

Modeling Information Processing within Social Networks: Understanding the Persistence of Contrarian Health Beliefs

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Overview

- Research motivation
- Study context
- Model design
- Experimental results
- Model extensions
- Conclusions

Problem Statement

- Opinion polarization is influenced by social networks
- Trust and confirmation bias mediate community members' acceptance (and retention) of information from sources aligned with majority, minority, and neutral/scientific positions
- Misinformation campaigns threaten the well-being of society in terms of public health, environmental sustainability, and representative democracy

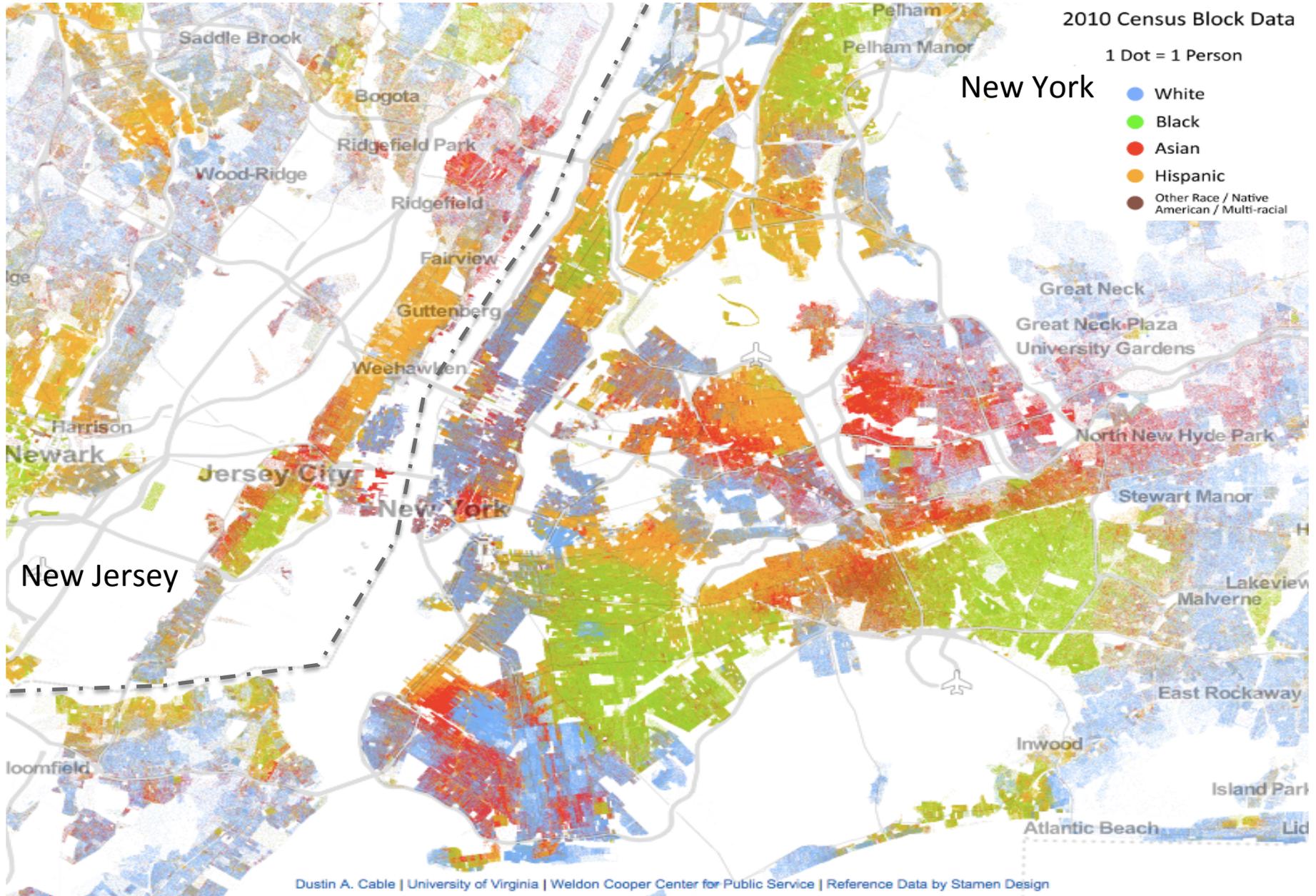
Research Motivation

- Opinion polarization influenced by social networks
- Trust and confirmation bias mediate community members' acceptance and retention of information aligned with majority, minority, and neutral (scientific, governmental) positions
- Misinformation campaigns threaten the well-being of society in terms of public health, environmental sustainability, and representative democracy

Study Context

- Chinese American residents of New York City
 - public health intervention to promote oral health for low-income community members through preventive screening and educational outreach events held at community centers
 - adoption of care-seeking behaviors such as brushing with fluoride and visiting dental providers regularly for preventive care
 - cultural considerations around awareness of and attitudes toward dental care

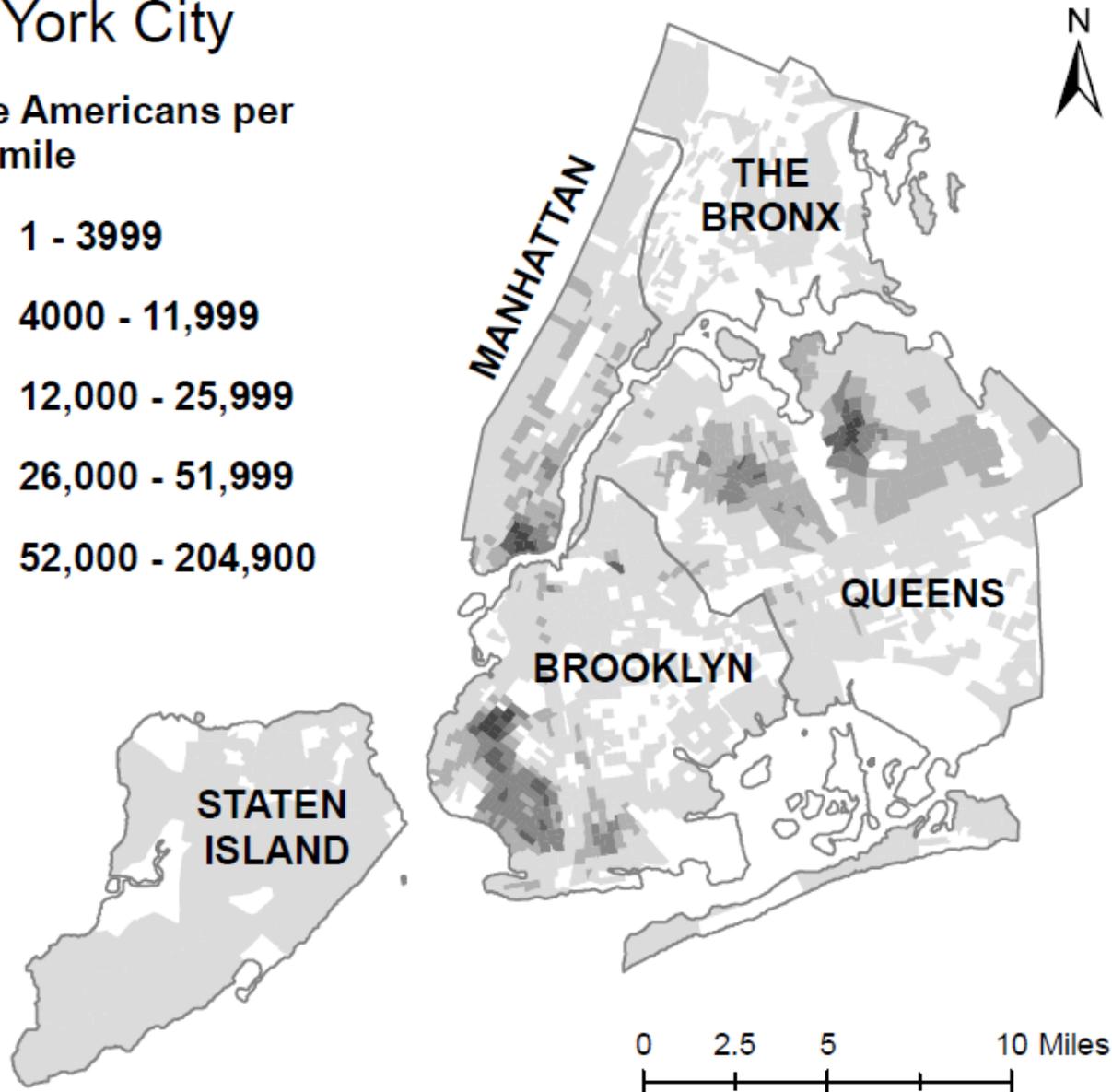
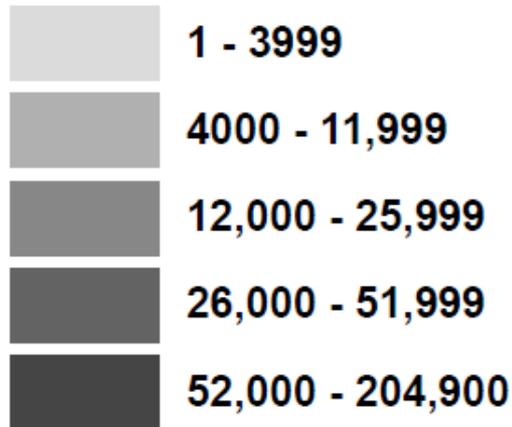
New York City Racial/Ethnic Diversity



