Models of Social Dynamics
An Introductory Module

Paul E. Smaldino
University of California, Merced

Unit 3:
Opinions

Opinions, attitudes, and beliefs

<u>A position on some issue</u>

- How good is cake?
- Is Batman really a hero?
- Is the theory of Natural Selection true?
- How much should one pray?
- How many licks does it take to get the Tootsie Roll center of a Tootsie Pop?

Building a model of social influence

A model of opinion dynamics requires assumptions of three categories:

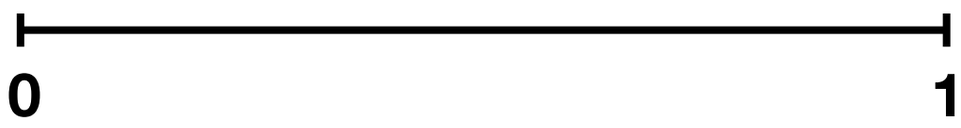
1. A representation of opinions, attitudes, or beliefs
2. A mechanism for social influence
3. A population structure

A representation of opinions

- Ultimately, we might want something sophisticated, like a multidimensional semantic network.

- For now, let's start simple. A vector in which each item is an independent opinion, that can take on continuous or discrete values.

- Continuous values:



A mechanism for social influence

How do opinions change as a result of social interaction?

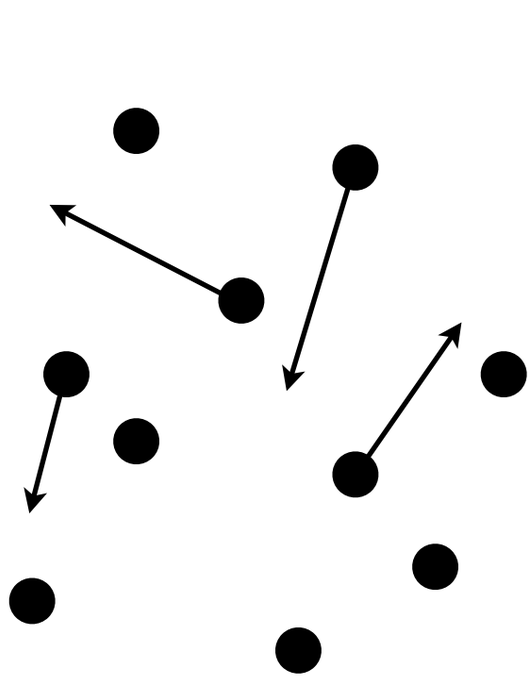
- **Positive influence.** Agents interact and become more similar.

- **Bounded confidence (or biased assimilation).** Agents ignore those who are sufficiently different.

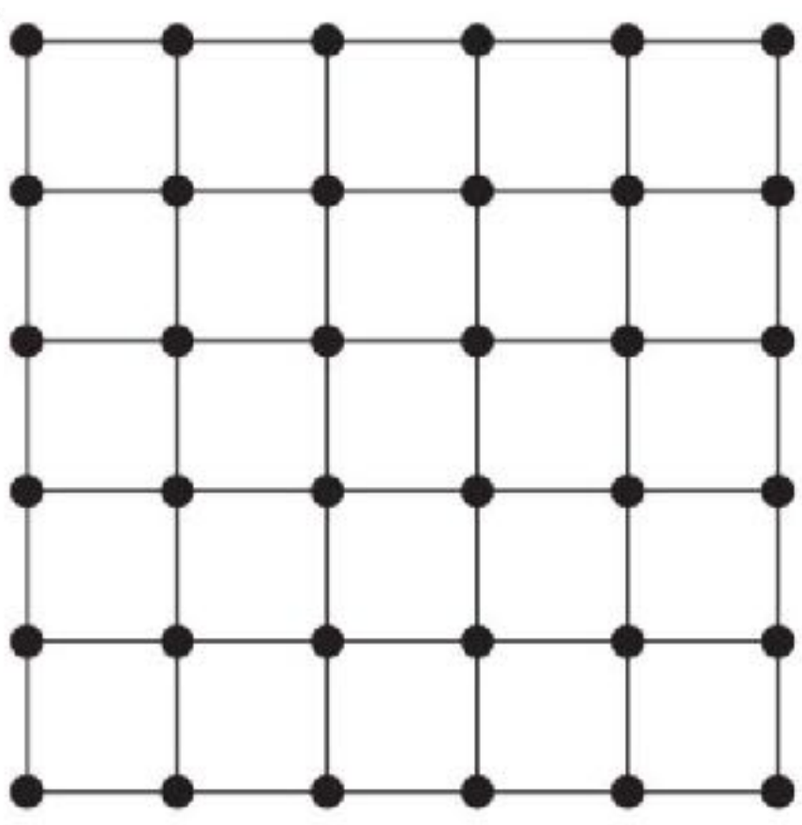
- **Negative influence.** Agents interact and become more *dissimilar* from those that differ sufficiently from them initially.

A population structure

Who interacts with whom?



Random mixing



Square lattice

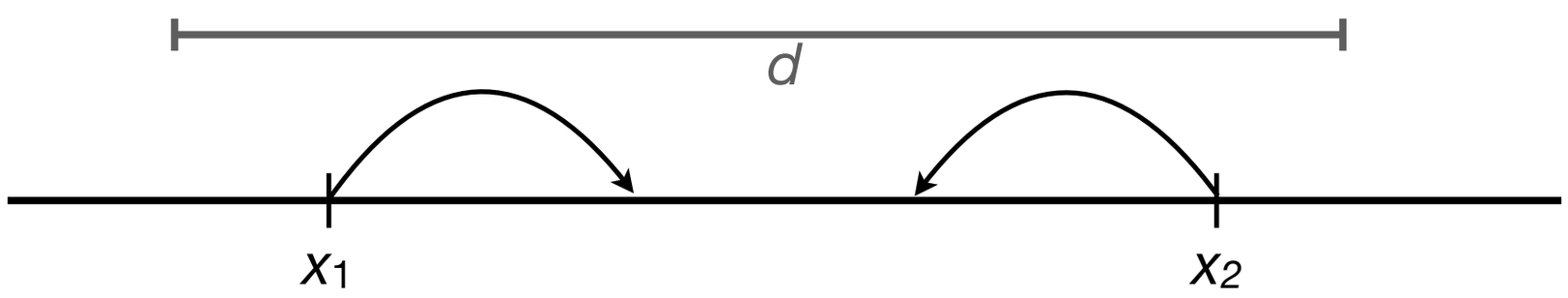
The Bounded Confidence Model

- Two agents, with opinions x_1 and x_2, interact and influence each other if and only $|x_1 - x_2| < d$.

