

Dynamic phenomena and human activity in an artificial society

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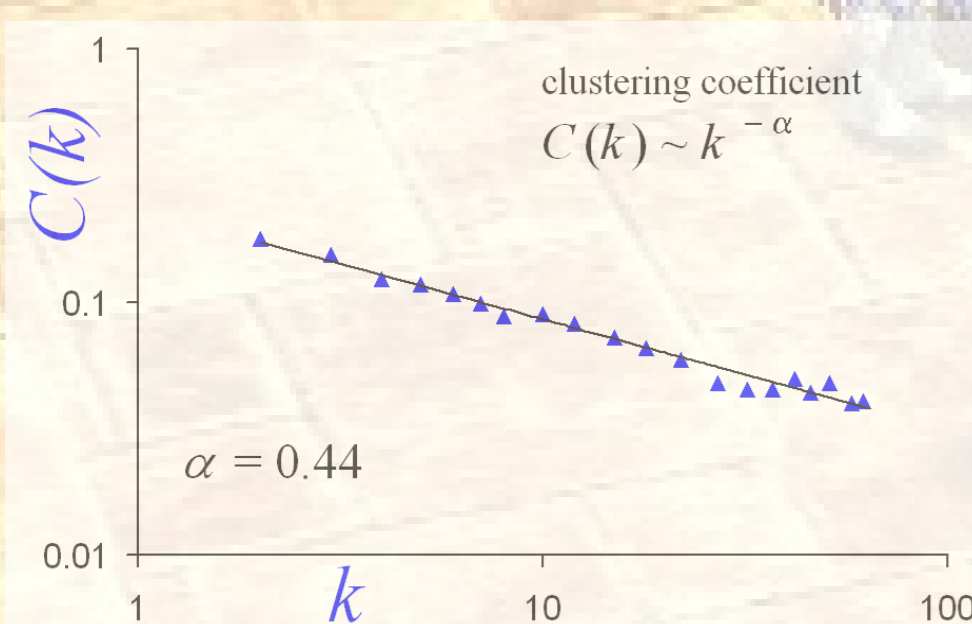
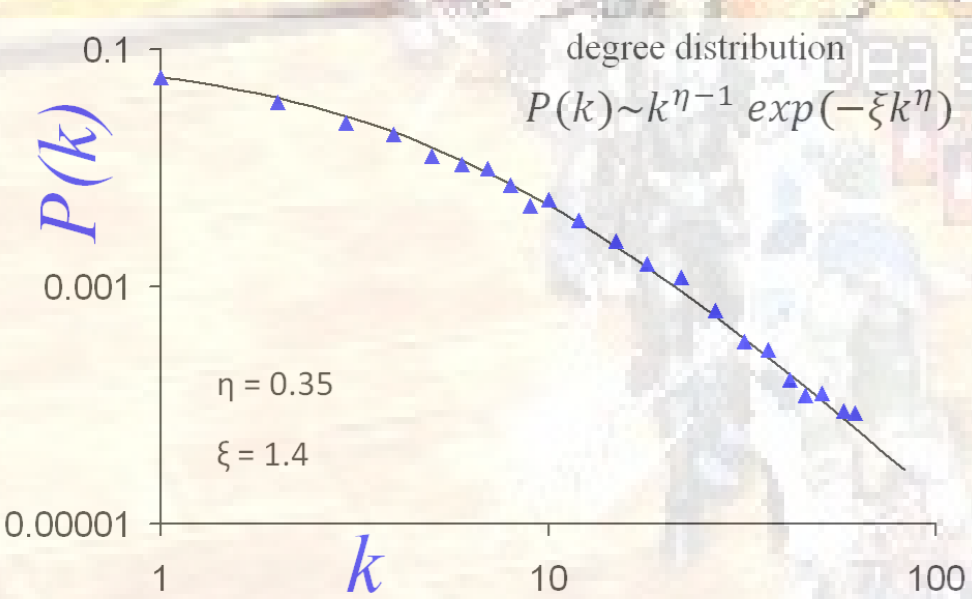
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Introduction