Chinese American Population Density

New York City

Chinese Americans per square mile

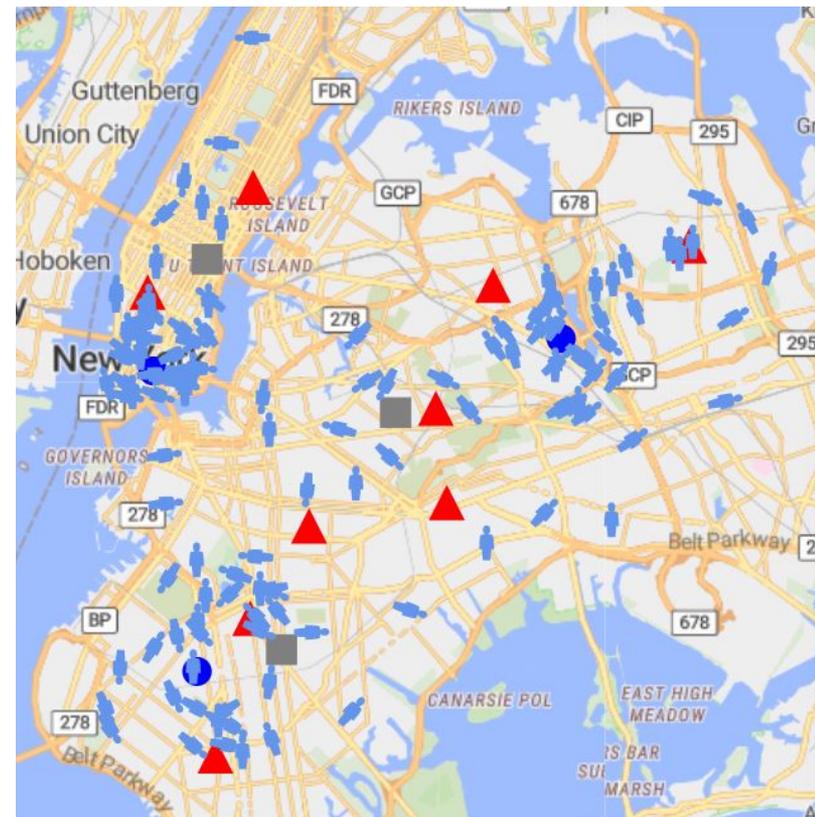


Model Design

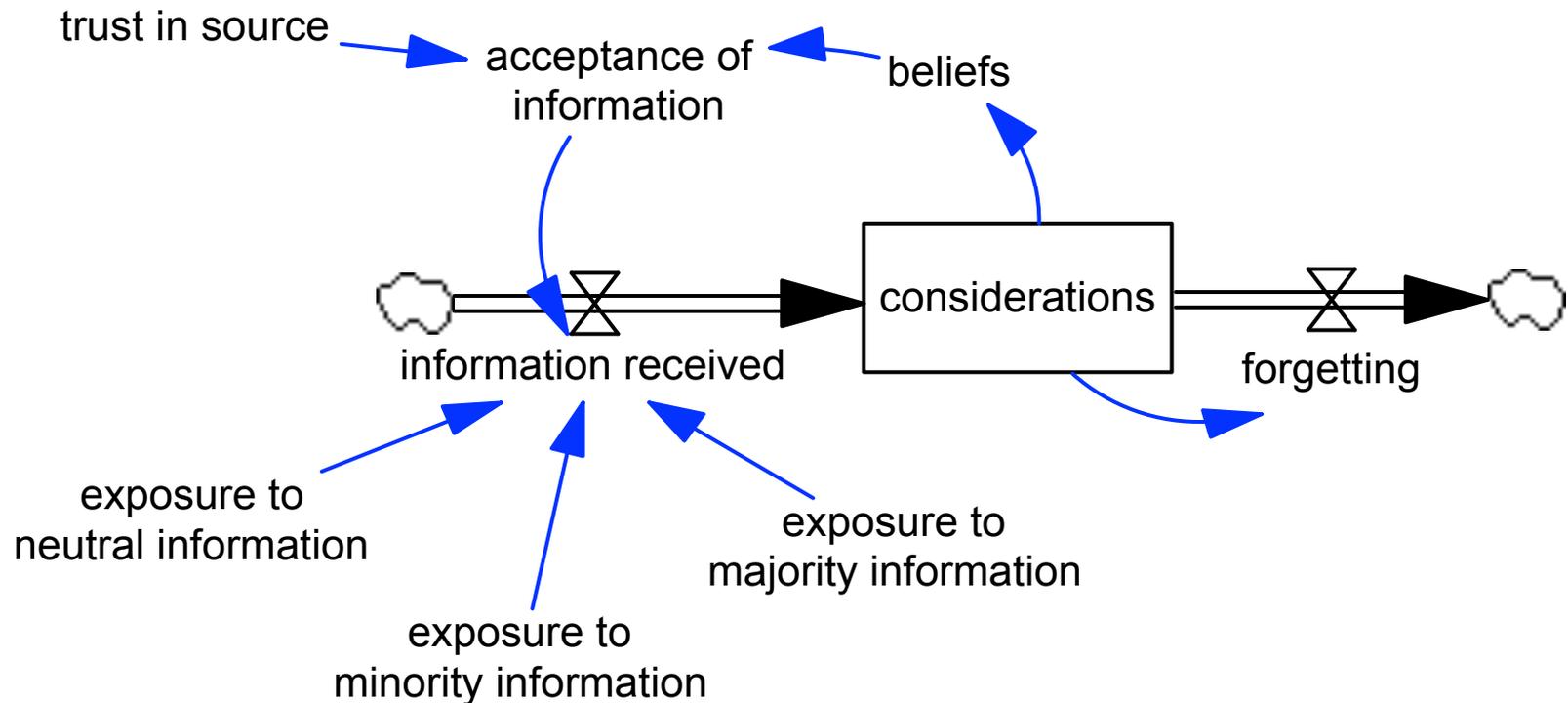
- Multiplicity of considerations in the receive-accept-sample model, suitable for agent-based modeling
- Agents:
 - community members with dynamic opinions
 - information sources with fixed opinions
- Urban environment as information landscape
 - minority, majority, and neutral sources
 - minority and majority community members
 - community members visit information sources (akin to outreach centers)

Agent-based Approach

- Agents:
 - mobile community members with dynamic opinions
 - stationary information sources with fixed opinions
- Urban environment as information landscape
 - minority (circle), majority (triangle), and neutral (square) sources
 - minority (people icons) and majority community members



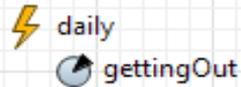
Intra-Agent Stock-Flow Mechanism



This conceptual stock-flow model shows the feedback loop confirmation bias. The stock of considerations would be implemented within each agent as an array by type: considerations of the majority position, considerations of the minority position, and considerations of the neutral position. An individual would then sample from those combined stocks to update their beliefs over time.

Person Agent Class Structure

- id
- ethnic_identity
- homeX
- homeY

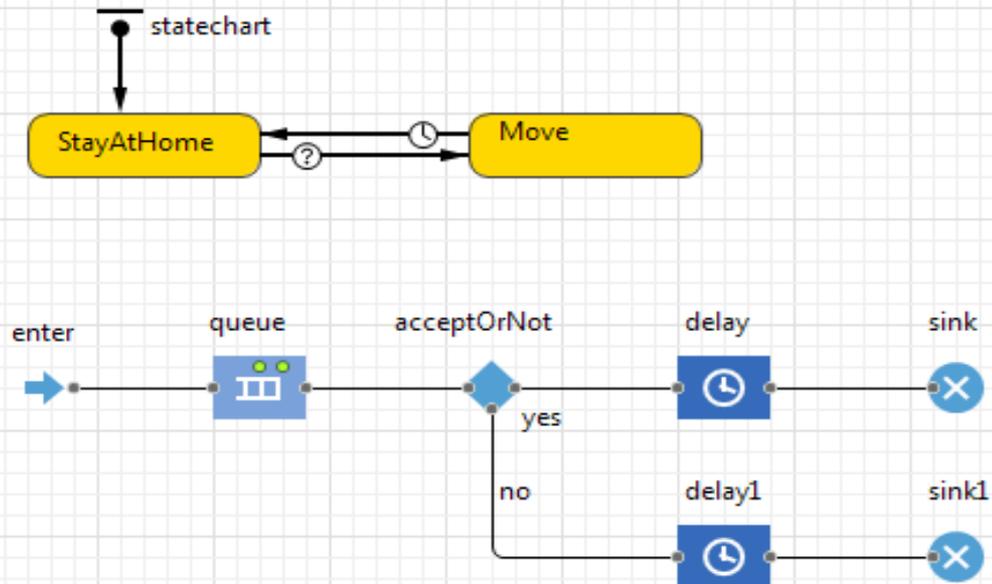


- dynamicDS
- chooseSourceLocation
- sourcesCollection
- sourceSelected
- info_Value
- info_Type
- accept_binary
- expose_count
- accept_count

