Common Knowledge and Collective Action on Directed Communication Networks: Models and Experimental Findings

Introduction

Social media helps protesters organize and reach a critical participation mass (1); • In repressive regimes, a single protestor risks prosecution and violence, but can mitigate risk if many others coordinate action.

Coordination requires that people know about each other and that this information is common knowledge (CK) (2).

Common knowledge refers to an infinite string of embedded levels of knowledge: If I want to participate, but I don’t know whether you know it, then I don’t participate. This is because I don’t expect you to participate without sufficient information (that I want to participate if you do). One Egyptian says, "facebook used to set the date, twitter used to share logistics, youtube to show the world, all to connect people" #jan25

Social networks facilitate information sharing that generates common knowledge within groups. We use models of Facebook and Twitter-type communication networks to understand how information can spread locally and facilitate common knowledge and collective action.

Previous Theoretic Models

Chwe & Korkmaz et al. provide game-theoretic models of collective action on bidirectional communication networks. Both models have the following features:

Incomplete information coordination game with heterogeneous agents with private thresholds (willings to participate).

Knowledge of what other players know about other players is crucial for coordination. Agents choose to stay home or participate. Communication networks facilitate coordination through common knowledge creation.

The models differ on the following features:

Feature | Chwe & | Korkmaz et al.
---|---|---
Communication Type | Directed (unreciprocated) | Directed (unreciprocated)
Network Knowledge | Globally Known | Locally Known
Minimal Substructure | Cliques | Complete Bipartite Graphs

Research Questions

1. What are the characteristics of directed network structures that generate CK of thresholds among a group of agents when the network structure is globally and locally known? What are the minimal substructures required for CK to occur?

2. Do our theoretic predictions hold in experimental data?

Network Assumptions

Facebook

A link from i to j indicates that i writes her threshold on the J's wall. We say that i is a friend of j if there is a link from i to j or k to j. All J's friends can see 1) J's threshold, and 2) that J writes on the wall of i.

Twitter

A link from i to j indicates that J follows I and thus that J views the threshold of i. Additionally, we assume that j retweets the threshold of i.

Thus, if a follows j, j knows the thresholds of i, and that j observes the threshold of i.

Theoretic Findings

Globally Known Structure

Agents know each others' thresholds either (1) directly or (2) through the wall of a friend.

Locally Known Structure

Agents know each others' thresholds either (1) directly or (2) through the wall of a friend, and (3) all agents must observe the communication between all other agents. Each agent has at least one outgoing link and all agents are neighbors.

Network Information

Facebook

No named graph sub family, but includes (1) maximal, reciprocal distance-2 paths between agents and (2) complete bipartite graph with cyclic partitions in the form of 10-300C and 12-1200C.

Twitter

Reciprocal, maximal paths of distance-2.

Minimal Substructures

Globally Known Structure

- Cliques

Locally Known Structure

- Star

Communication network - 1 communication

Testing Global Network Knowledge Model

Outcome: Participation decision where players are rewarded only if a sufficient number of others in the group participate.

Key takeaways:

1. The conditions for CK are less restrictive for Facebook wall posting communication than in Twitter-retweet communication.

2. We find higher participation when our theoretic conditions are satisfied in the experimental setting.

Next steps

Use real network data to understand the dynamics of our models in larger complex networks, model additional Twitter functions, conduct experiments on Twitter-type networks, open form messaging, and repeated games where individual perceptions of each player are based on previous outcome.

Feature | No Message | FB Wall Message | No Message | FB Wall Message
---|---|---|---|---
Thom. 1 Cond. Not Satisfied | 0 | 0 | 0 | 0
Thom. 1 Cond. Satisfied | 0 | 0 | 0 | 0
Thom. 2 Cond. Not Satisfied | 0 | 0 | 0 | 0
Thom. 2 Cond. Satisfied | 0 | 0 | 0 | 0

Experimental Results

Testing Local Network Knowledge Model

Outcome: Participation decision where players are rewarded only if a sufficient number of others in the group participate.

Key takeaways:

1. The conditions for CK are less restrictive for Facebook wall posting communication than in Twitter-retweet communication.

2. We find higher participation when our theoretic conditions are satisfied in the experimental setting.

Next steps

Use real network data to understand the dynamics of our models in larger complex networks, model additional Twitter functions, conduct experiments on Twitter-type networks, open form messaging, and repeated games where individual perceptions of each player are based on previous outcome.

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Intervention

Facebook

Twitter

Experimental Design

Completely randomized crossover design with a two-way treatment structure.

Between-session conditions (8 sessions): • Messaging condition: none, wall. • Network information: local, global. Within-session conditions (15 runs): • Threshold: low-1, high-3. • Network structure: star, circle, clique.

Group: 5 players in a network structure (120 subjects).

Discussion

Social and Decision Analytics Division

BIOCOMPXICITY INSTITUTE

Using the Facebook Wall Platform to Conduct Experiments on Social Networks