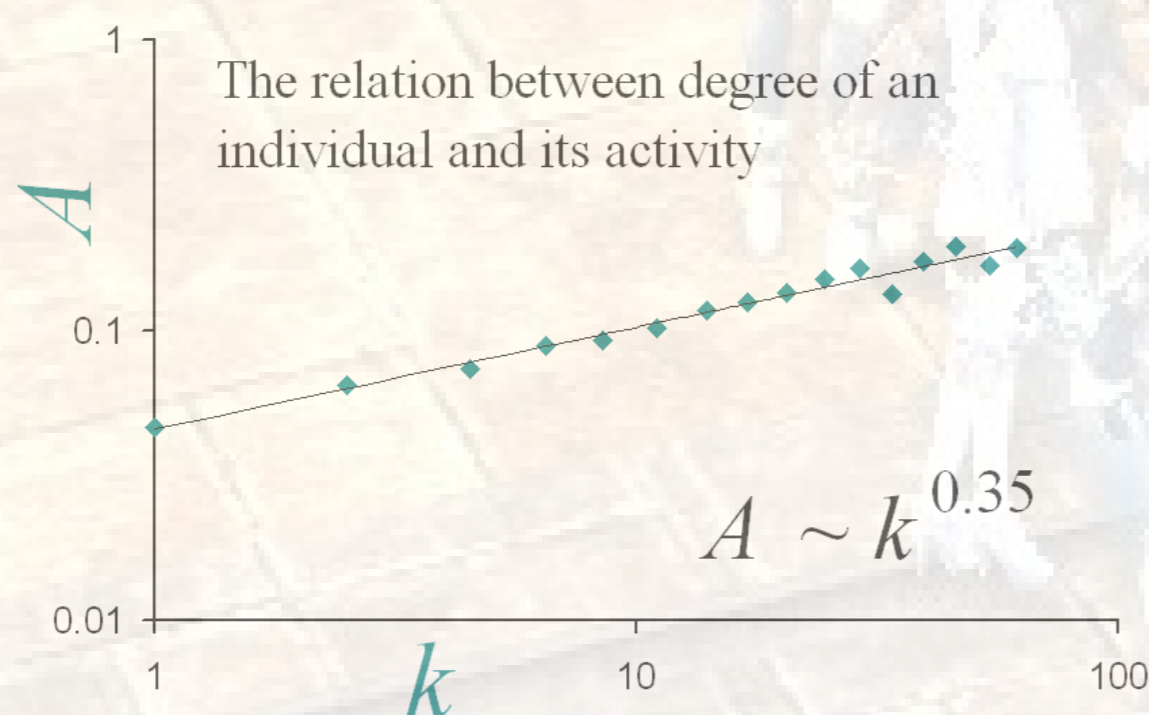
We study dynamic phenomena in a large social network of nearly 3×10^4 individuals who interact in the large virtual world of the Massive Multiplayer Online Role Playing Game (MMORPG). On the basis of a database received from the on-line game server, we examine the structure of the friendship network and human dynamics. To investigate the relation between networks of acquaintances in virtual and real worlds, we carried out a survey among the players. Furthermore we find very interesting scaling laws concerning human dynamics.

The structure of the network



Human activity

We calculate the activity of individuals, i.e. the relative time daily devoted to interactions with others. The distribution of activity is not uniform and is highly correlated with node degree.