- dynamicDS1
- makeDecision
- current_Opi_value
- trust_p
- income
- acceptCollection
- forgettingTimePerInfoUnit

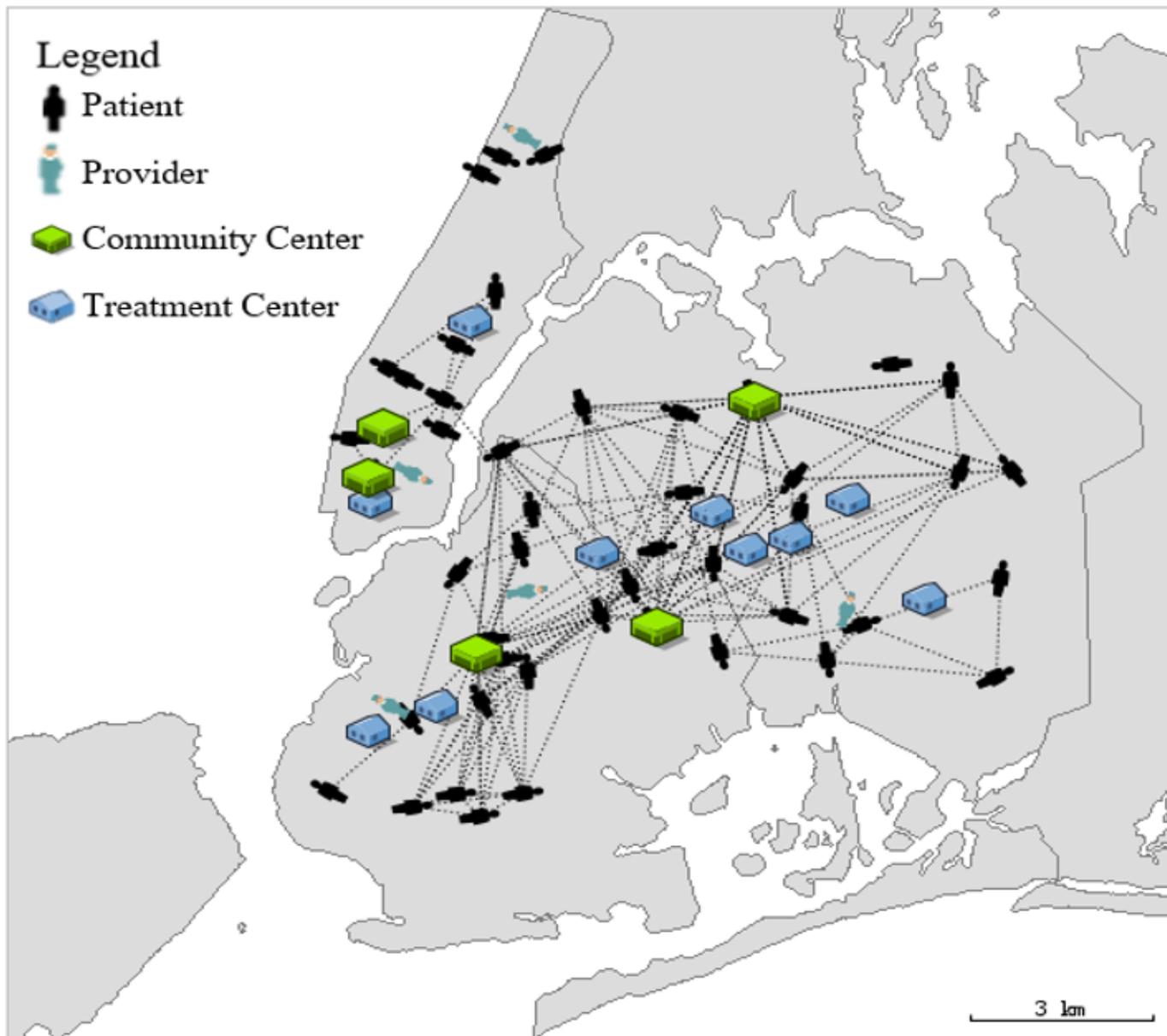
- dynamicDS2
- refershValue

location statechart



discrete event module for information retention

Agent-based Modeling with Networks



Model Visualization

Total Population = 500 Agents

- 125 Minority Agents (blue)
- 375 Majority Agents (not shown)



Total Population = 100 Agents

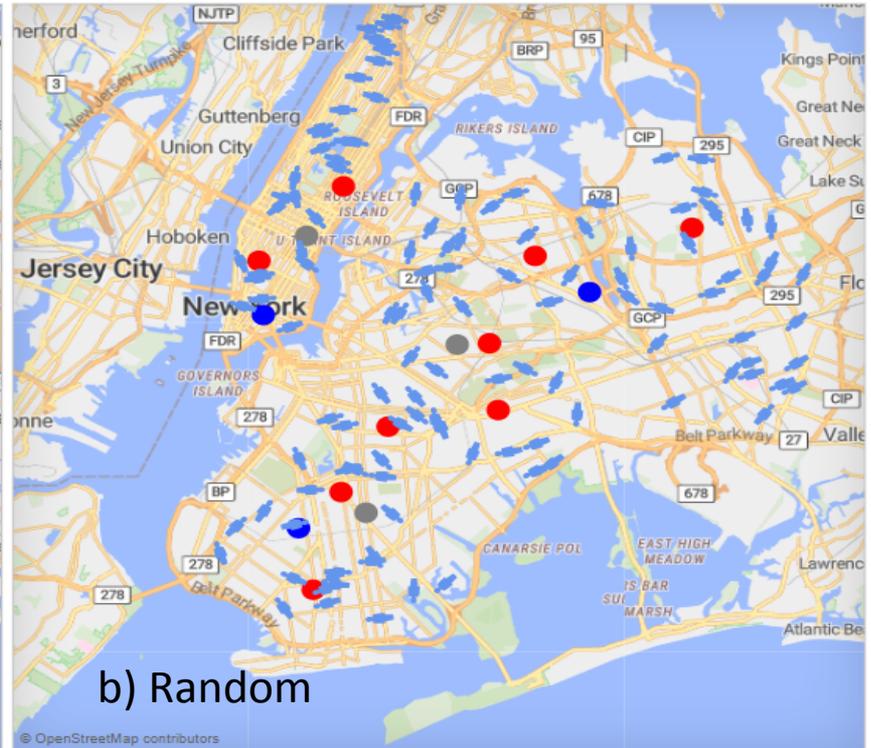
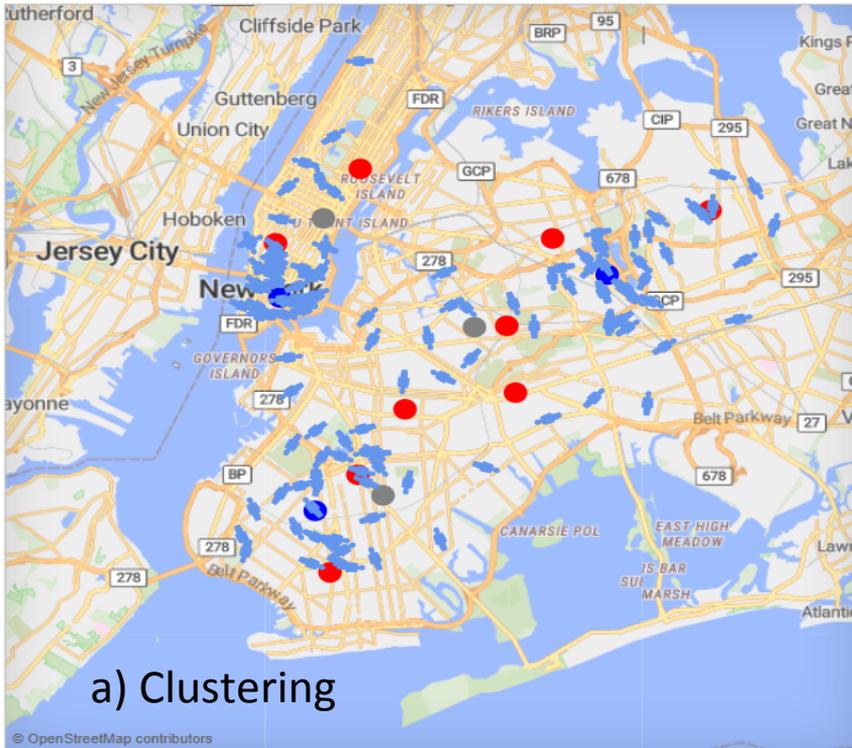
- 25 Minority Agents (blue)
- 75 Majority Agents (black)