- If they interact, opinions are updated thusly:

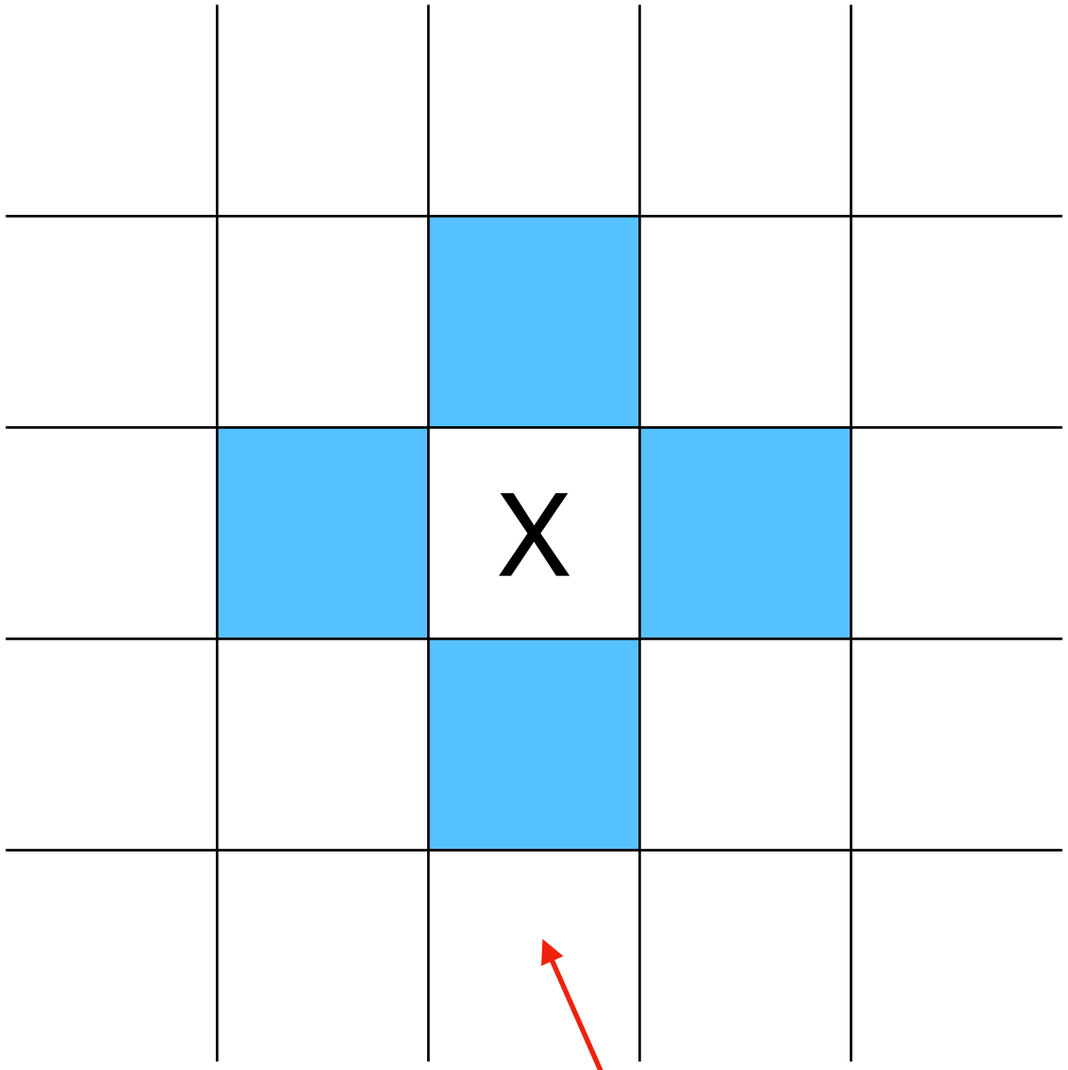
$$x_1 \leftarrow x_1 + k(x_2 - x1)$$

$$x_2 \leftarrow x_2 + k(x_1 - x2)$$



