information capacity in each category. We assigned the information to all the agents. Assigned information was selected at random up to the information capacity of each agent.

Figure 1 shows the relationship between kinds of information M and the average influence at each category. In Fig. 1, early adopters have the biggest influence when $M \geq 100$. This result is contrary to previous results of diffusion studies. That is to say, under information diversification, early adopters influence the whole community to a greater degree than innovators. We call this phenomenon "reversal of influence."

Next, we analyzed the cause of reversal of influence.The phenomenon is considered to be caused by the variety of information that innovators have. Innovators have a huge variety of information because their information capacity is large. Innovators cannot control the transmission of information because they have much information. That is to say,

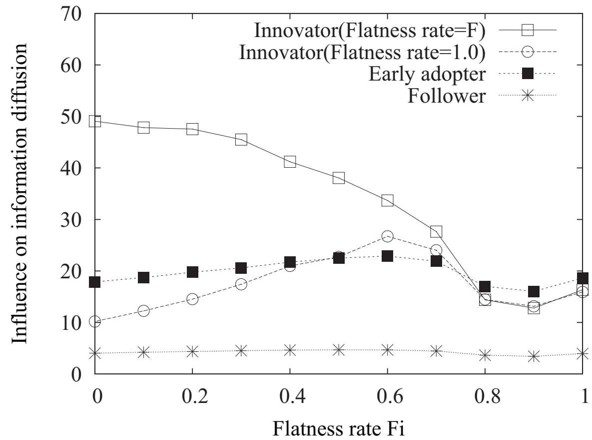

Figure 2: Relationship between degree of *flatness* F_i and average influence in each category ($M = 200$).

innovators cannot handle priorities of information and all values of information are the same. We say that in this situation "information is *flat*". Therefore, we focus on degree of *flatness*. We clarified the relationship between the degree of *flatness* and the decrease of influence. For this purpose, we define the *flatness* rate F_i of agent a_i as the following equations.

$$F_i = \frac{c_i - (\text{number of } b_1 \text{ that } a_i \text{ has})}{c_i} \tag{3}$$

In each trial, the following information is assigned to one innovator: $c_i \times (1 - F_i)$ information b_1, $c_i \times F_i$ information that is selected randomly except b_1.

Figure 2 shows the relationship between degree of *flatness* F_i and the average influence in each category under $M = 200$. In Fig. 2, reversal of influence occurs when $F_i > 0.7$, and there seems to be a threshold of reversal of influence near 0.7. Since early adopters also tend to have information that is *flat* in this simulation, the 0.7 is the value of whether information early adopters have is *flatter* than information innovators have. That is to say, reversal of influence occurs when information innovators have is *flatter* than information early adopters have.

4. CONCLUSION

In this paper, we analyzed the effect of information diversification on influence of individuals. From the results of simulation, we found a new phenomenon called "reversal of influence." The phenomenon means that the most influential individual changes with the increase of kinds of information, and this occurs when innovators have information that is *flat*. Our results encourage a reconsideration of the meanings of preceding studies for today's society.

5. REFERENCES

[1] T. Friedman. *The World Is Flat*. Farrar, Straus and Giroux, New York, 2006.

[2] M. Gladwell. *Blink: The Power of Thinking without Thinking*. New York: Little Brown and Company, 1st edition, 2005.

[3] E. Rogers. *Diffusion of Innovations*. Free Press, 5th edition, 2003.