Strategic Influence in Different Social Structures

Yunqi Xue and Rohit Parikh

April 14, 2016

Abstract

Throughout recent history, much information has been transmitted and acquired on a medium scale using methods like letters, telegrams and face to face interviews. In the age of Social Software, this process is speeded up, confirmed and aggregated for every user. We are able to maintaining an ever-increasing social network. Therefore we are influenced by more and more people. What are the epistemic and game-theoretic properties of social influence under current condition?

In this paper, we explain two different methods of belief updates, namely Friend Influence and Expert Influence. Both allow people to coordinate within a network in a decentralized fashion. We show how people can use a simple influence indicator, Expected Influence, to make strategic choices of belief update when two methods are in conflict. We discuss how network structure can affect such a decision making process. We are particularly interested in how influence spread in a large scale-free network.

keywords: knowledge, belief updates, social strategy, game theory, social network

Extended Abstract

As a cooperative species [1], we have always worked together and achieved wonders. Much of our cooperation is designed systematically and controlled centrally. Take, for example, a team of basketball players working together to beat the other team. Every player has his own position and plays a strategy that is designed by their coach. However, there are other types of activities, especially in the age of social media, that happen in a decentralized fashion. Often, scholars suggest that even in these decentralized activities participants need to have some common knowledge [2], such as full knowledge of the social network and decisions of the others [7] [2], in order to make optimal decisions. However, it is rarely the case that all participants share such common knowledge [6]. In this paper, we are interested in understanding how

we can make optimal decisions in decentralized social networks without sharing a common knowledge of the network.

Often, people can be locally influenced by their social network contacts. Eventually, these local influences can lead to a global coordination in the network.

In this paper, we look at two different methods of influence: Friend Influence and Expert Influence. Liu et al [4] do suggest a simple yet normative model for social belief change, called 'threshold influence'. They contrast strong influence which leads to belief revision and weak influence which leads only to belief contraction. For instance if I believe p but all of my friends believe $\neg p$, then I will change my own belief to $\neg p$. but if only some of my friends believe $\neg p$ then I will become undecided about p. We will call it *Friend Influence* in this paper.

Within a group of friends, beliefs tend to be adopted from one to the other. It creates a distribution of beliefs in the community. Liu et al [4] look at the influence one could gain from a socially connected agent.

The three possible doxastic states of a proposition p can be defined through following axioms:

- Strong influence: $S\varphi \leftrightarrow (FB\varphi \wedge \langle F\rangle B\varphi)$
- Weak influence: $W\varphi \leftrightarrow (F\neg B\neg\varphi \wedge \langle F\rangle B\varphi)$

Now we extend Friend Influence to show how influence on a subject travels in general. We call it *Expert Influence*. We will start a simple assumption of having one expert in each area in a social network at the beginning of an influence process. In addition, we look at connected social network only, i.e. there is no isolated person or groups in the network. We study how Expert Influence on a single proposition can travel through the network.

In this method, we employs all AGM axioms, P axioms from [5], and two new additional axioms that instruct agents what to do when they are influenced by an expert or a non-expert.

- **Influence from Expert to Non-expert:** Before a non-expert talks to an expert on p, he can believe p, believe $\neg p$ or have no opinion about p. Once the non-expert talks to a neighboring expert about p, he adopts the beliefs of the expert and become an expert on p himself.
- **Influence between Non-experts:** Between two non-experts, if they have different beliefs about p, they both contract their beliefs on p since none of them are authoritative on the matter.

In the past, we may still be able to find the information for deciding whether we would go to an event or take an action easily, since our social networks were generally smaller. In the era of *infostorms* [3],

not only we are overwhelmed by information, but also having ever expending social network through all kinds of social media. How do we make good decision given different kinds of influence in a large social network?

We have introduced two different belief update methods, namely Friend Influence and Expert Influence. It is clearly that both can be separately applied in different situations. In the case of a small dinner party, we probably get influenced through friends who are invited and coordinate with them. In the case of a gallery opening party, the influence may come naturally from an artist friend who is going and is an expert of such events. It is also possible that we get influenced both from our friends and experts at the same time. How do we choose which one to follow when the two are in conflict? More importantly, in an event that requires group coordination, can we choose strategically as an individual without global planning with all the participants?

We investigate how agents can be influenced differently in one event. We will first introduce the concept of *Expect Influence* which indicate potential influence of an agent or a group of agents. Then we will discuss how conflicting influence may raise between two different belief-update methods. At the end, we will discuss how network structure can affect people's choices of belief updates.

References

[1] Samuel Bowles and Herbert Gintis. *A cooperative species: Human reciprocity and its evolution*. Princeton University Press, 2011.

[2] Michael Suk-Young Chwe. *Rational ritual: Culture, coordination, and common knowledge*. Princeton University Press, 2013.

[3] Pelle G Hansen and Vincent F Hendricks. *Infostorms*. Springer International Publishing, 2014.

[4] Fenrong Liu, Jeremy Seligman, and Patrick Girard. Logical dynamics of belief change in the community. *Synthese*, pages 1–29, 2014.

[5] Rohit Parikh. Beth definability, interpolation and language splitting. *Synthese*, 179(2):211–221, 2011.

[6] Rohit Parikh and Paul Krasucki. Levels of knowledge in distributed systems. *Sadhana*, 17(1):167–191, 1992.

[7] Ji Ruan and Michael Thielscher. A logic for knowledge flow in social networks. pages 511–520, 2011.