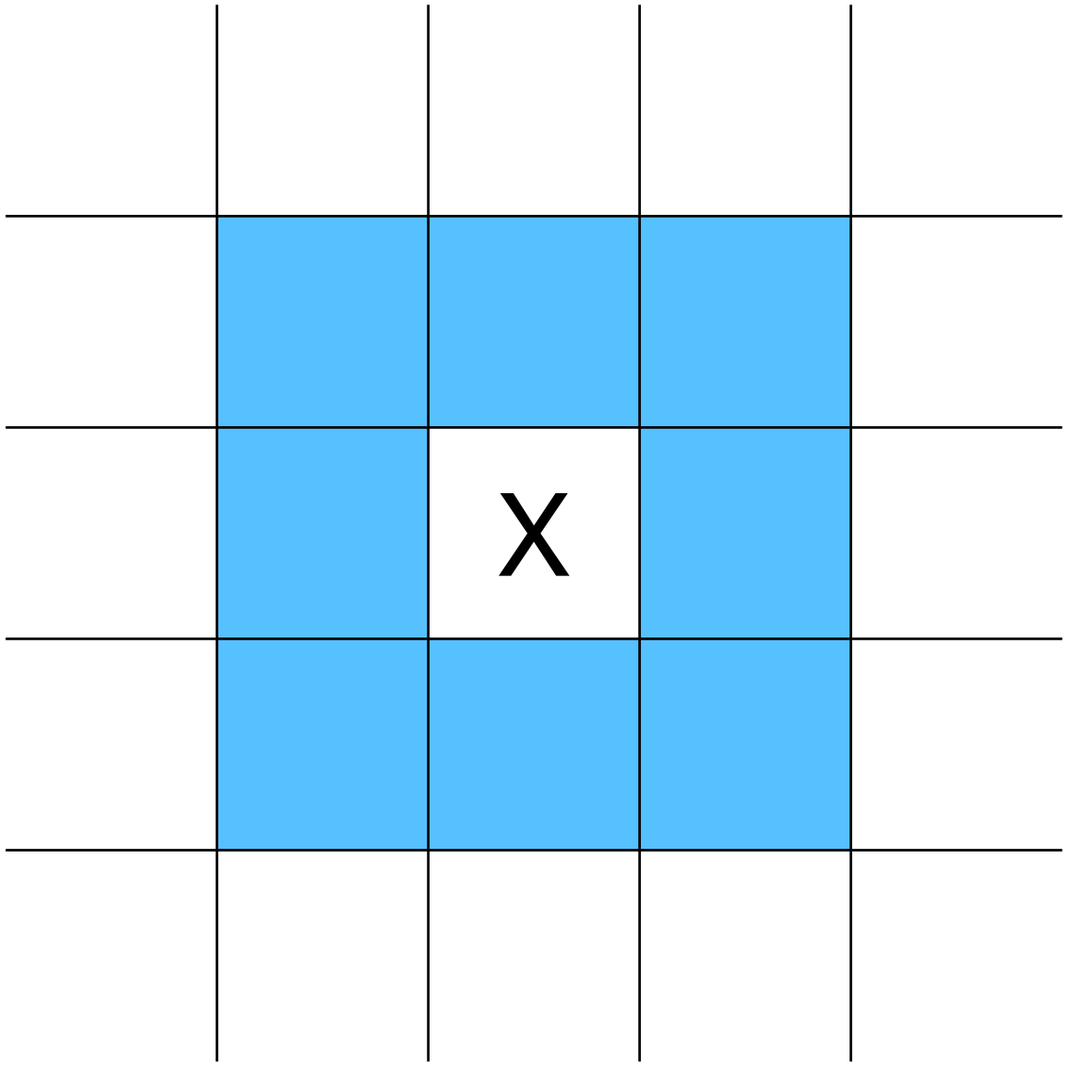
Lattice neighborhoods

von Neumann neighborhood



we'll use this one

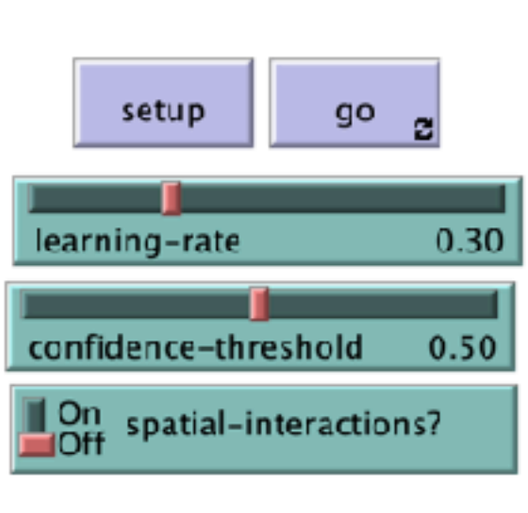
Moore neighborhood

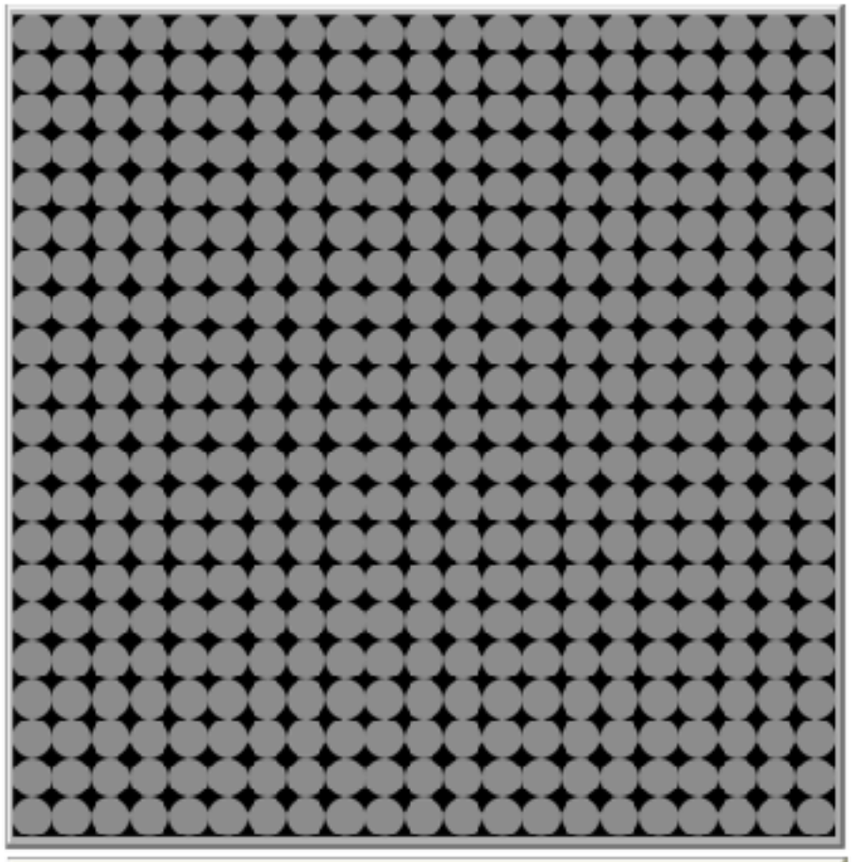