Results of a poll

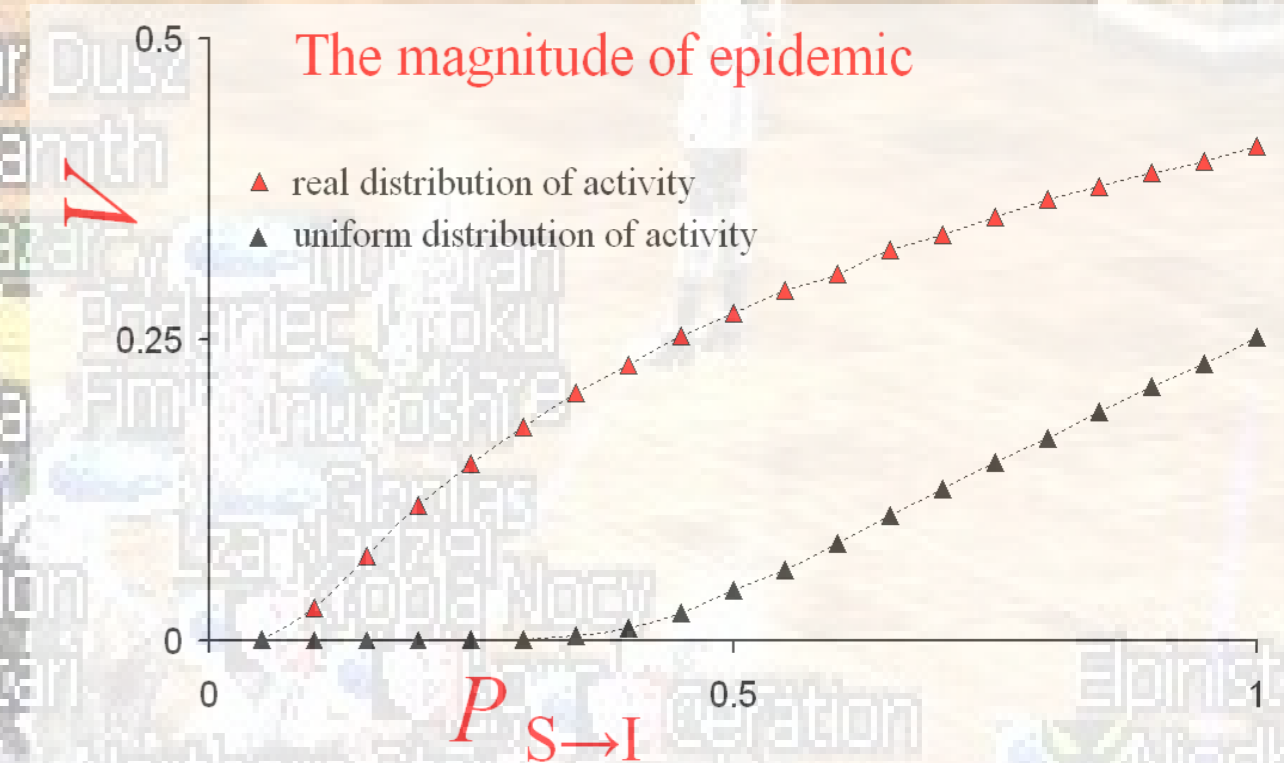
With the server continually accessible for two years and its software updated, there was an excellent opportunity to create a continually evolving virtual space where a specific local society could come into being. Social interactions with other players are an important part of each MMORPG. On the one hand such interactions influence the network of acquaintances in the real world. On the other some pre-existing acquaintances from the real world are maintained in the virtual one, too. To investigate the relation between networks of acquaintances in the virtual and real worlds, we carried out a survey among 360 players. The average number of pre-existing acquaintances N_C turned out to account for 13% ($N_C = 2.5 \pm 0.3$ people) of the friendship network in the virtual world. Hence, the network under investigation did not develop as a growing graph of an underlying network of social acquaintances in the real world. The average number of contacts established as a result of playing the game $N_D = 6.5 \pm 1.0$ people is significantly greater than N_C . The results of the survey indicate that on-line games may have a strong influence on the network of acquaintances in the real world.

Epidemic spreading

To investigate the influence of human activity on the spreading process (SIRS model) we made computations for two different distributions of activity, real and uniform $A(k) = \text{const}$. To obtain more comparable results the average activity was the same in both distributions.

$$S \text{ (susceptible)} \rightarrow I \text{ (ill)} \rightarrow R \text{ (resistant)} \rightarrow S \text{ (susceptible)}$$

The epidemic spreads faster and the magnitude of epidemic is larger in the case of real distribution of activity, as result of the presence of very effective super-spreaders in the social network.

