

Opinion formation in a social network

The role of human activity

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Introduction

The aim of our work is to investigate the influence of human social activity on dynamic phenomena in a social network. In the present work we use data on a social network consisting of 6×10^3 individuals. It is a giant component of a network of individuals who interact in the large virtual world of the MMORPG [1]. On the basis of playing time, we calculate the activity A of individuals, i.e. the relative time devoted daily to interactions with others. On the basis of human activity calculated as above, we investigate process of opinion formation in a real social network. For modeling of the process of opinion formation, in the case of two possible states (i.e., the positive or negative answer to a certain question), the Ising-based models are used by many authors [2,3]. We study the influence of correlation between the activity of an individual and its connectivity on the process of opinion formation. We find that such correlations have significant influence on the temperature of the phase transition and the effect of the mass media, modeled as an external stimulation acting on the social network.

The process of opinion formation

The probability that an individual changes their state S_i depends on the local field and temperature T :

$$S_i(t+1) = \begin{cases} S_i(t); & \frac{\exp(-h_i/T)}{\exp(-h_i/T) + \exp(h_i/T)} \\ -S_i(t); & \frac{\exp(h_i/T)}{\exp(-h_i/T) + \exp(h_i/T)} \end{cases}$$

where the local field h_i depends on interactions with k_i neighbors and external stimulation I :

$$h_i(t) = -S_i(t)A_i \left(\sum_j^{k_i} A_j + I \right)$$

The external stimulation I may be regarded as a global preference towards one of the opinions stimulated by mass-media, government policy, etc. The value of local field acting on individuals is proportional to their activity; less active individuals (i.e. individuals who spend less time in the virtual world) have fewer opportunities to interact with others than more active ones. Similarly, the greater the activity of neighbors, the greater their influence on an individual.

Results

Computations were performed for the initial conditions corresponding to a paramagnetic phase, $\langle S \rangle = 0$ for $t=0$ using synchronous dynamics. To investigate the influence of human activity on the process of opinion formation we made computations for four different distributions of activity, real ($A \sim k^{0.35}$), uniform $A_i = \text{const}$ and for weak ($A \sim k^{0.1}$) and strong ($A \sim k^{1.0}$) correlations between degree and activity. To obtain more comparable results the average activity was the same in all cases.