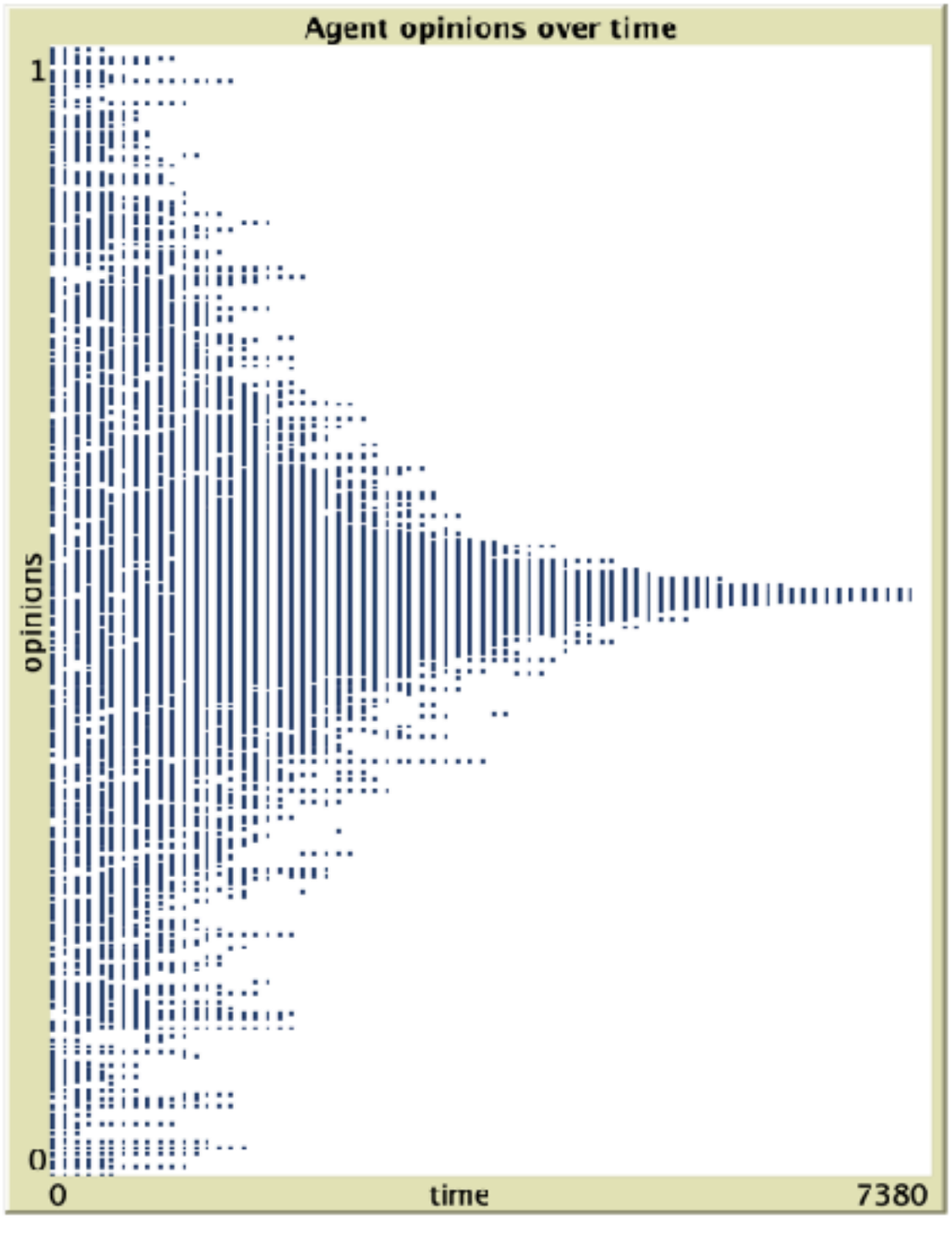
the bounded confidence model

CODE: opiniondynamics_BC.nlogo

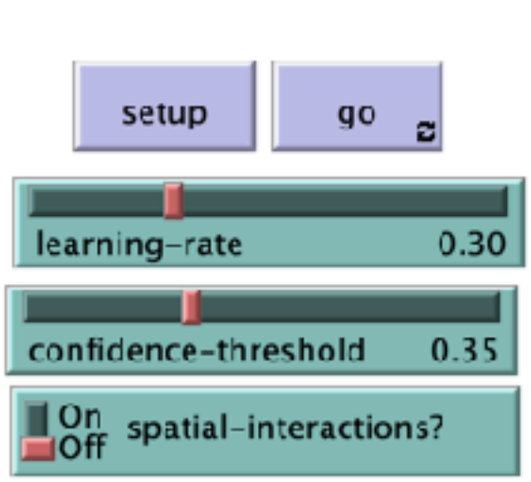
Results (non-spatial)

