

Challenges and Opportunities for Modeling Violent Collective Action Computationally

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SDAL

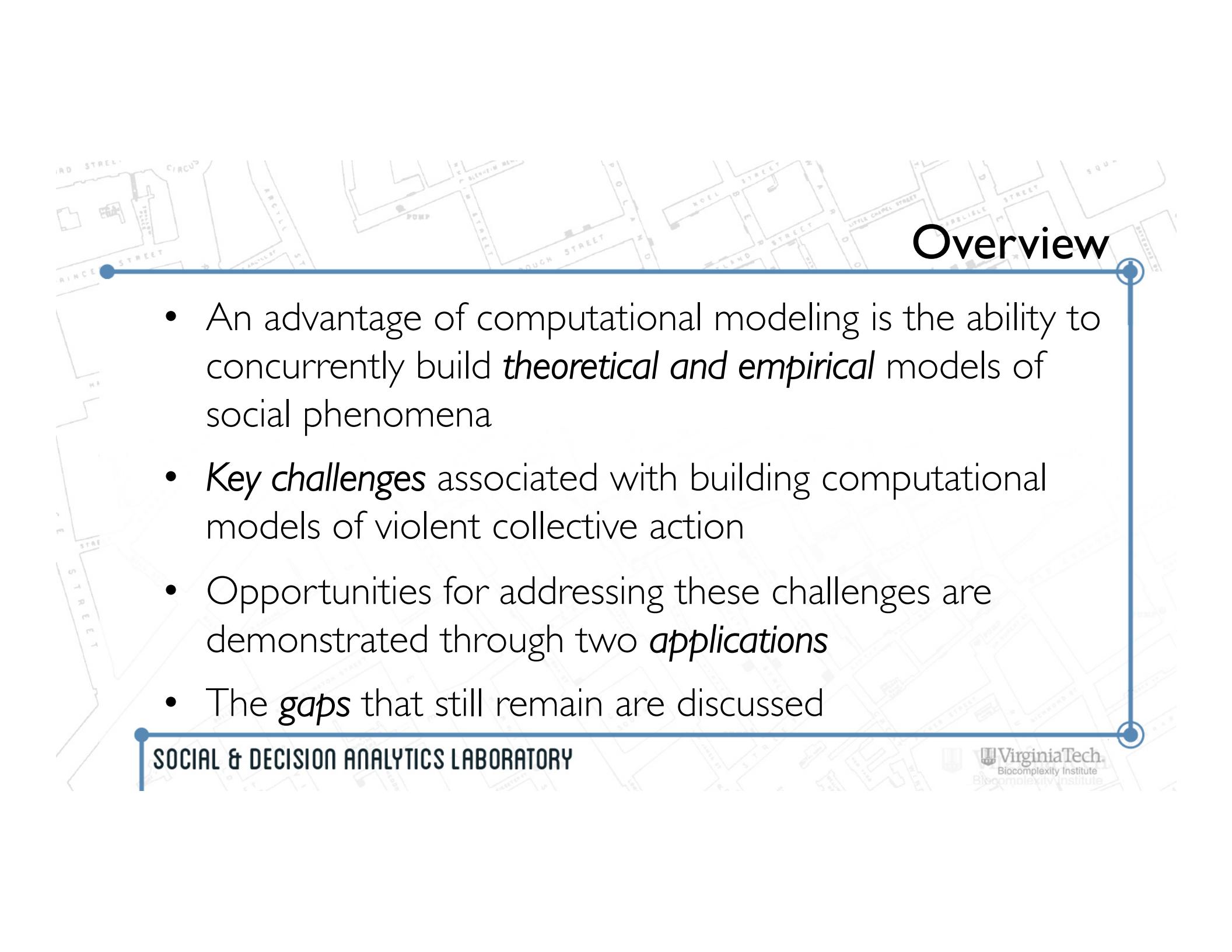
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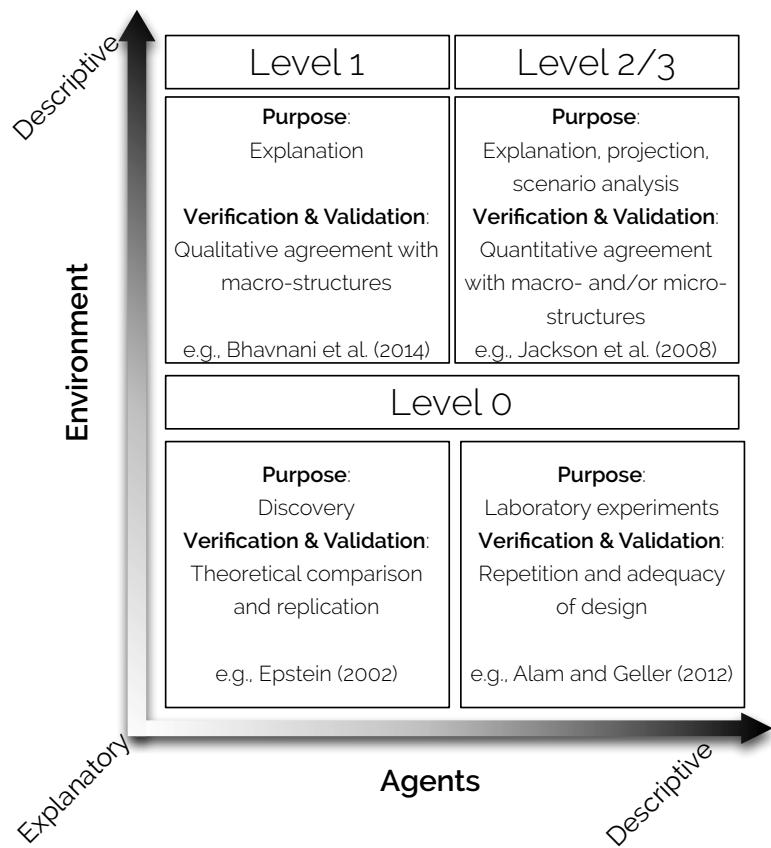
What is Violent Collective Action?