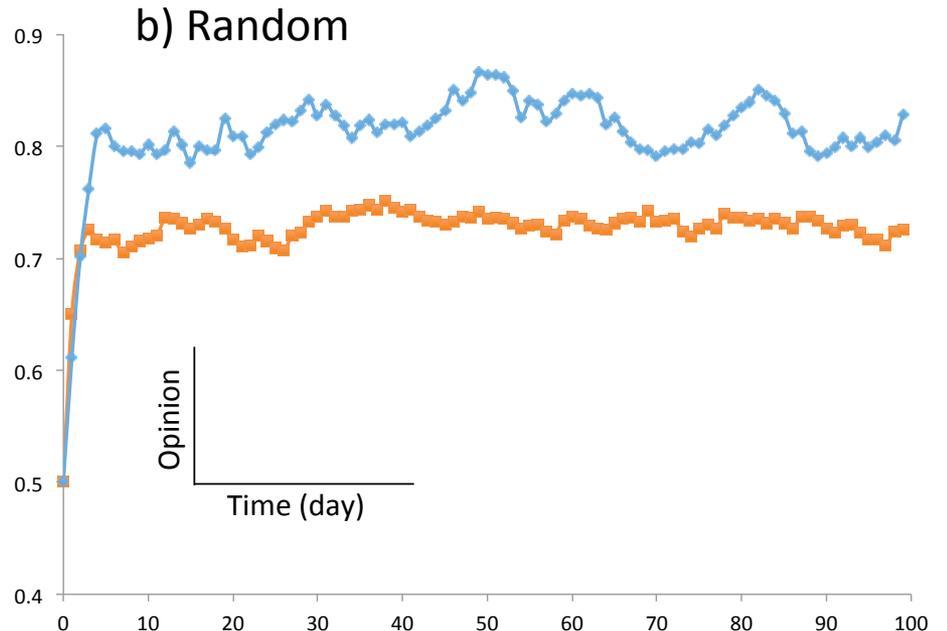
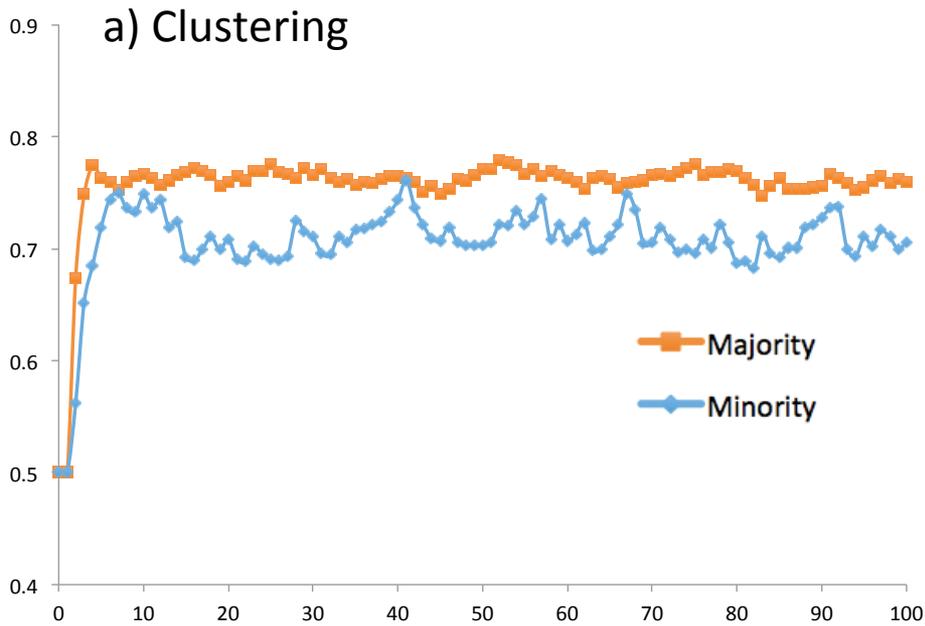
Experimental Design

- We compare results across the following scenarios where the probability of acceptance $P\{\}$ is as follows:
 - Scenario A: $P\{\text{in}\}=0.6$; $P\{\text{out}\}=0.6$
 - equivalent odds of acceptance regardless of source
 - Scenario B: $P\{\text{in}\}=0.75$; $P\{\text{out}\}=0.45$
 - greater odds of acceptance for in-group source than out-group source
 - Scenario C: $P\{\text{in}\}=0.9$; $P\{\text{out}\}=0.3$
 - Scenario D: $P\{\text{in}\}=0.95$; $P\{\text{out}\}=0.05$
- In all of these scenarios, $P\{\text{neu}\}=0.6$ and minority group size is 25% (125 out of 500 agents)

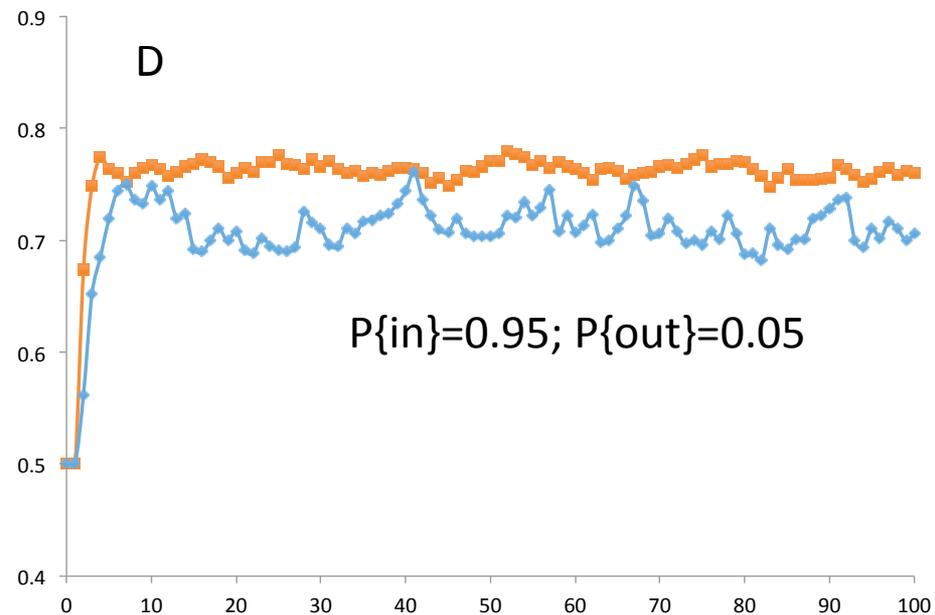
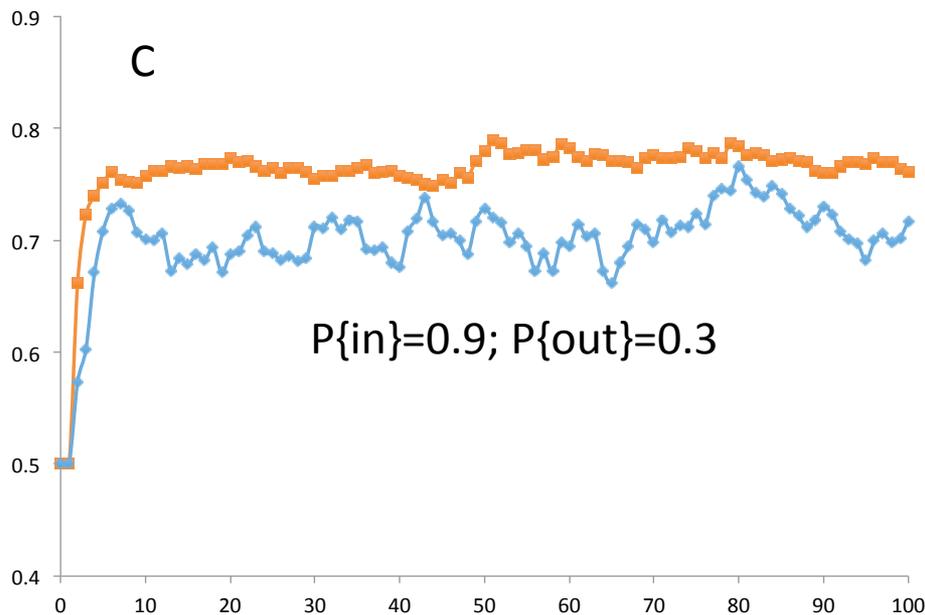
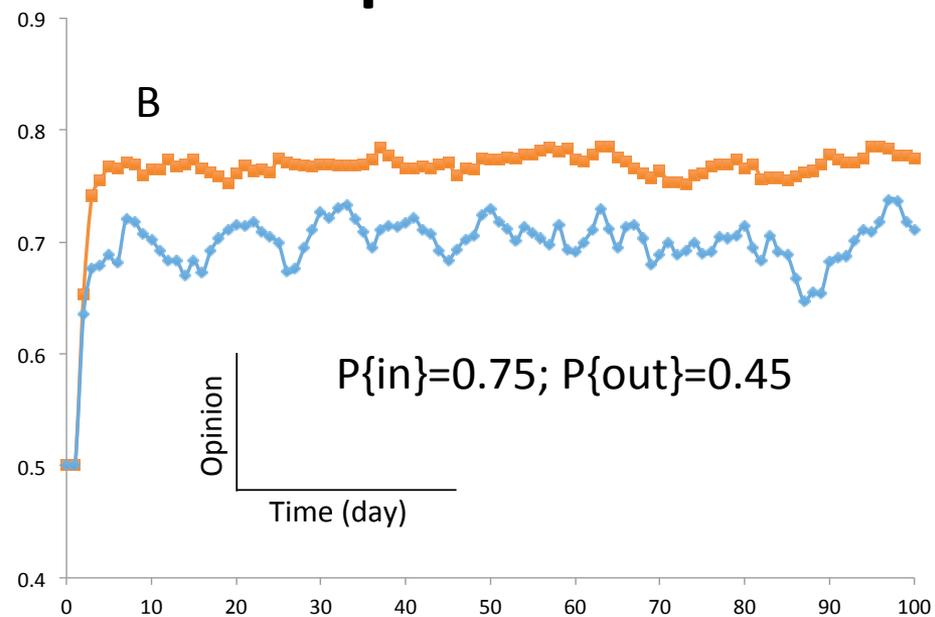
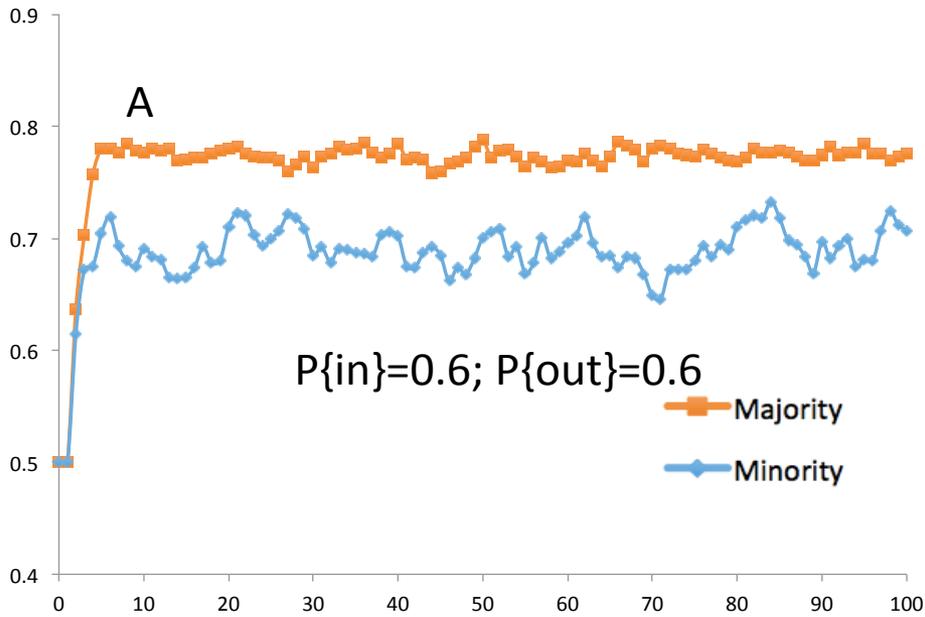
Clustering v. Random