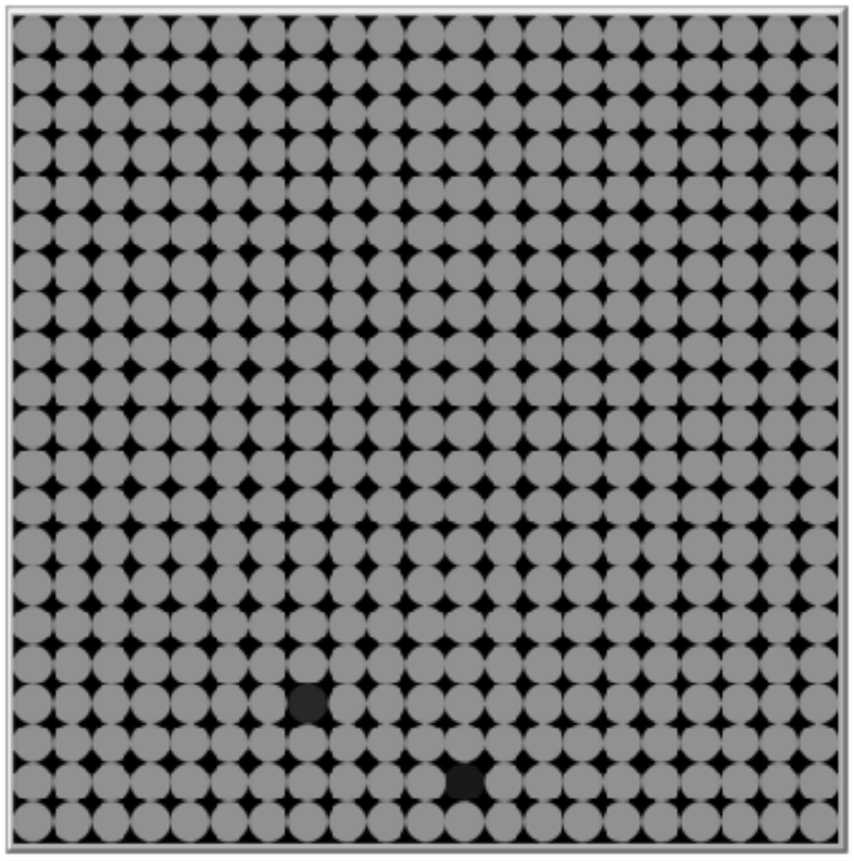


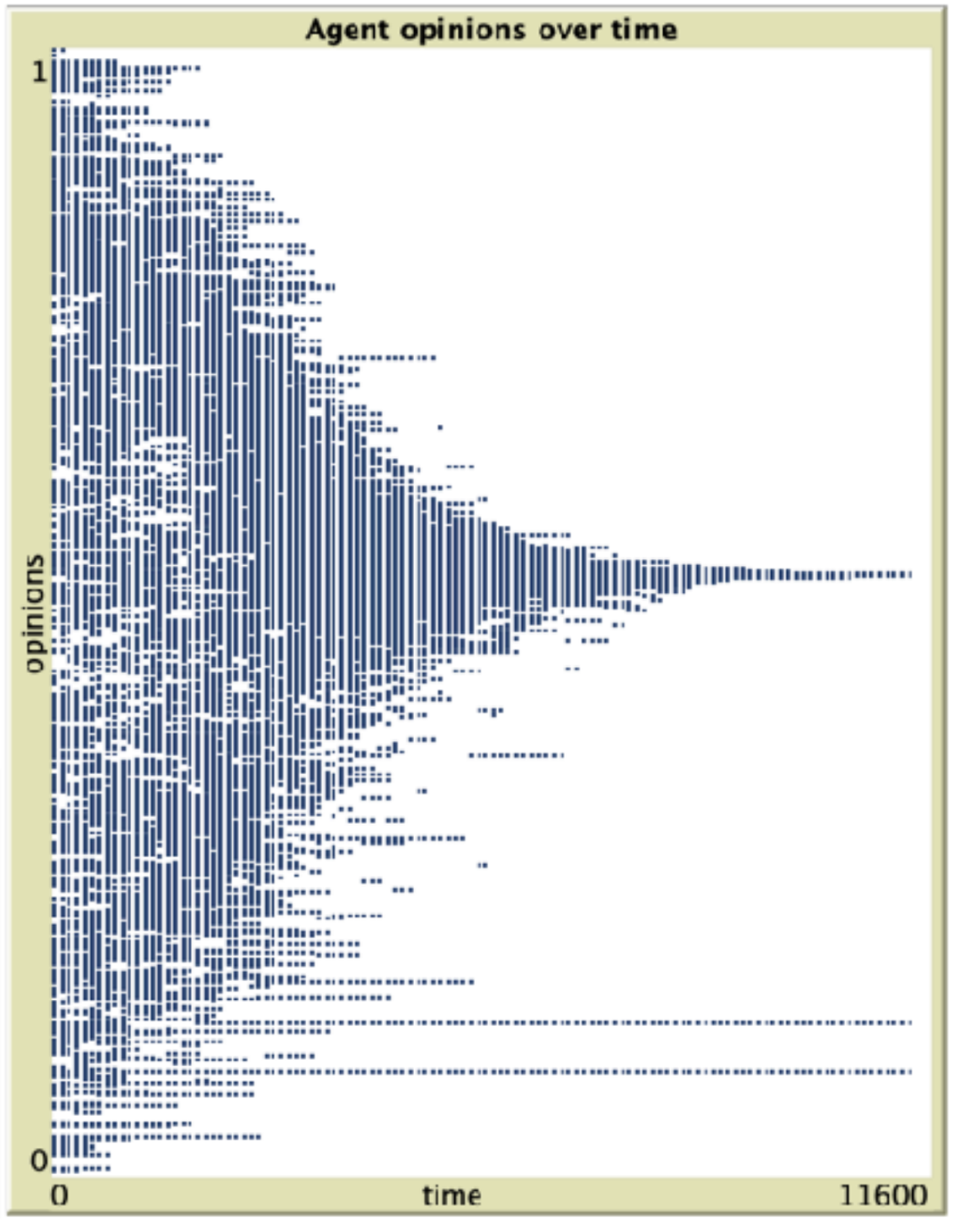




Results (non-spatial)







