Influence maximization in simplicial contagion

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A recently proposed model of simplicial contagion highlighted the rich behaviour of social spreading phenomena obtained when combining non-linear contagion rules with an hypergraph representation of social interactions, in this case using simplicial complexes [1]. Unfortunately, the heterogeneity of the hypergraph structure and of the time evolution of the contagion have yet to be studied due to constraints in previous mathematical formalisms. This work aims to fill this gap by providing an approximated master equation analysis [2] that is precise enough to capture those features, but yet is simple enough to yield explicit results. Using this new framework, we tackle the problem of influence maximization in social contagions. Is it more impactful to target influential spreaders or influential simplices? We solve the problem by identifying the best set of initial conditions required to optimize the spread of a given simplicial contagion and find different optimal strategies at different levels of non-linear contagion rules. These results are discussed in the context of viral memes, emerging social norms and online influencers.

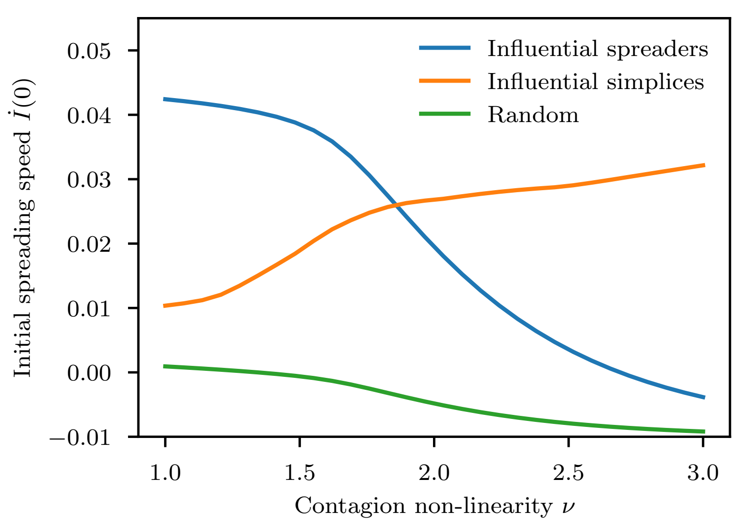

Figure : **Effectiveness of different influence maximization strategies.** The simplicial contagion model is run on a heterogeneous hypergraph structure: nodes have a membership m drawn from a power-law distribution ($\propto m^{-3.8}$) determining in how many simplices they are involved, and simplices are of size drawn from a Poisson distribution. The contagion is seeded in $I(0) = 1\%$ of nodes, picked randomly or targeted either by their membership m (*influential spreaders*) or by the state of the simplices in which they are found (*influential simplices*). Within a simplex with i infectious nodes, the contagion spreads with transmission rate proportional to i^{ν}. We investigate complex simplicial, i.e. $\nu > 1$, and the critical ν value determining which targeting strategy will be most effective.

[1] I. Iacopini et al., Nat Commun 10, 2485 (2019).
[2] L. Hébert-Dufresne et al., Phys. Rev. E 82, 036115 (2010).