Statistical Models of Collective Social Network Behavior

Elisabeth Baseman, David Jensen
UMass Amherst

Michael Kearns, Stephen Judd
UPenn

Motivation

- Social networks are heterogeneous and dynamic
- Social computation techniques provide controlled experiments on social networks
- **Goal 1:** Cluster actors in a social network by identifying similar behavior
- **Goal 2:** Predict collective network behavior based on network structure

Social Computation Data

- Experiments at UPenn challenge participants to perform graph computations
- Participants can only see their immediate neighbors
- Tasks are either to color the graph, or to come to a consensus in limited time

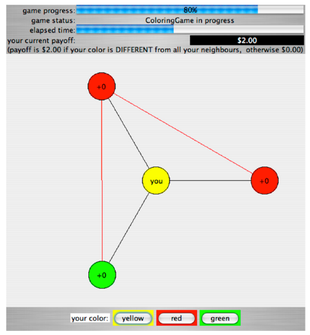


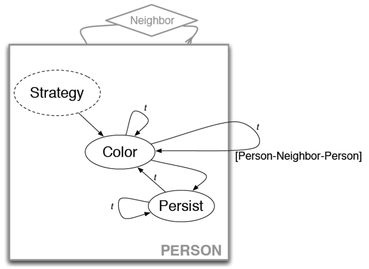
Figure from S. Judd *et al,* 2010.

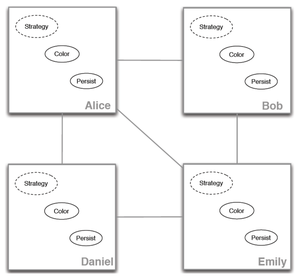
- 36 participants in varied network structures
- Static network structure for each experiment
- Both tasks are usually successful, with some consensus experiments failing

Figure from S. Judd *et al,* 2010.

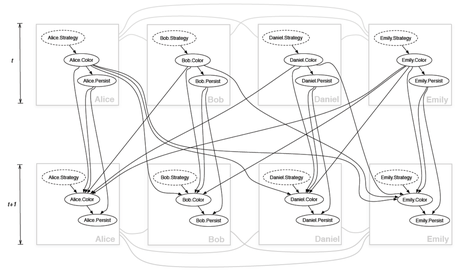
Relational Approach

- Participants' actions are dependent on their neighbors in the network
- Start by designing a model template for individual behavior



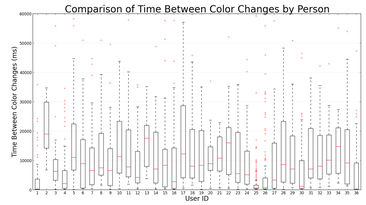


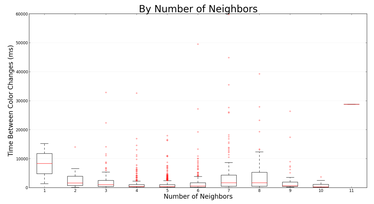
- Create relational skeleton from the experiment's network structure and location of individuals within the network
- Combine model and skeleton to build a dynamic Bayesian network
- Model participants' action strategies as a latent variable



Exploratory Analysis

- Detect “signaling” strategy by frequency of changes
- Compare behavior based on person to behavior based on network neighborhood



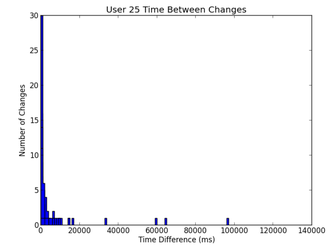


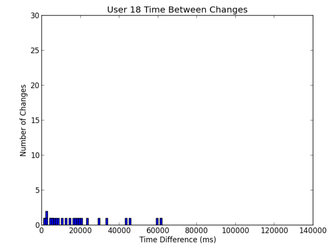
Summary

- Data from social computation experiments provides a unique opportunity to model social network behavior
- Individuals within a social network exhibit different behavioral strategies
- We can attempt to account for interactions within a social network using a relational approach

Continuing Work

- Identify more subtle differences between behaviors using individual or network neighborhood distributions:





- Consider other extracted features, such as whether or not individuals choose to change to majority color
- Consider other characterizations of strategies, such as individuals' conflict tolerance
- Design evaluation criteria for prediction of collective and individual behavior

Selected References

- S. Judd, M. Kearns, and Y. Vorobeychik. Behavioral dynamics and influence in networked coloring and consensus. PNAS 107(34):14978-14982, 2010.
- Michael Kearns. Experiments in social computation. Commun. ACM, 55(10):56-57, October 2012.
- J. Neville and D. Jensen. Relational dependency networks. JMLR, 8:653-692, 2007.