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Evolution of public opinions in closed societies influenced by broadcast media

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HIGHLIGHTS

- The SJBO model is extended to study the opinion evolution in a closed society.
- The effect of broadcast coverage on the size of their supporters is insignificant.
- Individuals' interaction promotes the diffusion of opinion from mainstream media.
- Diverse attitudes toward mainstream media prevent the opinion uni-polarization
- The dominance of mainstream media can be broken by 30% inflexible contrarians.

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ABSTRACT

Studies on opinion evolution in a closed society can help people design strategies to emancipate from the control of public opinions and prevent the diffusion of extremism. In this work, the social judgment based opinion (SJBO) dynamics model is extended to explore the collective debates in a closed system that consists of a social network and a broadcast network. The broadcast network is a group of channels through which the so-called broadcast media or mainstream media transmit the same opinion to social agents. Numerical experiments show that the broadcast media can assimilate most of the agents when contrarians are absent. Including agents' diverse attitudes toward the broadcast media, although downsizes the supporters of broadcast media, fails to make contrarians outnumber the supporters. The dominance of broadcast media in a closed system can be overturned by introducing a small number of inflexible contrarians. Influenced by the competition between contrarians and broadcast media, few centrists survive the collective debates. The scale of supporters is maximized when agents neither have their own initial opinions nor have access to the contrarians, whereas the development of contrarians can be boosted when agents start with non-zero opinions and the repulsion to broadcast media is taken into consideration.

1. Introduction

Nowadays, rapid advances in information technologies are changing the way that people exchange and share information, which in turn facilitates the dynamic evolution of public opinions. The widespread use of newspapers, radio,

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and television ushered in an era of live broadcast media that feature one-to-many information transmission [1]. The broadcast media usually spread information and their underlying opinions to users unidirectionally, i.e., they impact their users but receive little (if any) influence from them. Consequently, public opinions are more or less directed by the broadcast media especially in a closed society. The development of new platforms for information propagation has been stimulated by inventions of the Internet and modern digital devices that include laptop computers, tablet computers, smart phones, and other portable devices. These new platforms, also known as social media or "we media", enable one-to-many and many-to-many communication by using services such as Facebook, Twitter, Wechat, and Microblog. Anyone with a digital device and an Internet connection can publish information and express opinions, and this is dramatically changing the patterns in which information and opinions are diffused.

In reality, individuals' opinions are influenced by information both from the broadcast media and over the social media. In the meanwhile, individuals express their opinions and interact with others through the social media, influencing the opinion evolution in the social media. With the modern information sharing platforms, some researchers argued that individuals may even push the broadcast media to adjust their opinions if they intend to expand their followers [2]. In this complex social context, the problem of how to disseminate a preset opinion has attracted much research attention with intent to develop the optimal strategy for corporate marketing and advertising, innovation diffusion, and even political propaganda. In an open society, guiding of opinion evolution usually can be accomplished by using opinion leaders or informed agents. The informed agents are common individuals who are employed or chosen to steer a society toward a preset opinion. Since hiring opinion leaders is sometimes infeasible or prohibitively expensive, employing informed agents has been considered as a cost-effective way for disseminating a preset opinion. Using the bounded confidence model, Afshar and Asadpour [3] revealed that only a small number of informed agents are required to achieve such a goal. Fan and Pedrycz [4], however, found that the effectiveness of informed agents is mainly dependent on the characteristics of ordinary individuals if the exchanges of inner opinions among individuals are not available. AskariSichani and Jalili [5] proposed an algorithm for identifying the target nodes in a complex network in order to connect to informed agents and then maximize their influence. Bassett et al. [1] studied the effects of different media and of their neighbors on the information dissemination and decision dynamics when there is a pending natural disaster.

In this paper, we consider the following question: How do public opinions evolve when individuals of a closed society are exposed to information from the broadcast media that propagate a preset opinion. The closed society here means that the individuals have no access to the external broadcast media and social media. In this scenario, although some social media are still available to individuals, the interactions through social network are confined in an isolated society, and individuals have no way to acquire information from foreign media. As a result, the opinion evolution is governed by the influences coming from local broadcast media as well as pairwise interactions between individuals connected through a confined social network. We consider the specific case that broadcast media disseminate the same information and opinion as a whole although they appear in different forms, such as newspapers, radio, television, and other officialized websites. Understanding the opinion evolution influenced by broadcast media can assist enterprises to design the best marketing strategy, help people figure out ways to promote the diffusion of authentic information and opinions, and contribute to the formulation of techniques to shake off the control of public opinions.

Opinion dynamics, an attempt at exploring how microscopic interactions among individuals can shape the global evolution of public opinions, has been considered as a powerful tool for modeling and studying the formation, evolution and diffusion of opinions in a system. Opinion dynamics models have been applied to multiple fields of science [6–14], and the obtained results have shed light on some important sociological phenomena, such as hung elections [15], extremism propagation [16,17], rumor spread [15], and development of social norms [16]. Since people's opinions on a given object usually vary smoothly from one extreme to the other, we turn to the social judgment based opinion (SJBO) dynamics model [4,17] to study the opinion evolution driven by the broadcast media. The SJBO model is adopted because it incorporates not only the compromise between similar opinions but also the repulsion between dissimilar opinions. The latter interaction mechanism, in particular, is prevalent in online social media [18,19] but is not included in the bounded confidence models. To make the opinion evolution more realistic, we model the opinion interactions among individuals on a scale-free network [20]. Empirical studies have demonstrated that the scale-free network is a good description of some real-world networks such as the children friendship network [21] and scientific collaboration network [22]. In the meanwhile, since the broadcast media have the same voice, they are represented by one "global source". The transmission of information from the global source to each individual is implemented through a broadcast network that links the global source to each individual. In addition to the regular agents, a small group of special agents named inflexible contrarians are also introduced to the scale-free network. A contrarian is an agent who always has the opposite opinion to that of the majority of the surrounding agents [10], and an inflexible contrarian means that its opinion is always kept unchanged [23]. In this study, the inflexible contrarians hold a constant opinion that is opposite to the opinion disseminated by the global source.

Our results suggest that, in a closed society without contrarians, the broadcast media can turn a majority of individuals into their supporters. Endowing individuals with non-zero initial opinions and including individuals' diverse attitudes toward the broadcast media are capable of expanding the size of contrarians; however, the dominance of broadcast media in public debates is not reversed. The governance of broadcast media over public opinions can be overturned by introducing a small number of inflexible contrarians. The competition between contrarians and broadcast media makes it difficult for centrists to survive.