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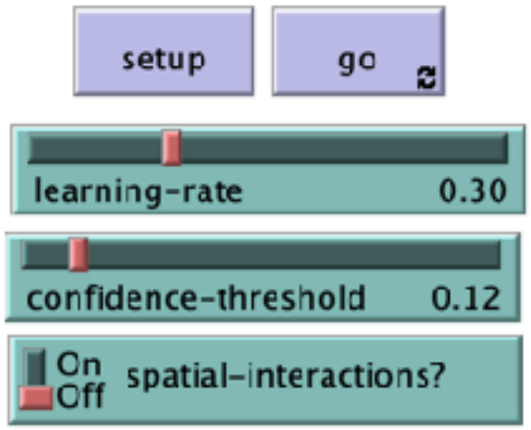
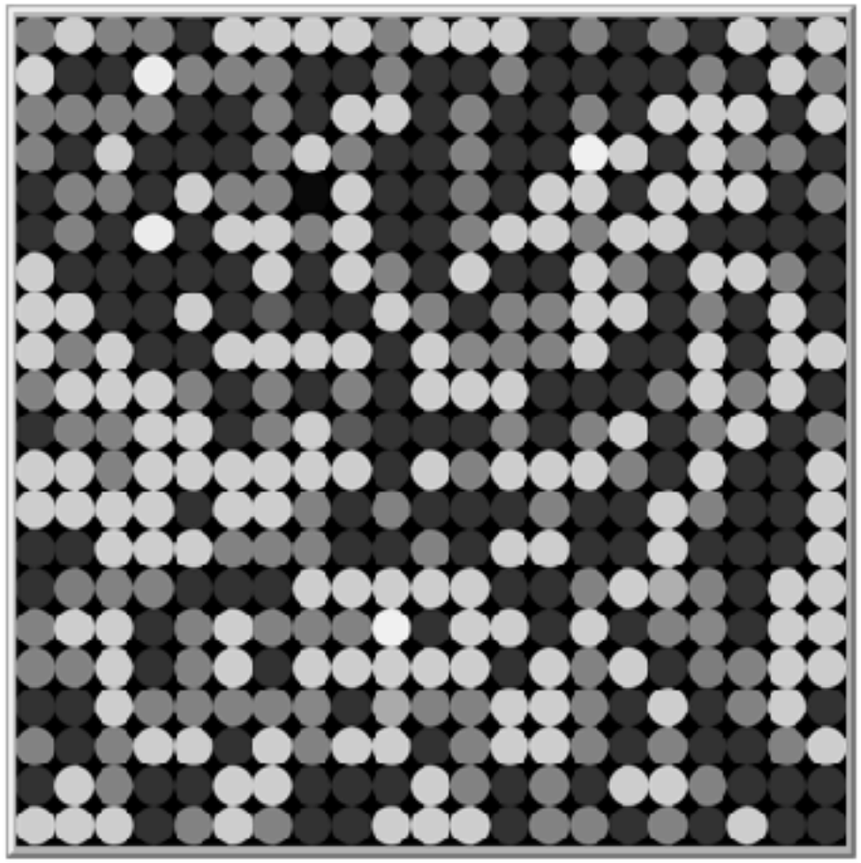
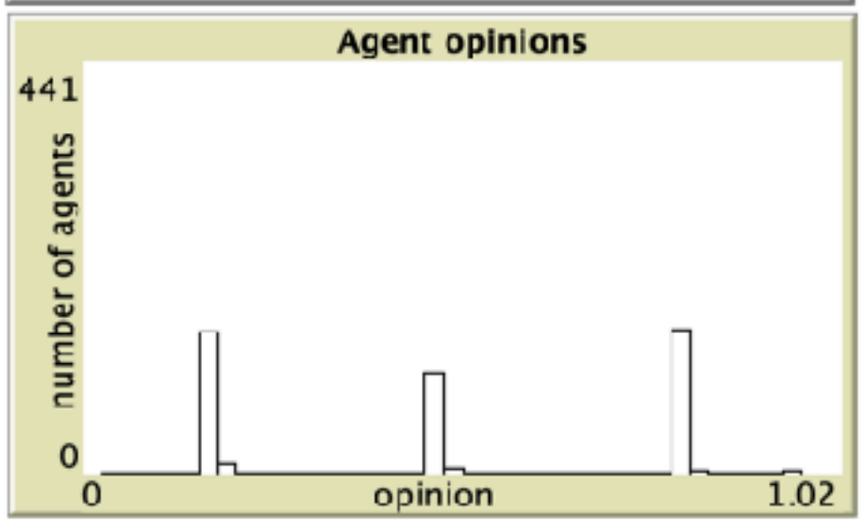
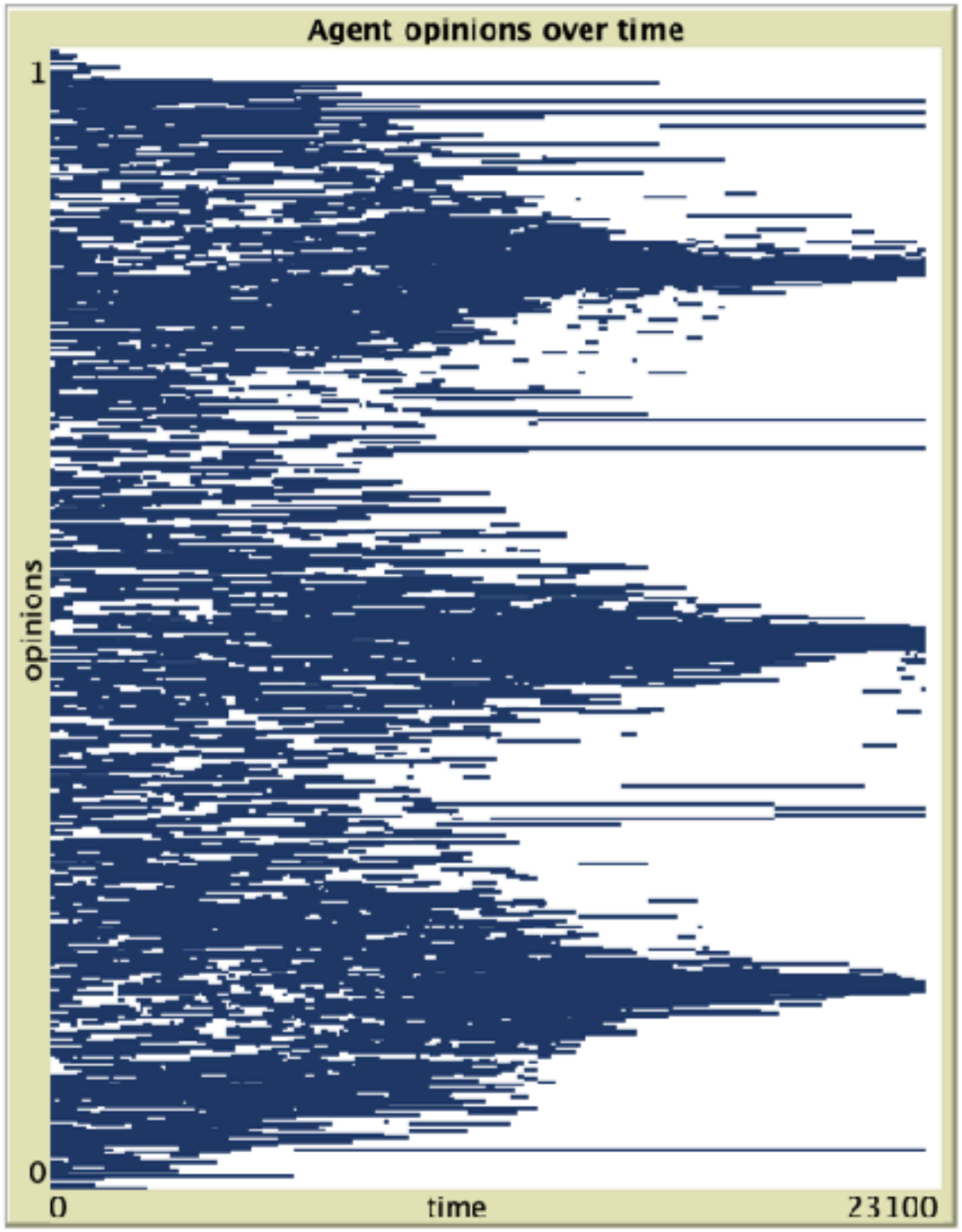