- Conflict relates to the *divergence* of interests; collective action relates to the *mobilization* of a group with common interests
- Violent collective action is a subfield of the broader conflict studies and collective action fields
- Violence can range from riots in a neighborhood to the civil war of a country



Overview

- An advantage of computational modeling is the ability to concurrently build *theoretical and empirical* models of social phenomena
- *Key challenges* associated with building computational models of violent collective action
- Opportunities for addressing these challenges are demonstrated through two *applications*
- The *gaps* that still remain are discussed



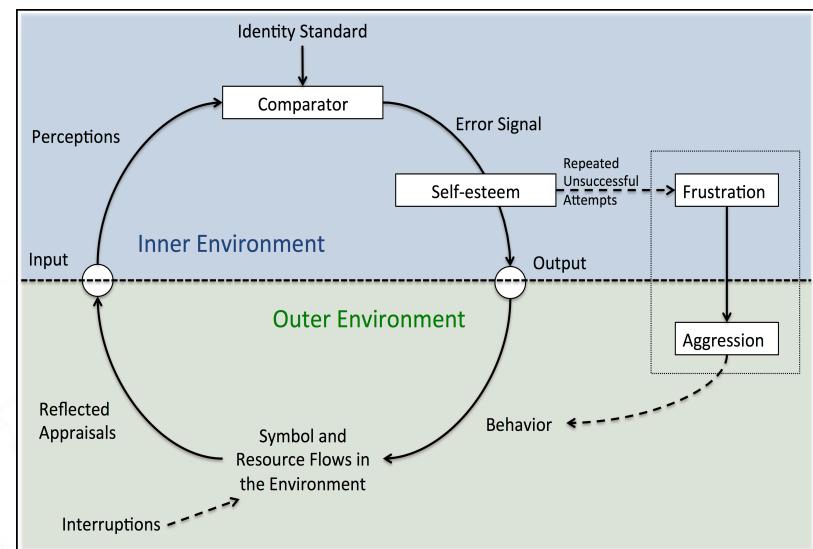
The explanatory-descriptive spectrum (adapted from Axtell and Epstein, 1994; Crooks and Castle, 2012; Parker et al., 2003).

Purpose of the Model

- ABMs can range from stylized models to fully calibrated models
 - Provide insights but difficult to evaluate against real world situations
 - Replicate real world phenomena but move away from theory exploration
- Purpose can vary from discovery to prediction
 - May be unclear until model is implemented
 - The model has to be built at the right level of detail to serve its purpose
- Data limitations may restrict purpose

Theory and Model

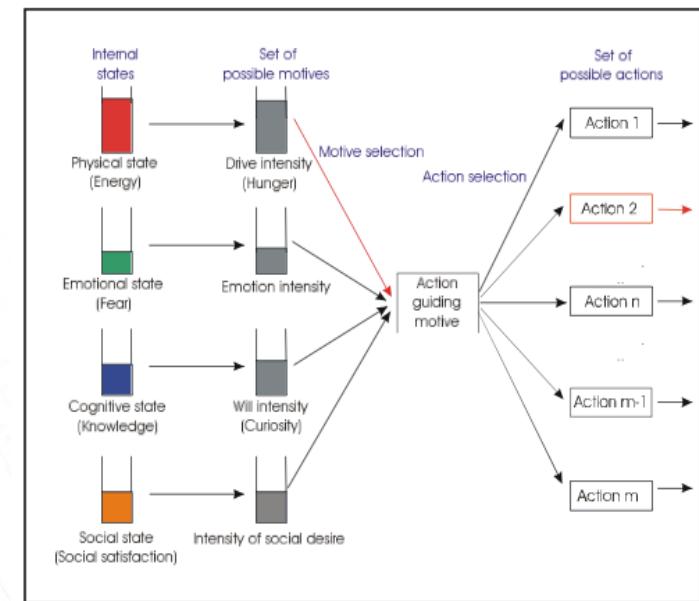
- There are many competing theories
- Relationship between theory and model
 - Test theory through “what if” scenarios
 - Apply theory in model development
- Theory is typically not designed for computer code
- Few ABMs have applied theory beyond threshold calculations