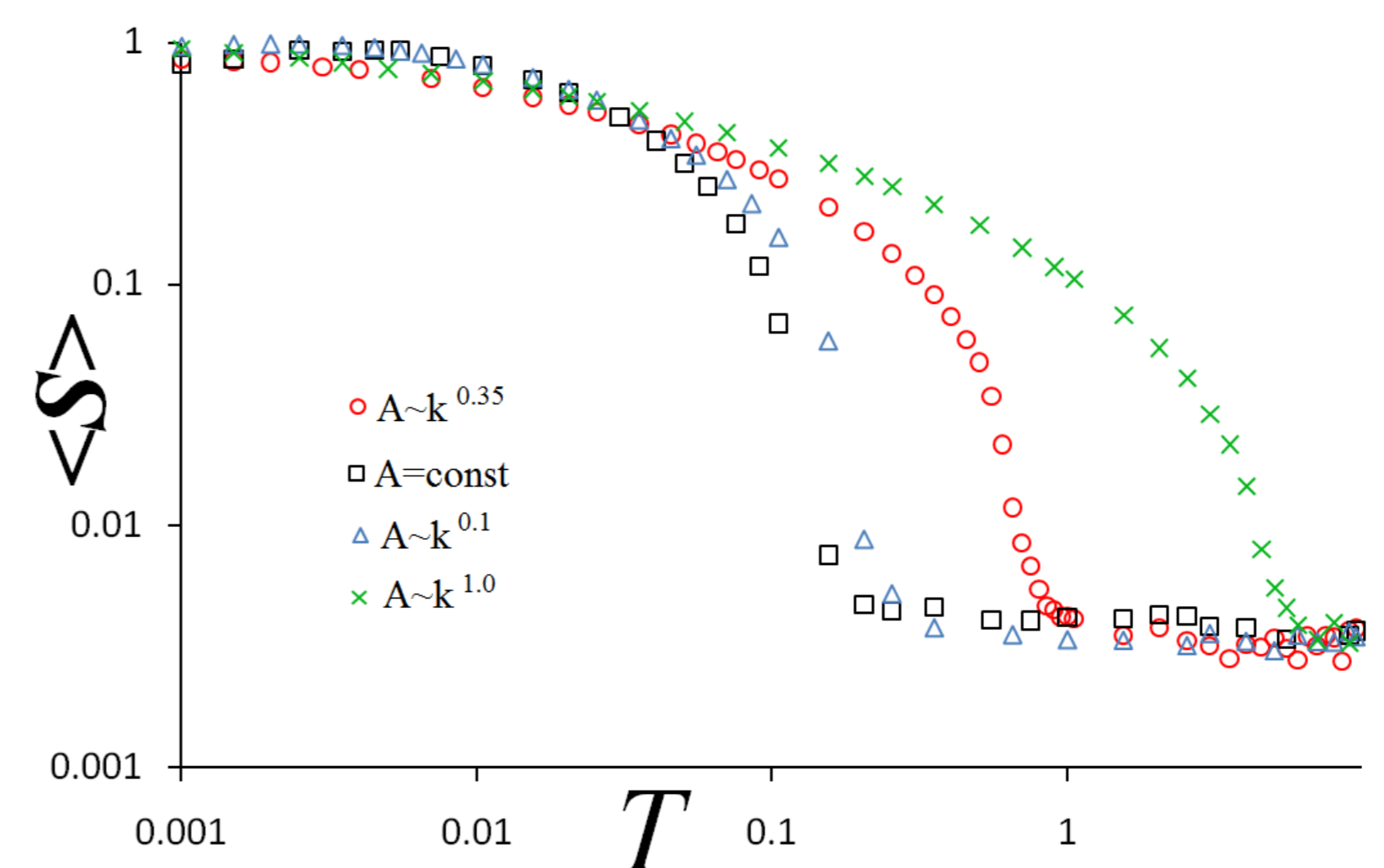


Fig.1. Relation between $\langle S \rangle$ and temperature T for different distributions of activity: original (circles), average (squares), and weak (triangles) or strong (crosses) correlations between degree and activity.

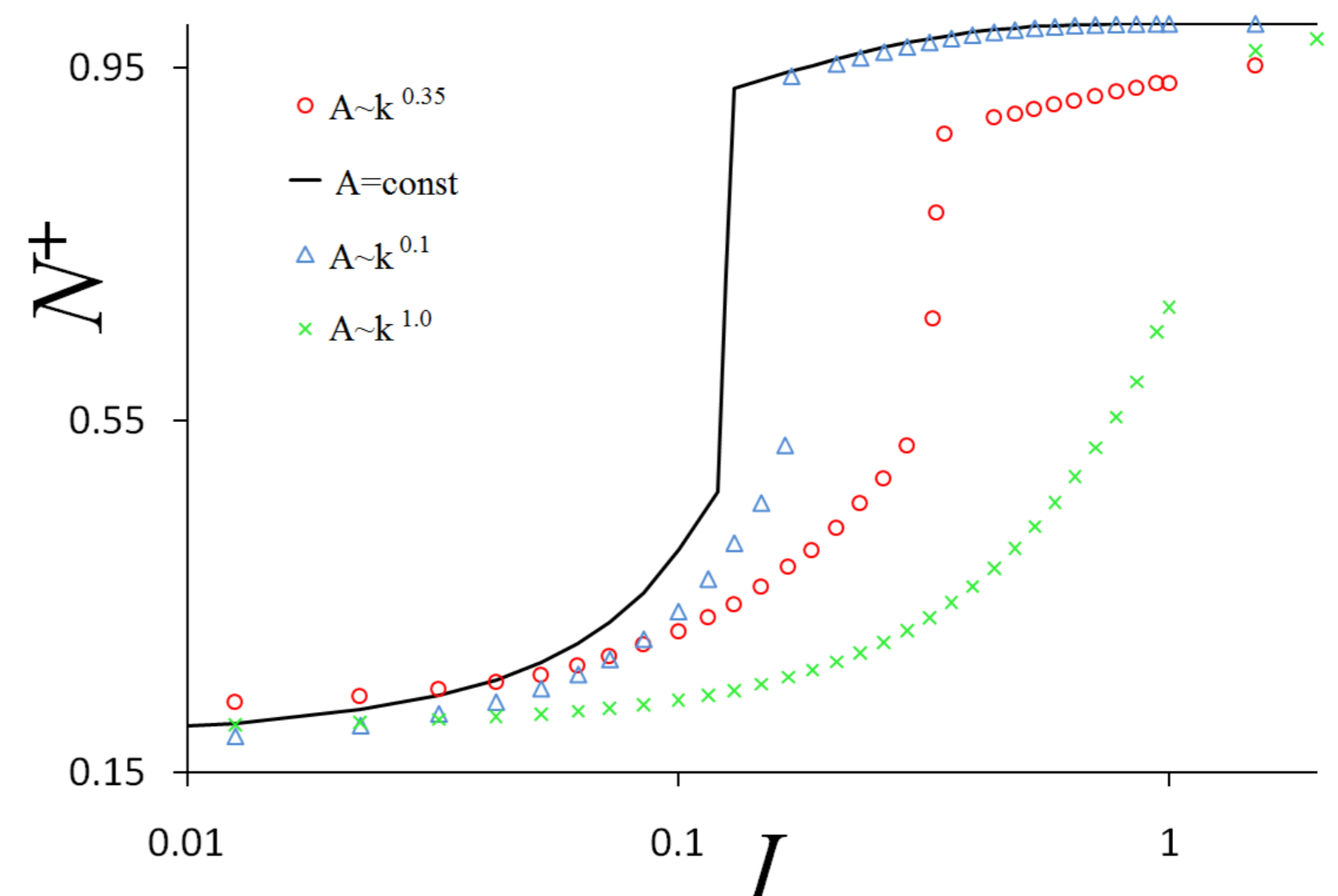


Fig.1. The relation between the relative number of individuals with the states conforming with external stimulation (N^+) and the value of external stimulation I .

Conclusions

We have found that the correlations between activity of an individual and its degree have strong influence on the process of opinion formation. In the case of real distribution of activity the critical value of temperature T_C is approximately ten times greater than in the case of uniform distribution of activity. Therefore, the presence of correlations between A and k causes that the dominant opinion can emerge even if the temperature is high. Moreover those correlations speed up the process of opinion formation. The influence of the mass media (I), in certain circumstances, can provoke critical rebuilding of opinions in the population. However, the stronger correlation between A and k , the more robust is the system against influence of external stimulation.

The Bibliography:

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