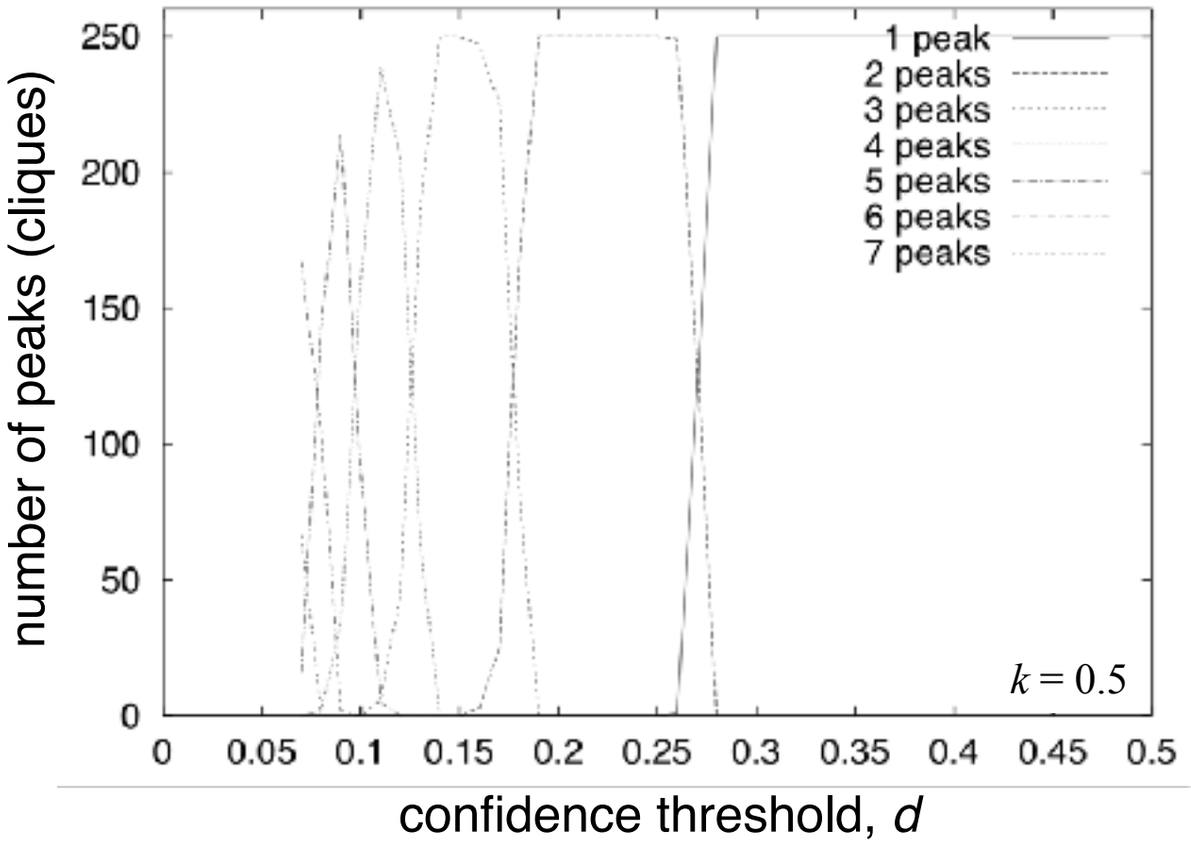




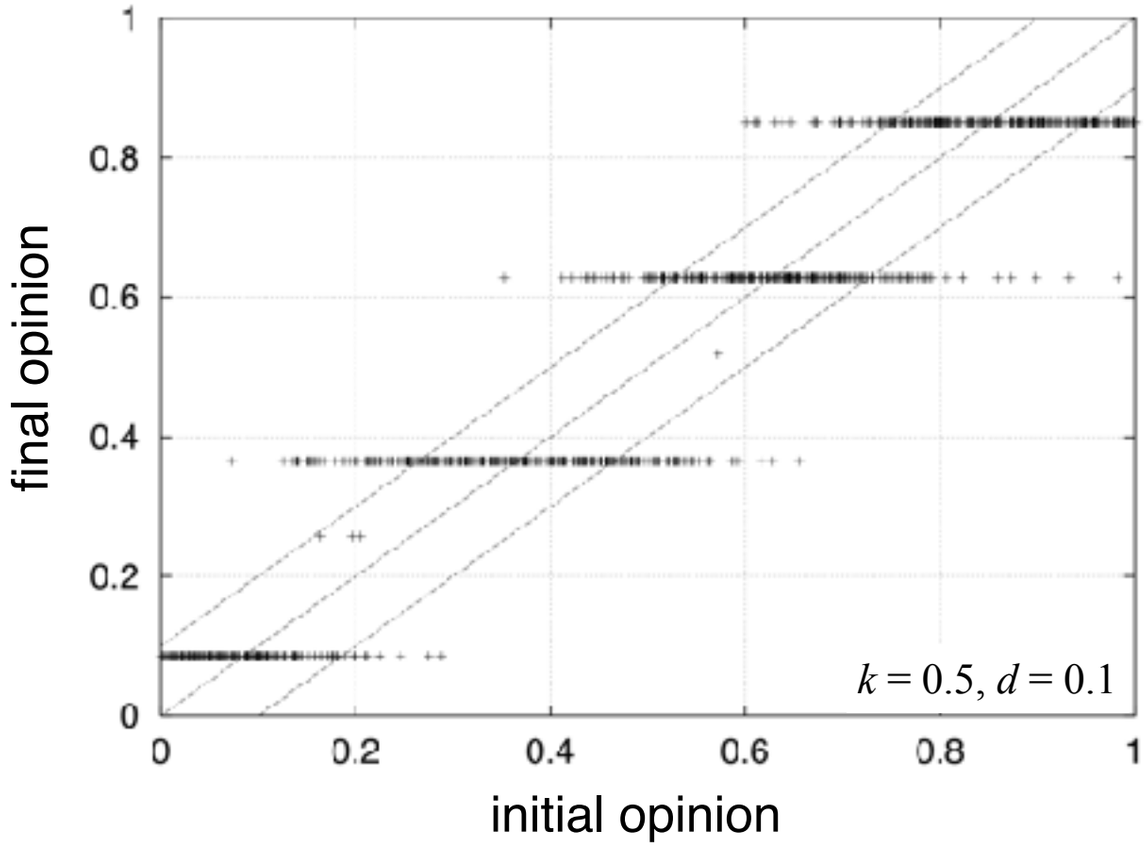


Results (non-spatial)

Lower confidence thresholds lead to more cliques