The identity model and the frustration-aggression hypothesis (adapted from Burke & Stets, 2009; Green, 2001) (Pires and Crooks, 2017).

Capturing Human Behavior and Relationships

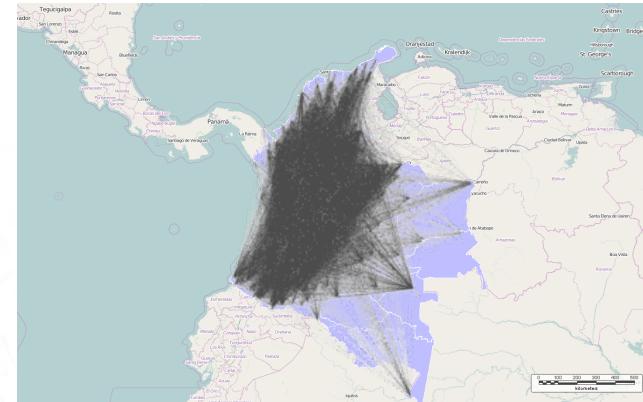
- Agent cognition is a simplification of human cognition
- Theory has suggested many factors impacting the decision to turn to violence
 - Conceptual frameworks can guide theory implementation
 - Social networks are important for diffusion processes, group identity, and social influence
- Implementation decisions still left to the modeler
- Computational resources may limit how much we can capture



The set of motives, motive selection, and the possible set of actions (source Schmidt, 2002).

Building Richer Models on Richer Data

- Conflict is “one of the messiest of all human activities to analyze”
 - Population and geographic data during conflict may not have been collected
 - Individual-level data on who rebelled and where is often not available
- Poses a challenge for model development, validation and calibration
 - Predictive and policy purposes
 - Showing that the model is representative of reality



The network of the Colombian conflict event data.

Generalizability

- Conflict theory stresses the importance of structural conditions in the emergence of violent collective action
- Creating one general model of conflict would not account for the unique demographic and environmental factors necessary
- Abstract models may not be enough for policy guidance
- Empirical data is a challenge and building ABMs is time and computationally intensive

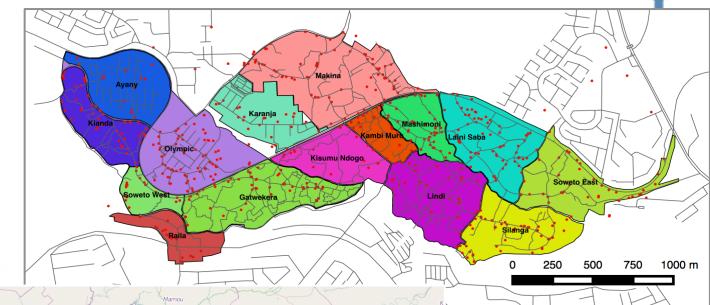
Applications

(1) The emergence of riots in an informal settlement (Pires and Crooks, 2017)

- Kibera houses approximately 235,000 residents
- Center of the post-election violence in Nairobi
- An ABM was integrated with SNA and GIS to explore the outbreak of riots

(2) The resource-driven civil war (Pires and Crooks, 2016)