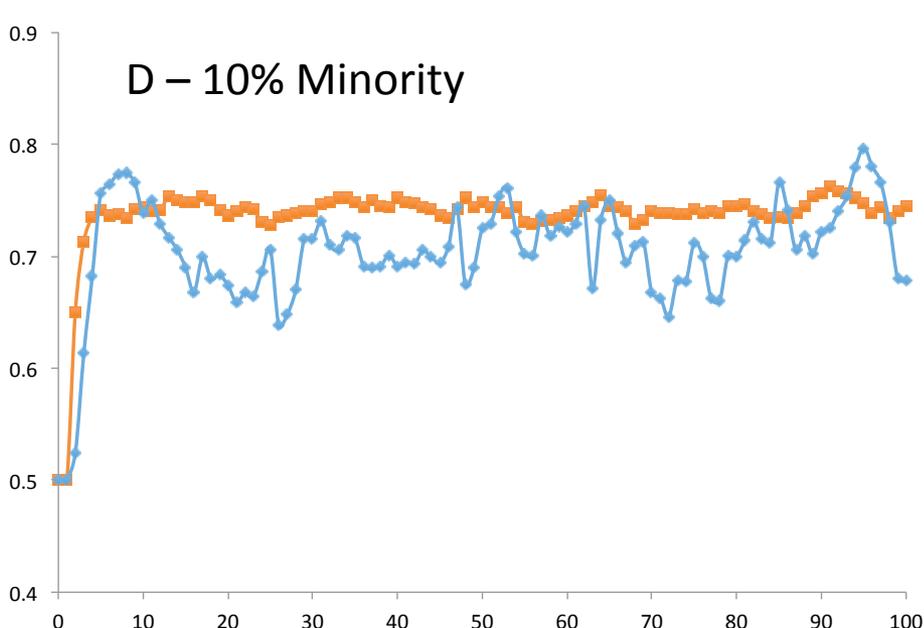
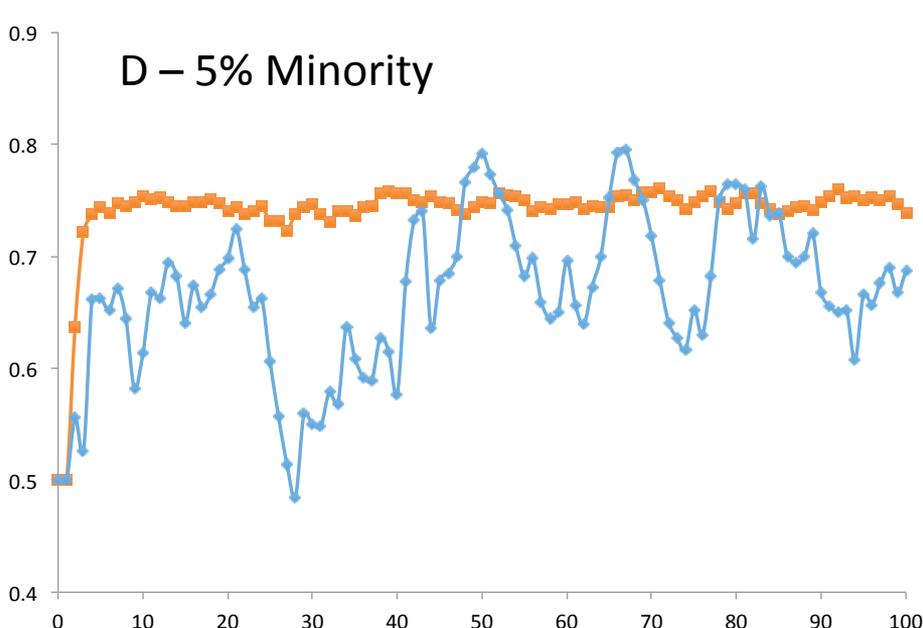
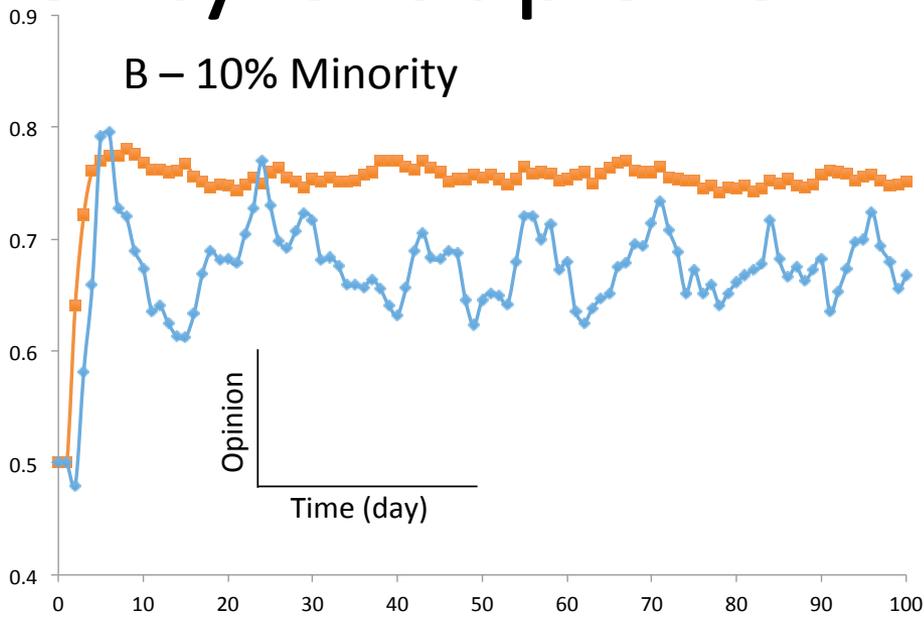
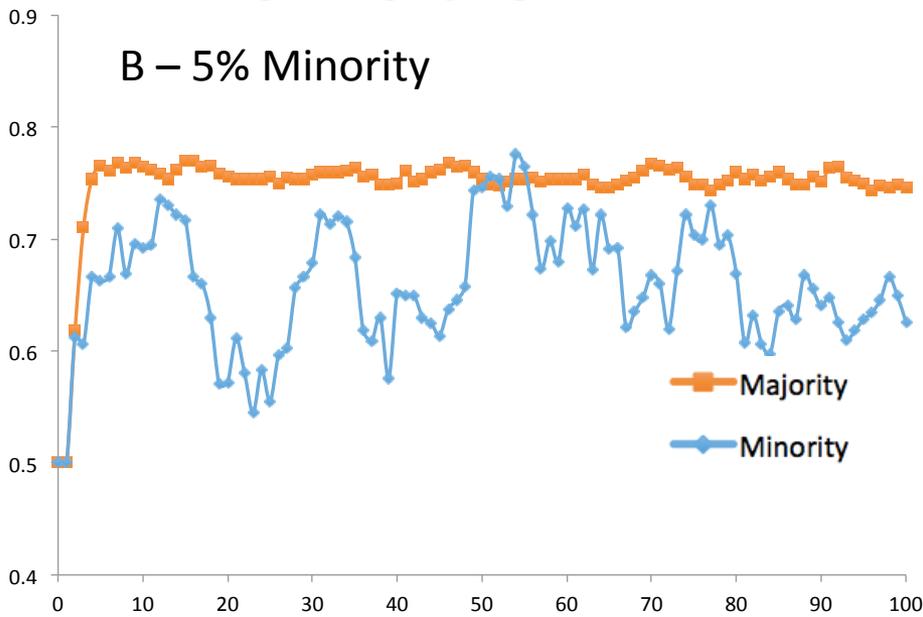
Clustering v. Random



