Time-varying networks and the weakness of strong ties

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In the last ten years the access to high resolution datasets from mobile devices, communication, and pervasive technologies has propelled a wealth of developments in the analysis of social networks. Particular efforts have been devoted to characterize how their structure influences the critical behavior of dynamical processes evolving on top of them. However, the large majority of the approaches put forth to tackle this subject utilise a time-aggregated representation of the interactions and neglect their time-varying nature. Indeed, the concurrency, and time ordering of interactions, even if the social network contains stable relationships, are crucial and may have considerable effects.

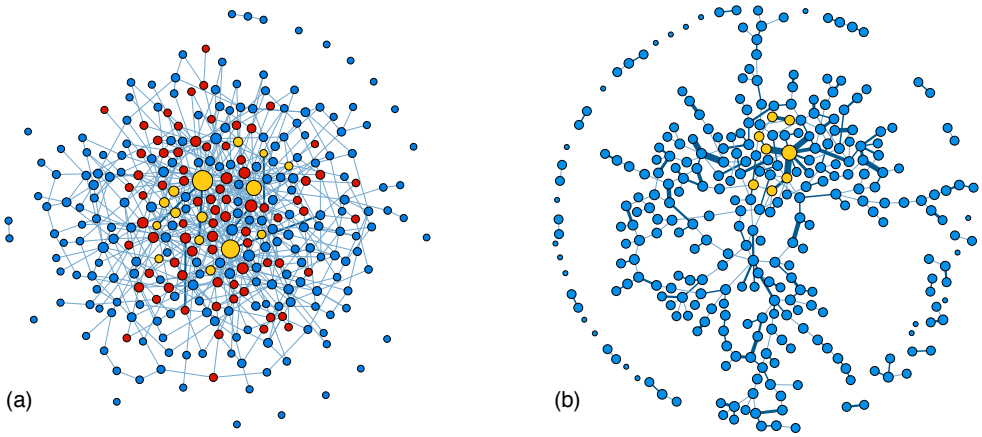

Figure 1: *Rumor spreading processes in (a) memoryless and (b) reinforced activity-driven networks of the same parameters. Nodes colors assign the actual node states as ignorant (blue), spreader (red) and stifler (green) states after the same number of evaluation steps. Node sizes, color, and width of edges represent the corresponding degrees and weights.*

In this work we analyze a large scale mobile call dataset to investigate the temporal evolution of the egocentric network of active individuals. We empirically observe a simple quantitative statistical law characterizing the memory of agents and encode the observed dynamics in a reinforcement process defining a generative computational network model with time-varying connectivity patterns. This reinforced activity-driven network model spontaneously generates the basic dynamic process for the differentiation between strong and weak ties. The model is used to study the effect of time-varying heterogeneous interactions on the spreading of information on social networks. We observe that the presence of strong ties may severely inhibit the large scale spreading of information by confining the process among agents with recurrent communication patterns. Our results provide the counterintuitive evidence that strong ties may have a negative role in the spreading of information across communities.