**Diffusion of ideas: percolation, social pressure and homophily**

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**1. Introduction**

The present paper performs a theoretical study of the influence of social pressure and homophily on the diffusion of ideas in a population of human agents. The diffusion process of ideas shares several features and factors with diffusion of new technologies and products (Centola 2010, Campbell 2013), such as consumer heterogeneity, imperfect information, delayed adoption, critical mass, etc. We build on a percolation framework to study the interplay of individual preferences and social pressure, in order to have a theoretical benchmark that can help understanding the role of structural factors such as clustering and average path-length in diffusion processes.

Recent literature finds two main types of diffusion processes on networks, namely simple and complex propagations (Centola 2010). In simple propagations, a single contact with an “infected” neighbor is enough to trigger the propagation in the neighborhood. In that case, long ties – connections between otherwise disconnected neighborhoods – allow opening the neighborhood towards new sources of information. In complex propagations, contact with multiple sources is usually required for adoption. In such a case, long ties can prevent cascade dynamics while clustered structures favor diffusion. Simple and complex diffusion processes are usually presented as mutually exclusive, due to their different behavior in different network structures (Centola 2010, Lu et al 2011). This paper introduces a hybrid model where processes can present different levels of complexity, depending on the so-called social pressure intensity.

The diffusion process is not only determined by the overall structure of the network, but also by the position of individuals in that network structure. Social networks usually present homophily: people tend to be friends with people who are similar to themselves (Campbell 2013). The effect of this property in the process of diffusion is unclear (Centola 2011). On the one hand, homophilious ties provide more reliable information, so they can promote diffusion. On the other hand, too much homophily can lead to disjoint clustered neighborhoods with no bridge between them to share information. In this paper we will analyze how homophily affects the outcome of simple and complex diffusion processes, depending on the network structure.

**2. Methods**

This study presents a theoretical model of the dynamics of propagation of an idea in a population of agents heterogeneous in their local influence on other agents and their willingness to adopt a new idea, or the minimum quality they require in order to adopt it. Agents will get to know about an idea after one of their neighbors have adopted it, and will decide whether to adopt it. In such a case, they will pass the information to their own neighbors and the process will go on until no informed agent is willing to adopt. Such a percolation model of diffusion (Solomon et al 2000) assumes that information is local and embedded in a social network: agents get to know about the existence of the idea via their friends or neighbors. The structure of the network is, thus, decisive to the success or failure of the diffusion process.

For the modelling of social networks we will use small worlds (Watts and Strogatz 1999), an interpolation between regular lattices and completely random networks, with varying average path length and clustering coefficient. Thus, they are a suitable network structure to study the effect of long ties and clustering ties to the diffusion process. Social pressure is modelled by decreasing the minimum quality requirement of agents when the number of adopting neighbors increases. To introduce homophily agents are positioned in the original lattice of the small world algorithm according to their minimum quality requirement.

**3. Preliminary results**

Our simulation analysis shows that social pressure may alter the dynamics of the diffusion of ideas. Some ideas with an original value so low that it would never get diffused can be spread due to the strength of social pressure. This effect also interacts with the structure of the network, with a more sizeable effect on small worlds with a low rewiring probability. This is mainly due to the deep influence of social pressure on the effect of clustering links. Clustering links are relations that increase the clustering coefficient, that is to say, relations between two friends of a third agent. They are traditionally assumed to be redundant, as the information they bring could be reached via another relation. When the number of links is limited, clustering links are harmful for diffusion: the links used to build a cluster are not used to open the neighborhood to new sources of information. Social pressure completely changes the picture, because sequential adoption of neighbors can make one agent adopt at later stages.

Preliminary results also show that a high degree of homophily favors diffusion. The reason is that homophilious structures are most efficient in spreading information to the “right agents”. The marginal effect of one more agent adopting is more effective when an agent with slightly higher quality requirement is more likely to be a direct neighbor of the adopting agent. Thus, there are no differences between simple and complex diffusion processes anymore. A second effect of homophily is that the structure of the network is not determinant anymore of the final size of diffusion. As long as the majority of the original connections are preserved, agents belong to homogeneous neighborhoods, qualitatively similar through the different small world structures.

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