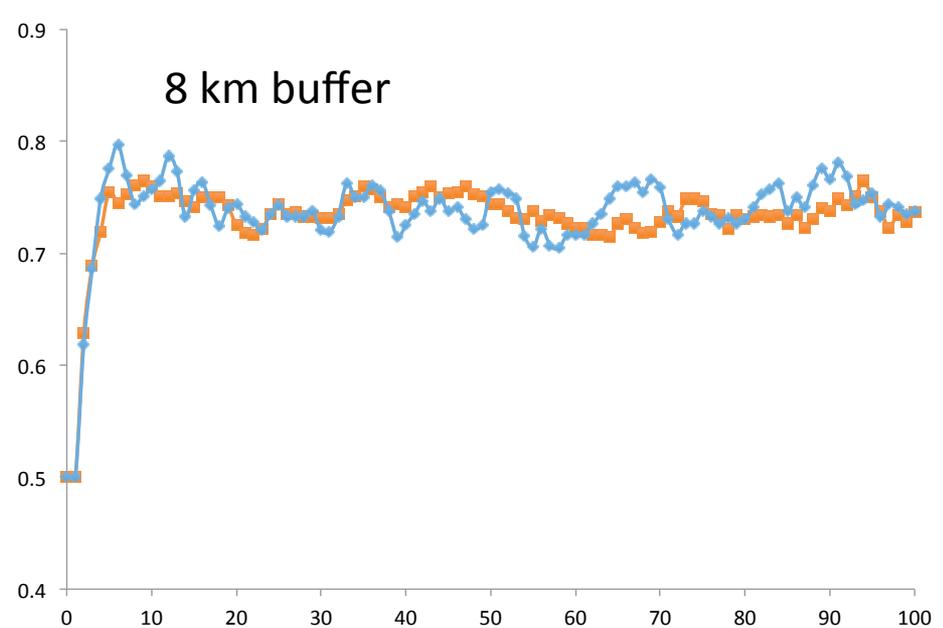
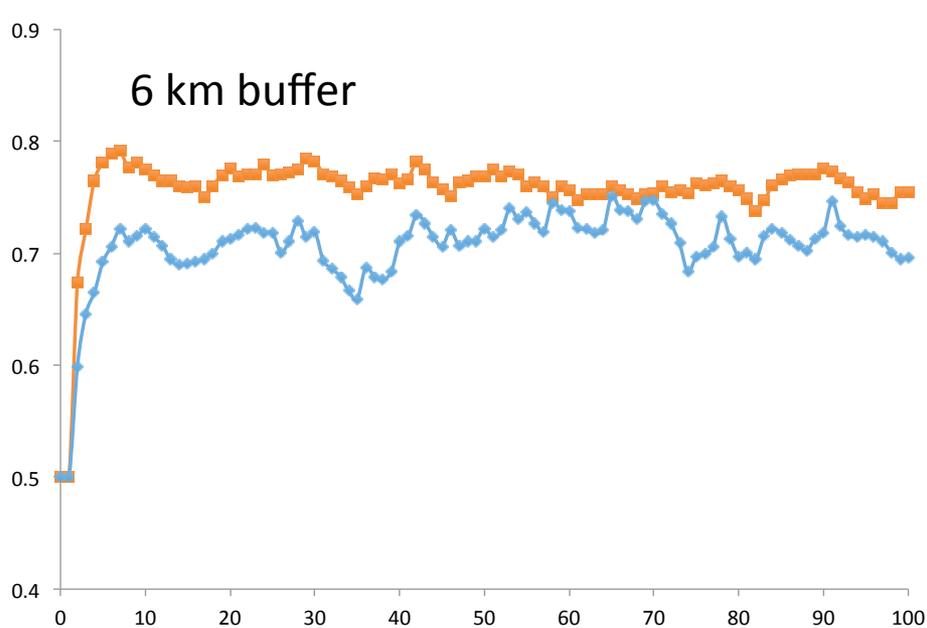
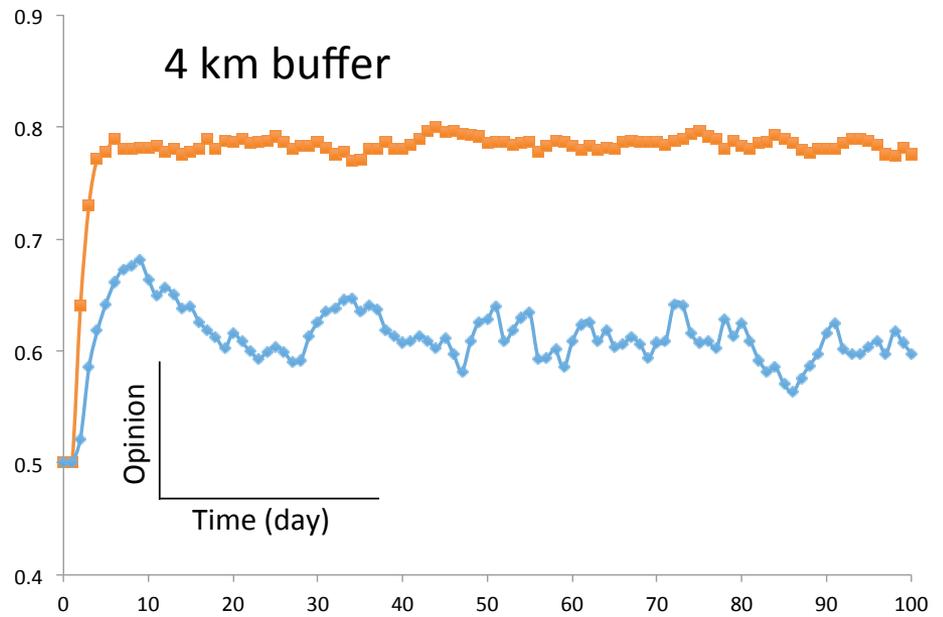
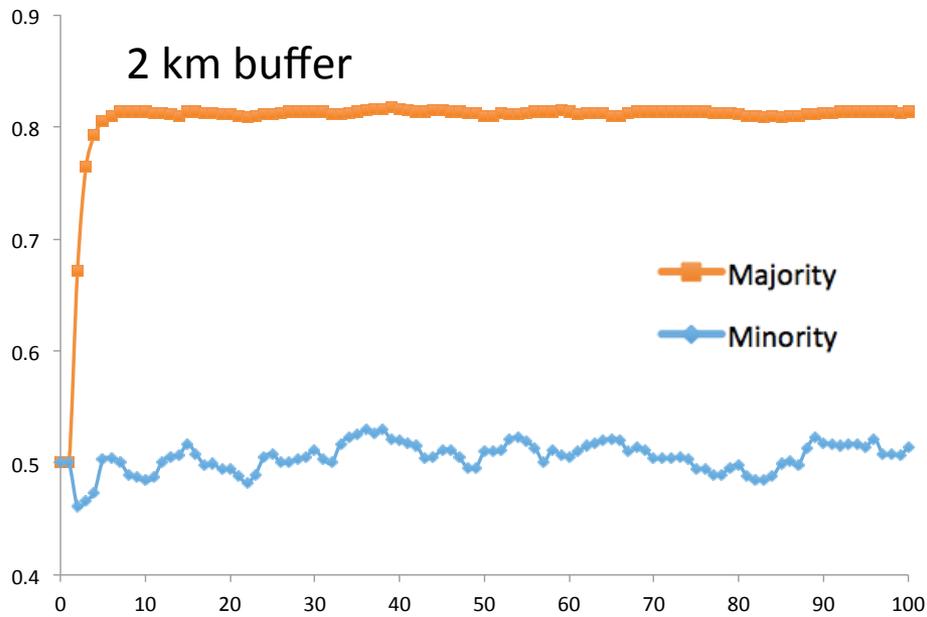
Variation of Belief Acceptance