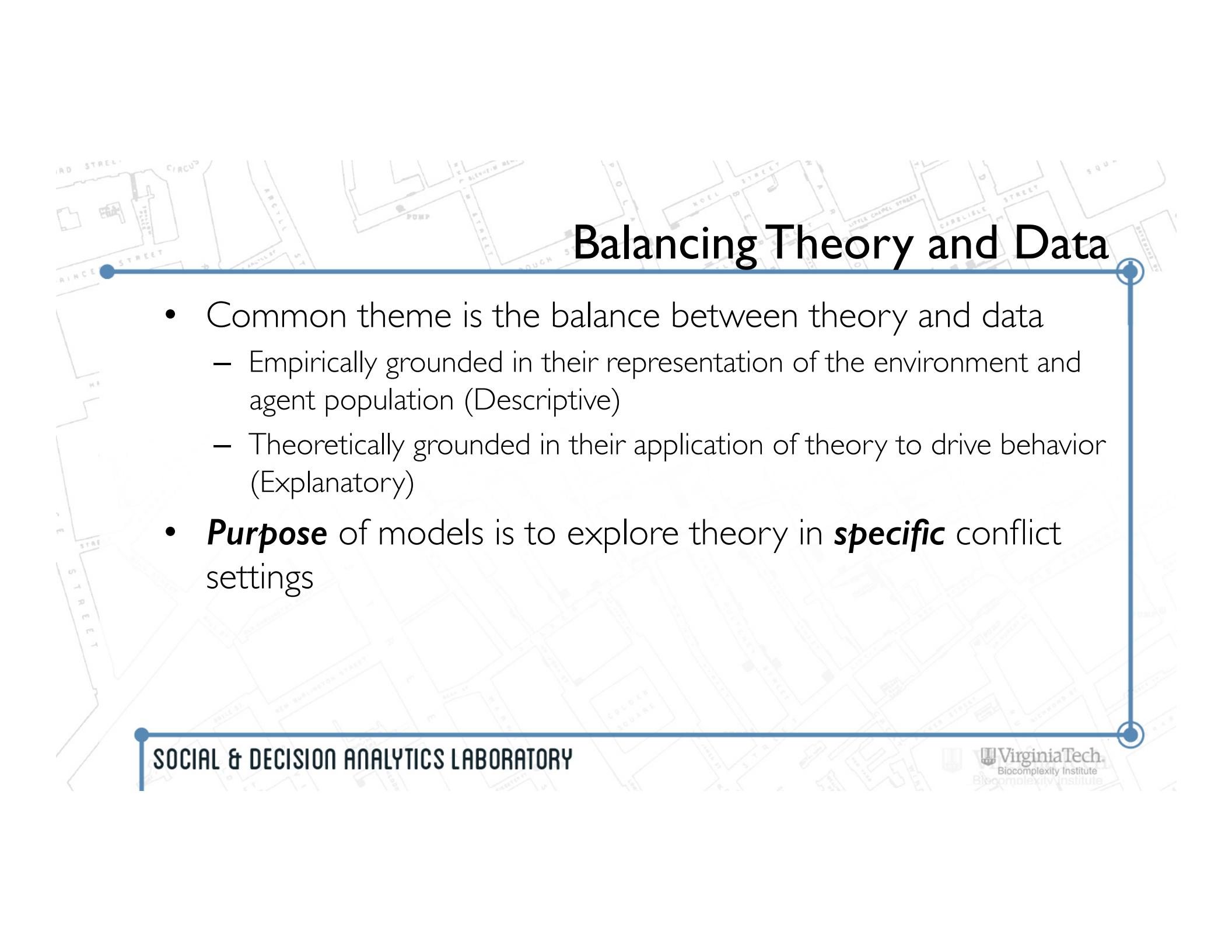
- Sierra Leone endured 10 years of civil war
- Endowed with an abundance of diamond resources
- Use ABM and GIS to explore Le Billon's (2001) theory about the spatial dispersion of a resource



Map of Kibera.



Map of Sierra Leone.