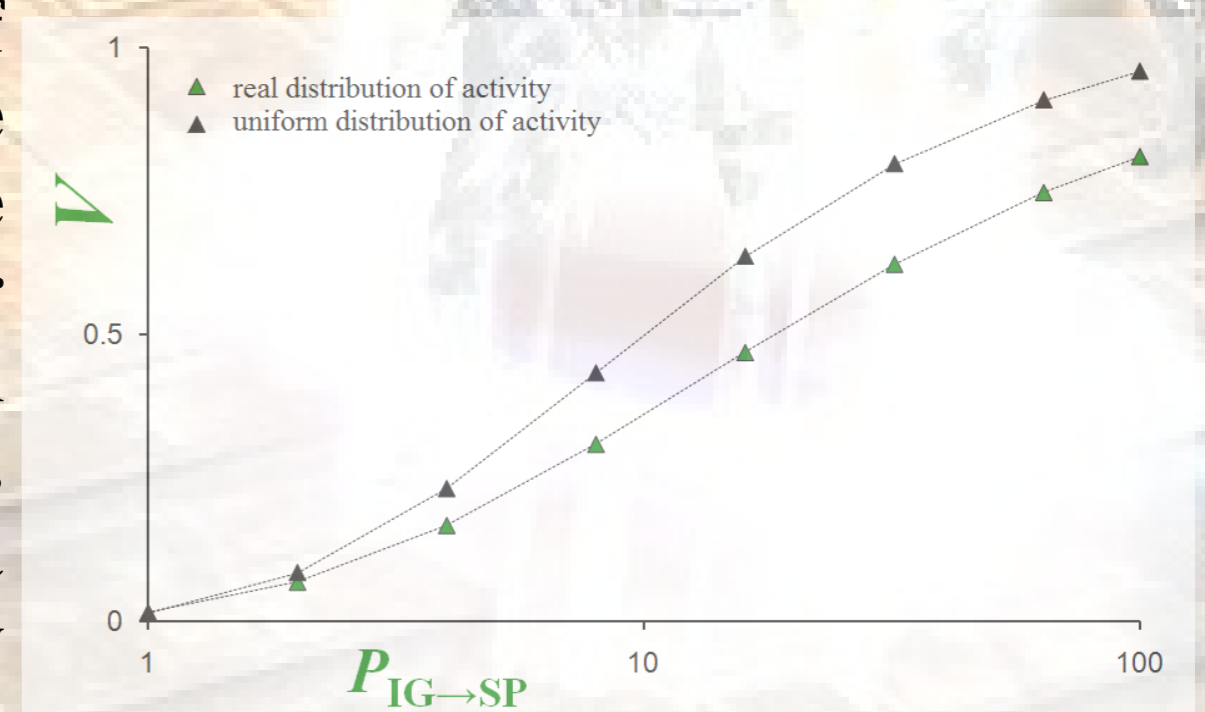


Rumor propagation

Next, we investigate the impact of human activity on the efficiency of rumor propagation. Each of the N individuals can be in three different states:

$$IG \text{ (ignorant)} \rightarrow SP \text{ (spreader)} \rightarrow ST \text{ (stifler)}$$

The final number of individuals affected by the rumor is lower and the rumor spreads much slower in the case of a real distribution of activity. Because individuals with a high k and A more effectively interact with their neighbors than in the case of $A(k) = \text{const}$, they very quickly learn that the rumor has lost its "news value" and turn into stiflers.



Conclusions

We have found that taking into account a real distribution of social activity speeds up epidemic spreading; however it decreases rumor propagation as a result of super-spreaders' various behavior.

Our results indicate that the influence of human social activity on dynamic phenomena in social networks significantly depends on the types of phenomena and interaction rules involved.

The Bibliography:

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