



Lahore School of Economics

Spring 2022

Term Project – Final Report

The Spread of Behavior in an Online Social Network Experiment

Macro Economics II

9th May' 2022

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The research paper consists of in-depth study carried out by Damon Centola on the diffusion of behaviors spread through different network types and the impact of reinforcements on the likelihood of individuals adapting to the behavior. Generally, it is believed that the spread of behaviors can highly depend upon the types of network, the two types of networks that were focused upon in this paper were Clustered Lattice Network and Random Network. The paper also explores all factors that can impact the diffusion of behavior in these networks and produces statistical data to support the study through experimentation.

It is believed that networks that had many clustered ties and higher degree of separation were found less effective in terms of behavioral diffusion. Another concern that was mentioned in the article was the impact of social reinforcement on the various types of networks. There were two hypotheses discussed in the article, one of which was “Strength of weak ties” such as small-world topologies and how it is able to spread a social health behavior farther and quicker than a network that is highly clustered. It mainly focused upon the spreading of behavior as a simple contagion such as a disease or information.

The power of long ties was discussed in the paper and how this would result in reduction of redundancy in the diffusion process. This can be achieved as long ties mean that it would be able to connect individuals who do not have mutual connections and introduce the behavior to individuals from other areas of the network rather than a cluster of individuals who are all mutual amongst one another. Random network was brought up to explain this concept of long ties as there would be a large population that belonged to a network and each individual would be connected to another individual from a different neighborhood. Due to this, information would spread faster and farther in distance than a clustered network where the group of individuals would mainly spread the information to specific areas of the network only.

There is another hypothesis discussed in this paper which would bring up the importance of reinforcement for the adaptation of behavior. It talks about the idea that unlike information/behavior such as diseases, social behavior is a different form of behavior. Social behavior is believed to require much more effort in-order to be adapted by other individuals. Damon Centola wrote about the need of multiple sources to convince the individuals to adapt to new social behavior.

As discussed previously, Random clustered networks are a far superior form of networks when it comes to social reinforcement as it connects individuals to neighbors from their own area as well as individuals from other areas. This form of network would spread behaviors across a large population and also provide social reinforcements to increase the likelihood of adaptation.

However, the empirical test cannot be conducted on these predictions since it would require the ability to individually vary the topological structure of a social network. Tests were run to distinguish the effect of network structure on the diffusion when it is tested in a controlled model. A health based internet community was created consisting of 1528 participants who were asked to create an anonymous profile consisting of a username, avatar and a set of health interests. In this controlled network, the participants were connected to other individuals of the community anonymously. These connections were known as health buddies for one another and all forms of direct communication were restricted in the model. Health buddies were made so that only they will receive emails from the study regarding their health buddies' activity.

Preservation of anonymity was a vital part of this experiment so the researcher blinded the identifiers that people used to ensure the individuals are unable to identify one another. Adaptation was dependent upon the adoption pattern of their health buddies and in relation to the controlled model that Damon used, he tested if the participants would register for an internet based health forum simply because their health buddies are doing so. This health forum was used as a tool to further test the theory of reinforcements as it provided access and rating tools for online health resources. As the individuals started joining the forum, their neighbors were sent signals to inform them of this activity. The forum was also only accessible to the participants of this study to ensure that all variables of the model can be monitored.

In order to test the effect of the two forms of networks, the participants were assigned networks at random. The two networks being clustered-lattice network and a random network. To maintain similar conditions implied on the networks every node of the network had the same number of neighbors. All conditions implied on the networks were exactly the same except the pattern of connectivity in social networks. In case any difference is detected in the dynamics of diffusion between the two networks, it is because of the effects of the network topology as all other conditions are uniform.

Damon decided to run this experimental design over observational data as he had previously studied the spread of health-related behavior that were unknown to the participants before the experiment. This would help eliminating the effects of all non-network factors from the dynamics of diffusion and allow the same process of diffusion process to be observed multiple times under identical conditions.

There were a total of 6 independent trials run on the model of both networks hence why it yielded 12 independent diffusion processes. By the term Node we refer to each participant of the network and each node had the same number of neighbors so when a random seed node was selected, it would send signals to their neighbors. The signal is supposed to encourage the neighbors to adopt the behavior as well and in case the behavior is adopted by multiple neighbors of a participant, he/she would receive multiple signals which would then act as reinforcers. The greater the number of neighbors who adapted the behavior, the higher the number of signals received by the participant. The diffusion process was run for 3 weeks for each trial. This helped in collecting the time series data of the spread of the behavior through population along with the number of signals and their impact on the likelihood of the behavior being adopted.

Some factors that can affect the model were population size and the number of health buddies. Three versions were tested with different values to understand the relationship of population size and health buddies on the diffusion in a social network. The conclusion of this experiment was that the population size did not have a significant effect on the dynamics of behavioral diffusion compared to the effect of health buddies. The network with higher number of neighbors performed better than networks with lower number of neighbors. This can also support the hypothesis of the importance of social reinforcers in behavioral diffusion on large population areas.

Topologies consisting of greater clustering and larger diameter were providing a much more effective way of spreading behavior. This was also concluded by the experiment of six trials that was run earlier on and the data collected from it. On average the percentage of population that adopted the behavior reached 53.77% for clustered networks and 38.26% for random networks. It can also be observed that after the second reinforcer the participants were much more likely to adopt the behavior compared to receiving only one signal. However, after

the second reinforcer, the marginal effect size of the reinforcer is not equivalent to the effect size observed from a shift of one signal to the second signal. Another significant effect of social reinforcers observed was that as the number of signals increased, it increased the level of engagement of participants and their return to the health forum.

Some of the limitations of the experimentation carried out were that it is often extremely difficult to adopt a behavior in real life than what is being portrayed in the test. The tests are quite possibly not a true representation of the diffusion of health behaviors as it may depend even more on the clustered network structures in real life than the diffusion dynamics recorded in the experiment. As direct communication was restricted to keep the network conditions identical, it cannot portray real life conditions.

In Conclusion, the researcher Damon Centola has performed multiple tests to observe the direct effect of the types of network topology on the dynamics of the diffusion of behaviors in a social network. All the test carried out were in a controlled model due to which the real life application may vary drastically as external factors were not a part of the experimentation. There needs to be a deeper study on the diffusion of behaviors in different network topologies while keeping other non-network variables in consideration to deduce a much more realistic conclusion.