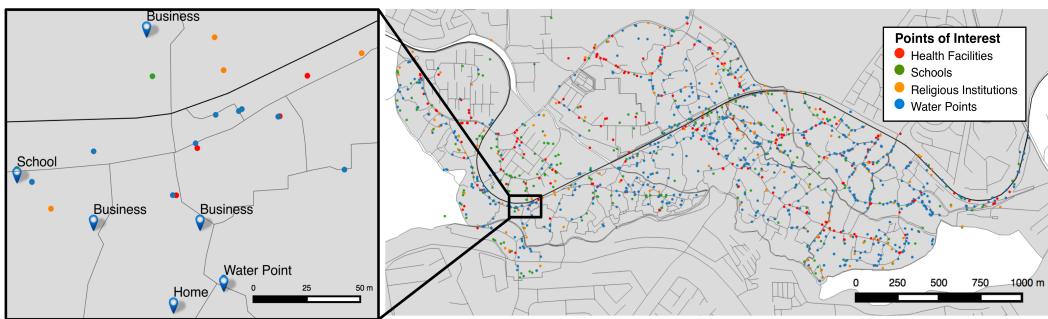


Balancing Theory and Data

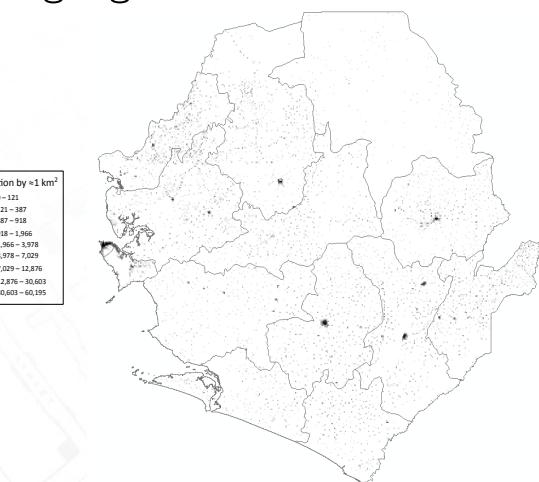
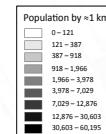
- Common theme is the balance between theory and data
 - Empirically grounded in their representation of the environment and agent population (Descriptive)
 - Theoretically grounded in their application of theory to drive behavior (Explanatory)
- **Purpose** of models is to explore theory in **specific** conflict settings

Empirically Grounded Environment and Population

- **Data** used to create the environment and population
 - Spatial data for transportation network, geocoded points of interest, etc.
 - Census of population including distributions on age, gender, and employment status
- ABM itself might help fill data gaps



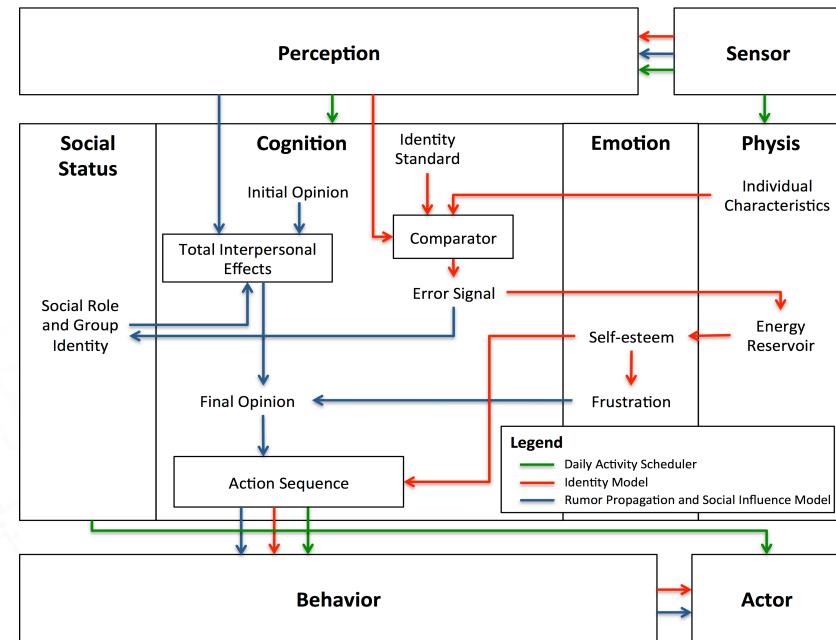
Points of interest and the activity locations of an example Household in Kibera.



Population raster surface of Sierra Leone.

Theoretically Grounded Behavior

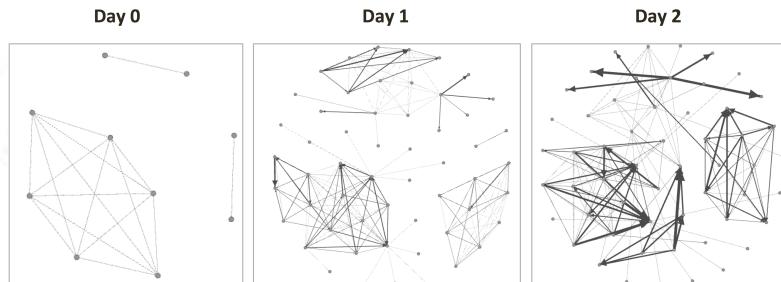
- A conceptual framework helped guide process of converting **theories** of **human behavior** to computer code
- **General** model for implementing agent behavior in settings of conflict



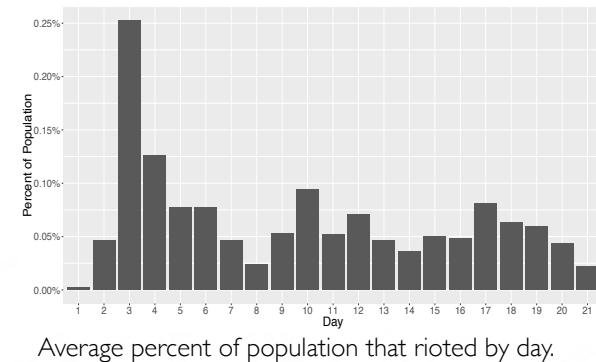
A high-level representation of an agent's behavior incorporated into the PECS framework (adapted from Schmidt, 2000).