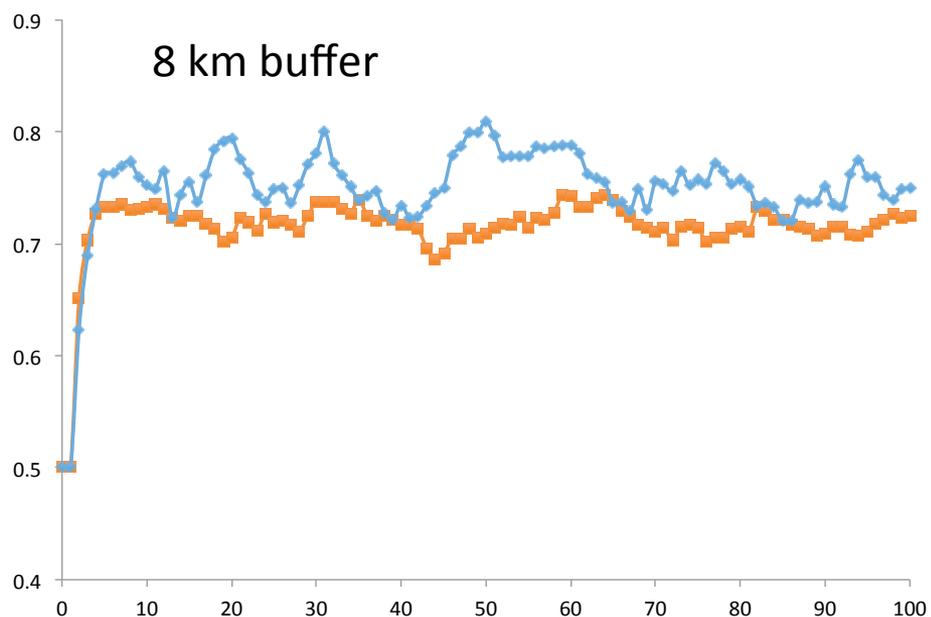
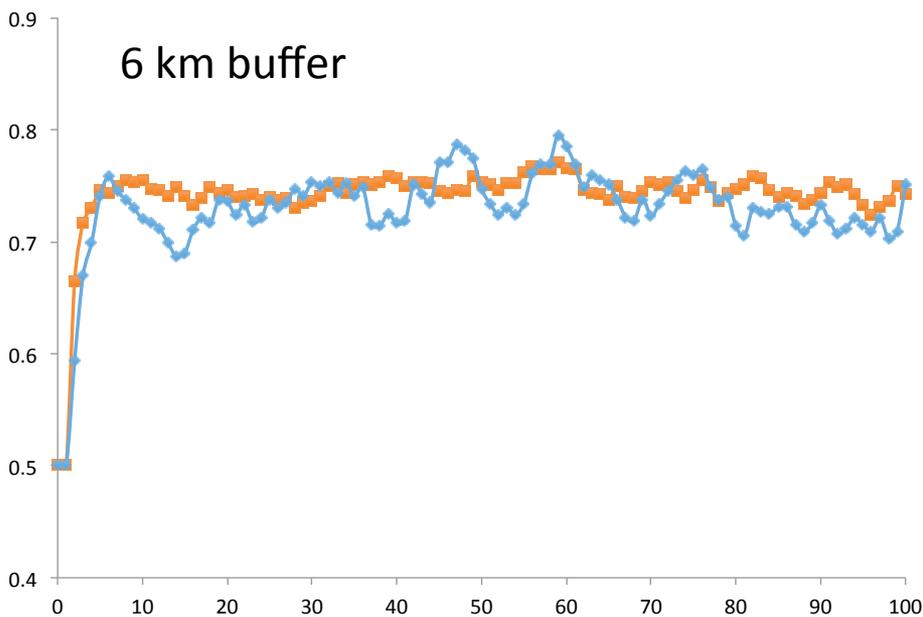
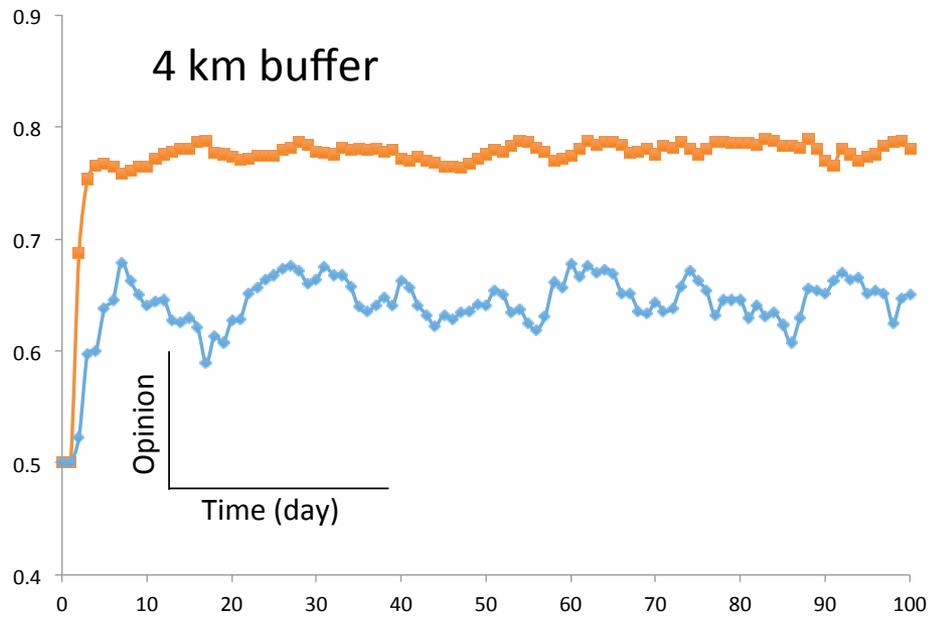
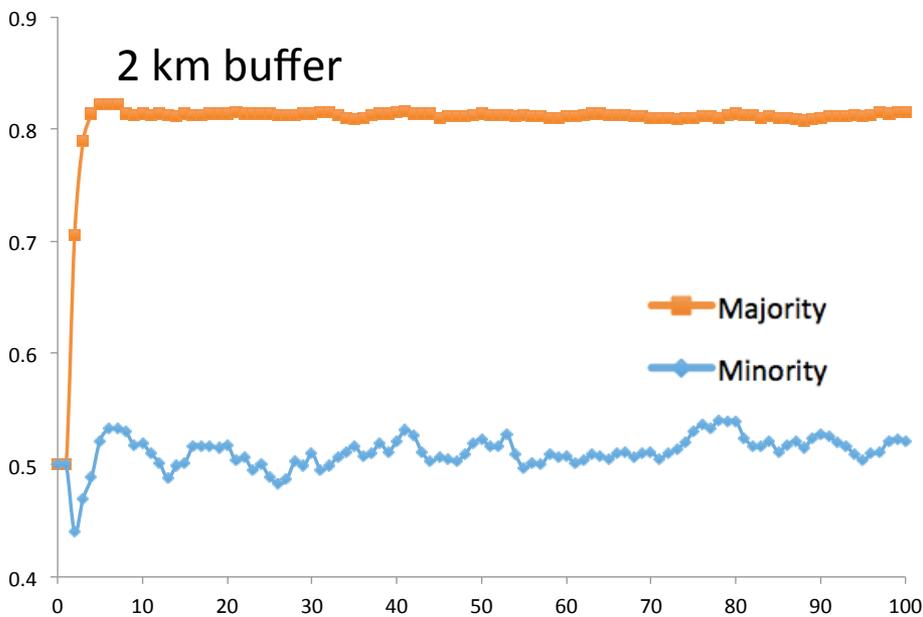
Variation in Minority Group Size



