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# An experimental study of persuasion bias and social influence in networks

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ABSTRACT

In many areas of social life, individuals receive information about a particular issue of interest from multiple sources. When these sources are connected through a network, then proper aggregation of this information by an individual involves taking into account the structure of this network. The inability to aggregate properly may lead to various types of distortions. In our experiment, four agents all want to find out the value of a particular parameter unknown to all. Agents receive private signals about the parameter and can communicate their estimates of the parameter repeatedly through a network, the structure of which is known by all players. We present results from experiments with three different networks. We find that the information of agents who have more outgoing links in a network gets more weight in the information aggregation of the other agents than under optimal updating. Our results are consistent with the model of "persuasion bias" of DeMarzo et al. (2013. Q. J. Econ., 909) and at odds with an alternative heuristic according to which the most influential agents are those with more incoming links.



## 1. Introduction

In many important social and economic situations, individuals receive information about a particular issue from multiple sources and also transmit information to multiple others. Examples are the sharing of political opinions among voters or of information about prospective job candidates in an organization's hiring process. When people exchange opinions about such issues within a group, some of the group members may have a stronger influence on the group's opinion than others due to the quality or accuracy of the information. However, influence may also often be due to social factors like the resources some people have available to invest in spreading their opinions, how well considered their opinions are in society or how well connected they are to others.

One basic source of social influence occurs in communication through networks, where there exists the possibility of one person's information reaching a particular other person repeatedly. When individuals are connected through a network, then they may receive information both directly and indirectly from the same source and send information directly and indirectly to a particular other source. In such situations, perfectly rational aggregation of information by an individual involves taking into account the structure of the network and adjusting how one weighs the information one receives

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accordingly. However, boundedly rational agents may have difficulties with this process and aggregate in biased ways—for example, by failing to adjust properly for repetitions of information[1]. In this paper, we present results from laboratory experiments that shed light on how people aggregate information when they are connected in a network.

DeMarzo et al. (2013) present a stylized version of an information aggregation situation in a network, together with a model of a particular bias to which boundedly rational agents may fall prey. They posit a situation in which a set of agents all want to find out the value of a numerical parameter. Each agent starts with some initial private information about the parameter, the aggregation of which is all the information available to the group of agents in the network. Agents then communicate their estimates about the true parameter to one another through the network. The network consists of a number of connections between the set of agents that specify who sends information to whom—or, alternatively, who listens to whom. There are multiple periods of communication between the agents, a feature meant to represent a lengthy deliberation process. In each period, each agent listens to the estimates of those who, following the network structure, send him information and sends his estimate to those who listen to him. After each period, each agent can update his own estimate in order to approximate the true parameter based on any new information received from other agents.

There is a rational way to aggregate information in such a setting, which involves agents discounting information that reaches them repeatedly through distinct channels in the network. But it is possible that boundedly rational individuals will not use this optimal process. A priori, there are many distinct ways in which information could be aggregated non-optimally. DeMarzo et al. (2013) propose a particular model of boundedly rational information aggregation, based on DeGroot (1974), which leads to "persuasion bias." According to this model, all agents treat all information they receive as new, ignoring the fact that an estimate received in a particular period may contain information that has already been received – directly or indirectly – from another source. Agents treat the information they receive in each period as new and independent and do not adjust for the fact that over time the information of some agents might contain more repetitions than that of others. The implications of this kind of biased information aggregation depend on the structure of the network. Some networks may cancel out the biased weighting of information, so that agents subject to the boundedly rational persuasion bias may nevertheless reach an unbiased estimate of the true parameter. However, other networks will not have this property and the consequence will be that the presence of a bias at the level of individuals processing information yields groups that arrive at biased estimates of the parameter.

The model of bias proposed by DeMarzo et al. (2013) is a plausible one. Nevertheless, it is not a priori obvious that if people turn out to be biased, they will be so in the precise way posited by the model. There are many ways to aggregate information and addressing the questions of which bias will occur and how it will affect group outcomes requires empirical information. Therefore, we use laboratory experiments to explore the internal validity of the persuasion bias model. The laboratory provides an ideal environment to study the relation between network structures and the kind of information and communication processes necessary to test the persuasion bias model. The two principal values of laboratory experiments are control and replicability. Causal knowledge requires controlled variation (Falk and Heckman, 2009) and the laboratory allows for tight control over the environment in which interaction takes place. At the same time, the laboratory allows the generation of sufficient data to test theoretical predictions in a simple way.

In this paper, we present results from experiments with three different networks. The first two are directly inspired by the discussion in DeMarzo et al. (2013). We study behavior using their examples of both "balanced" and "unbalanced" networks of four agents. In the balanced network, four agents are located in a circle. They all receive one piece of information and all send their estimate of the parameter to and receive it from the two agents closest to them. In such a balanced network, DeMarzo et al. (2013) predict no bias in the consensus estimates of the group. In the unbalanced network, the four agents all receive one piece of information, but some agents send information to a larger number of others and receive information from a smaller number of agents than others. In such an unbalanced network, the model of DeMarzo et al. (2013) predicts a precise biased outcome to which the group's estimates should converge.

We find that observed behavior is consistent with persuasion bias and, importantly, with many of the precise predictions of the model of DeMarzo et al. (2013). In the balanced network, subjects' estimates move in the direction of estimates in which the private information of all four players carries identical weights, as predicted by the theory. In contrast, in the unbalanced network, subjects tend towards biased estimates that give greater weight to the private information of those agents with more outgoing communication channels and those connected to such agents, which is consistent with theoretical predictions of DeMarzo et al. (2013). Moreover, with experience, the estimated empirical weights of the different private signals correspond closely to those of the persuasion bias model. Hence, our data provide substantial support for the notion of persuasion bias[2].

In a set of experiments conducted independently, Corazzini et al. (2012) find that the network structure plays a significant role in determining social influence, but that the most influential agents are not those with more outgoing links, as predicted by the persuasion bias hypothesis, but those with more incoming links. Their study presents data from a

[1] See, for instance, Gale and Kariv (2003), Golub and Jackson (2010) and Acemoglu et al. (2011).

[2] Banerjee et al. (2013) and Mobius et al. (2015) contain some field evidence consistent with the DeGroot model. Our experiment also relates to a paper by Enke and Zimmermann (2013) on correlation neglect, which describes agents' tendency to overweight information, received from multiple sources, that is correlated due to its origin from the same source. They report a laboratory experiment in which subjects' exhibit correlation neglect and overweigh information that they receive repeatedly through multiple channels. They show experimentally that in such contexts many people neglect these correlations in the updating process and treat correlated information as independent.