Relationships/Social Networks

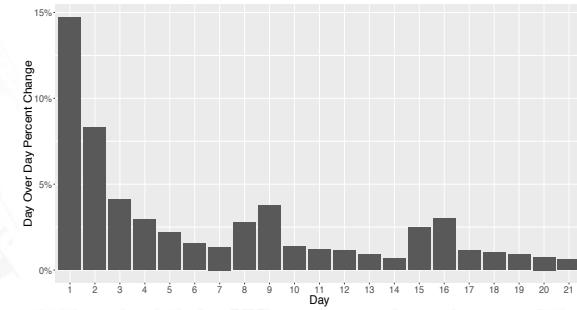
- Social networks allow us to capture and structure ***relationships***
- Created a situation of positive reinforcement resulting in a cyclical pattern of riots
- Relationship between network-level cohesiveness and spikes in rioting



Social networks of ten agents across the first two days of a simulation run.



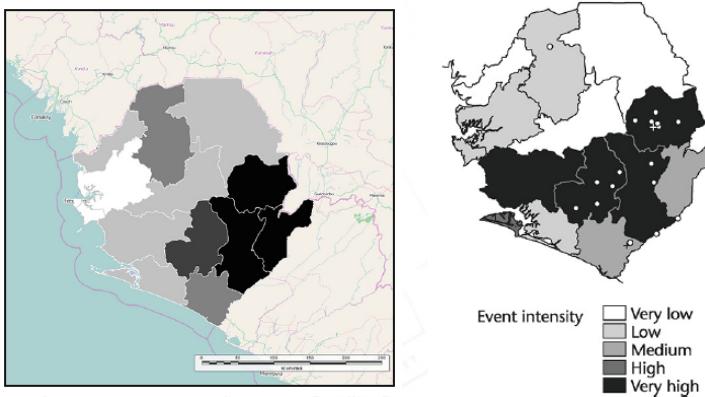
Average percent of population that rioted by day.



Average day-over-day change in network density.

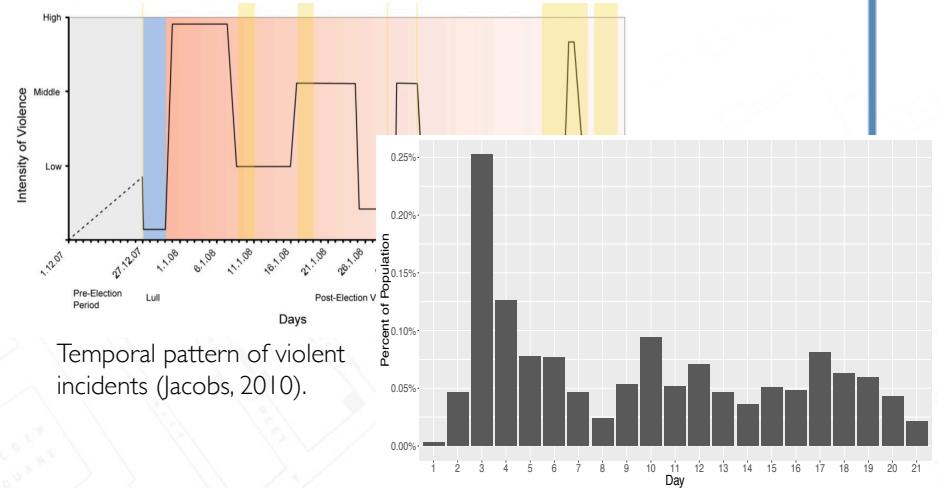
Calibration and Validation

- Qualitative agreement of model results to event intensity by district



Model results as compared to actual event intensity (Le Billon, 2008).

- Qualitative agreement with the temporal dynamics of riots

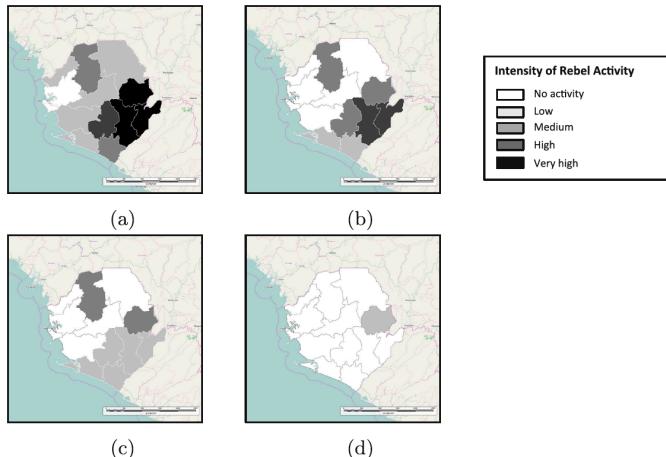


Temporal pattern of violent incidents (Jacobs, 2010).

Average percent of population that rioted by day.