Scenario B

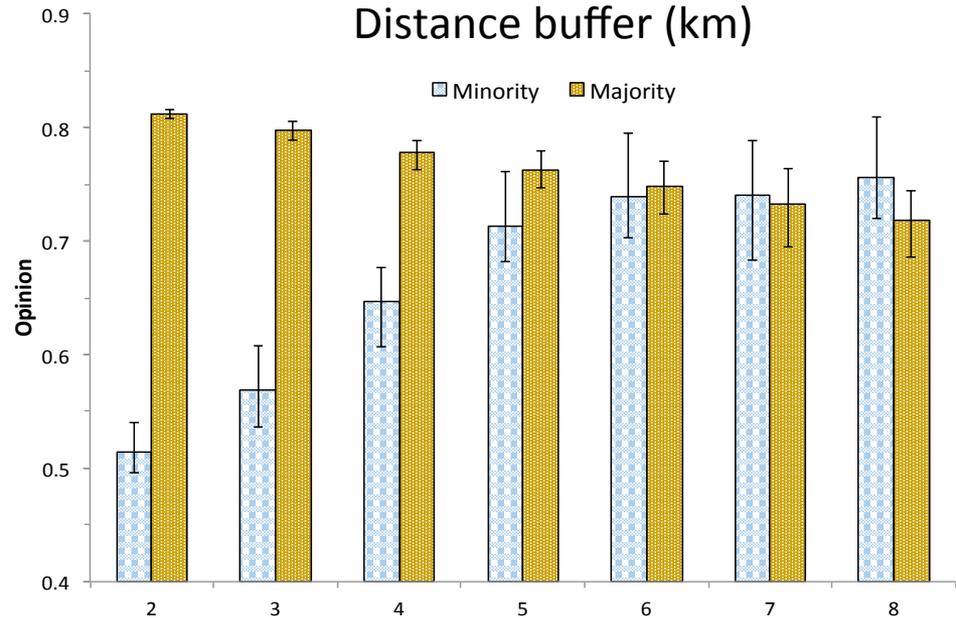


Scenario D

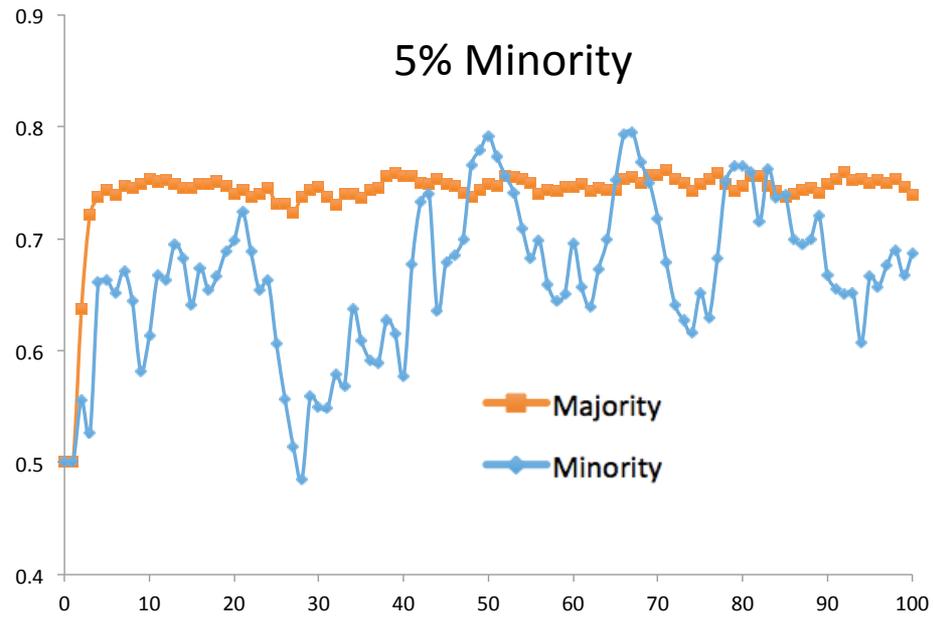


Results Summary

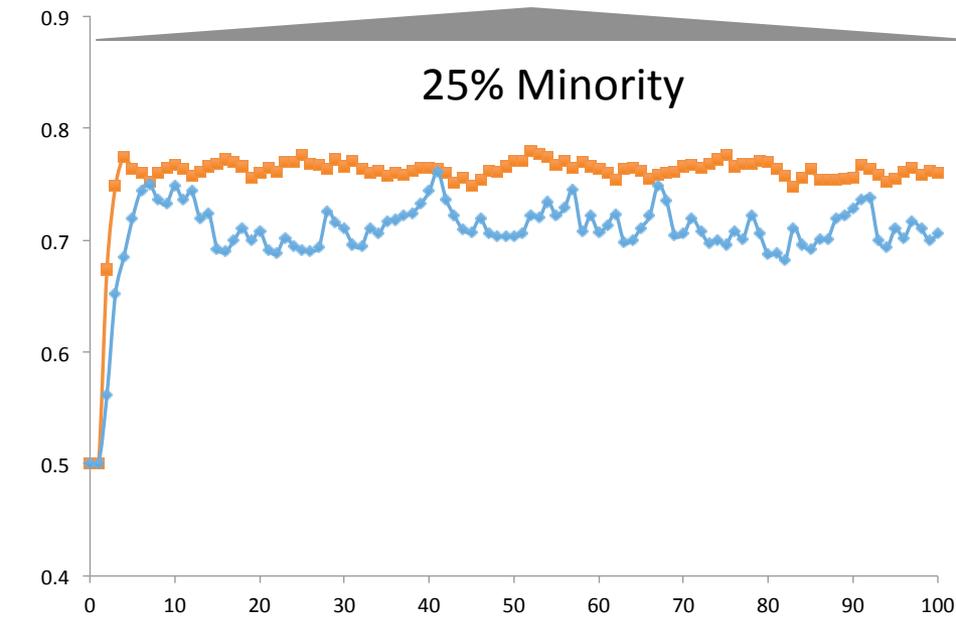
Distance buffer (km)



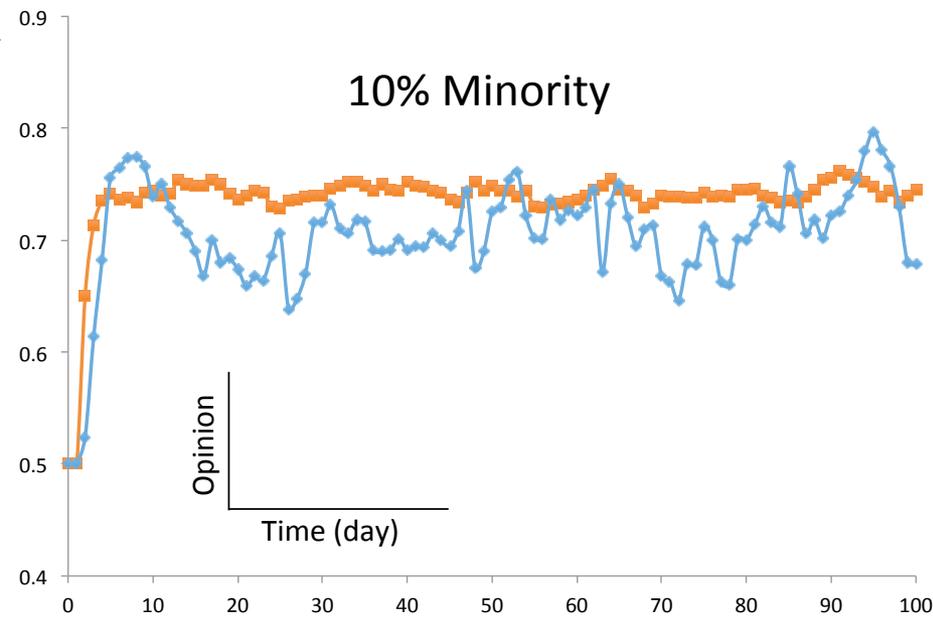
5% Minority



25% Minority



10% Minority



Results

- greater variation in opinion dynamics with smaller minority group size
- a small distance buffer produces majority-minority opinions closer to expectations but lacks the variability of a large distance buffer
 - relative significance of spatial contingency

Model Extensions

- explicating and testing feedback mechanisms
- modeling agent memory with stocks and flows
 - allow forgetting to be influenced by amount in memory
- social network influence
 - allow community members to become opinion leaders
- experimentation with information landscape
 - beyond fixed random location (variance, GIS)
 - overcome spatial contingency of results to date
- adjustment of algorithms
 - rules for selection of information source influenced by opinion group

Conclusions

- Certain parameter settings facilitate the emergence of oscillatory minority opinion cycles and a sensitivity to the prevalence of the minority group in the broader population.
- Variations in the probability of acceptance of opinions from conflicting identity sources reveal both convergent and divergent outcomes for minority and majority groups across a range of scenarios.

Thank you! Questions?

- Email: smetcalf@buffalo.edu
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