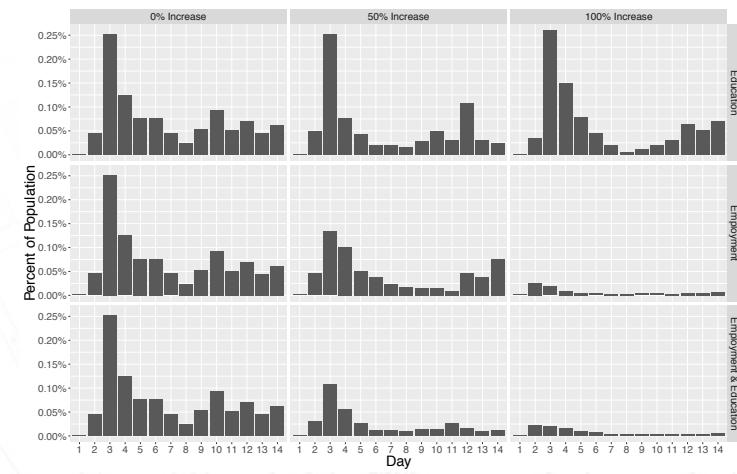
Testing Theory Through ‘What if’ Scenarios

- Le Billon's **theory** examined four types of conflicts and the environmental factors required for each to emerge
- Impact of increasing employment and education opportunities
- Support given to Maslow's **theory**

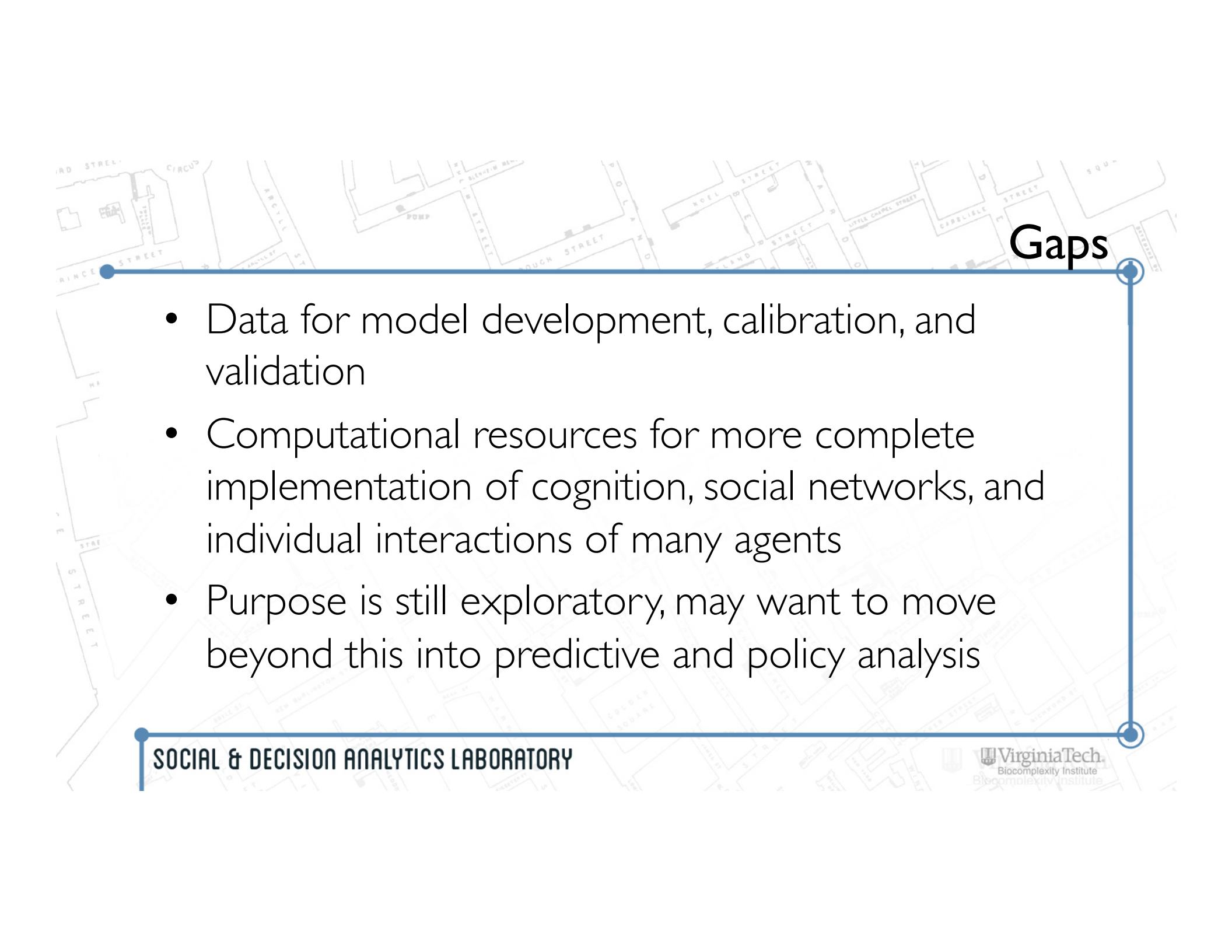


Average model results in year 10 when resources are distant as government control is increased.

- Impact of increasing employment and education opportunities
- Support given to Maslow's **theory**



Average percent of population that rioted as education and employment opportunities were increased by 50% and 100%.

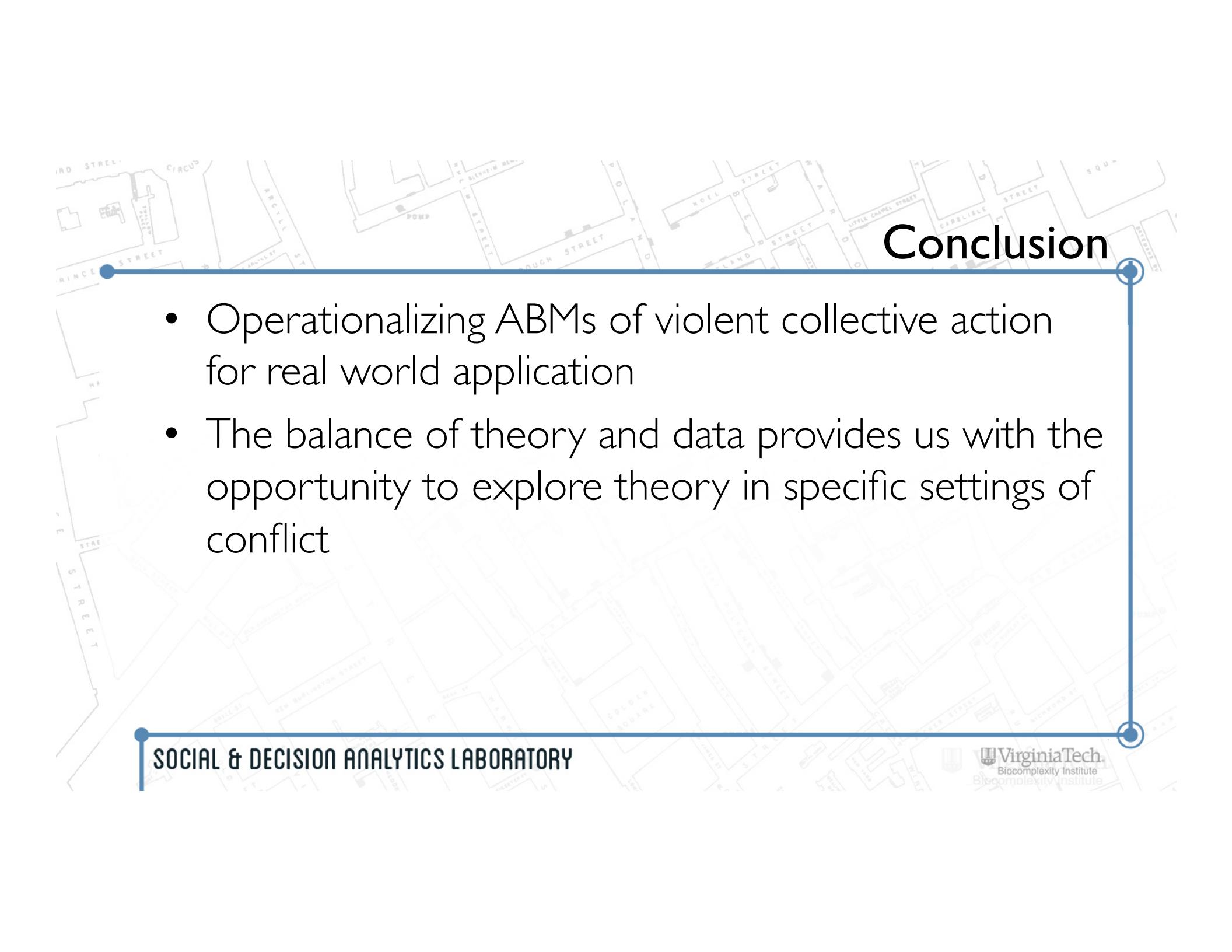


Gaps

- Data for model development, calibration, and validation
- Computational resources for more complete implementation of cognition, social networks, and individual interactions of many agents
- Purpose is still exploratory, may want to move beyond this into predictive and policy analysis

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Conclusion

- Operationalizing ABMs of violent collective action for real world application
- The balance of theory and data provides us with the opportunity to explore theory in specific settings of conflict

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