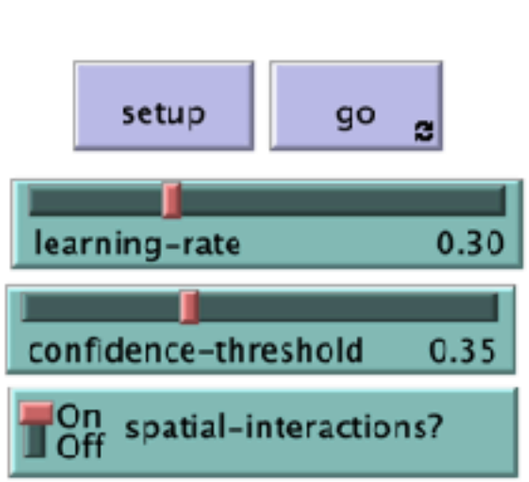


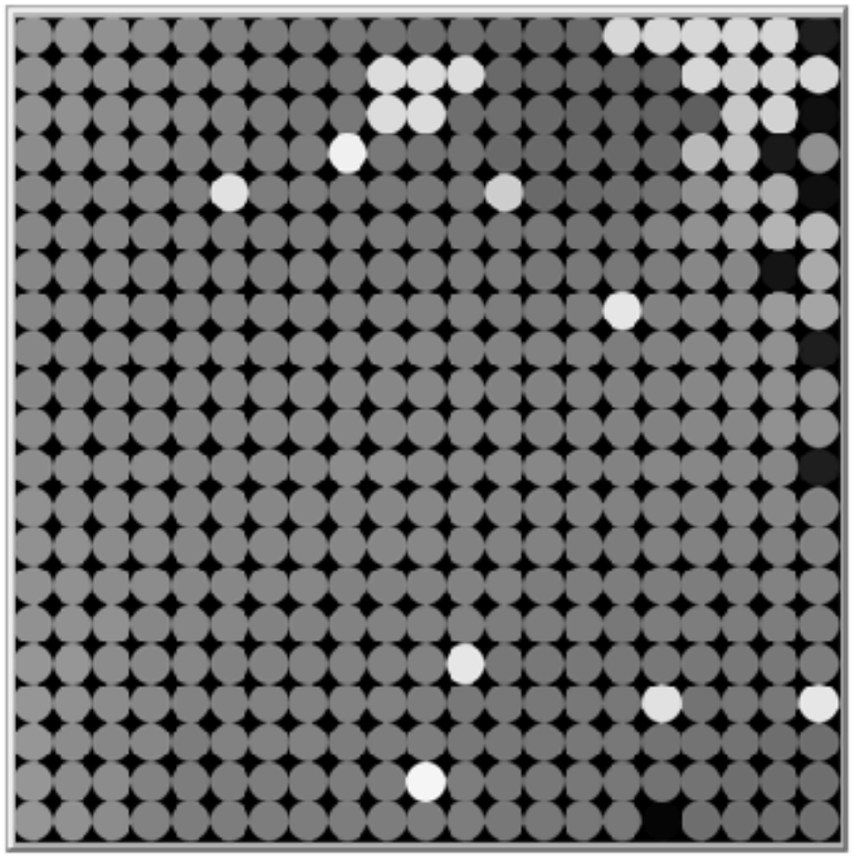
Initial opinion is imperfectly related to final opinion

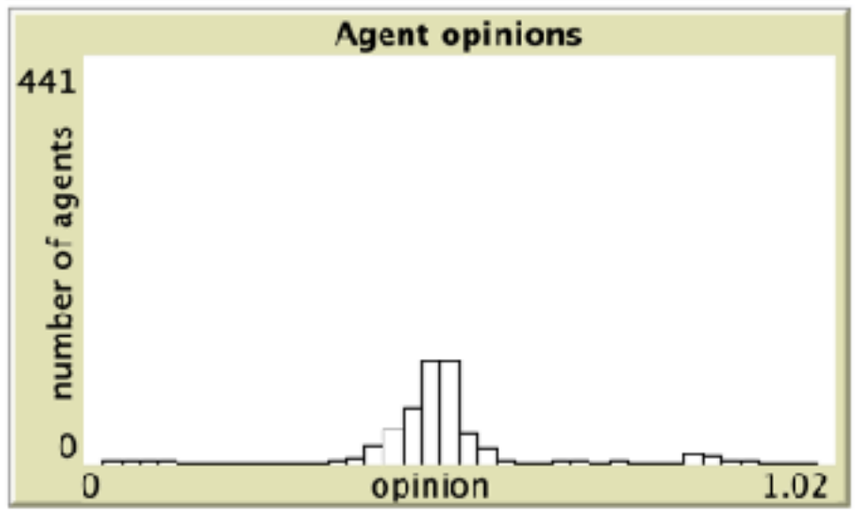


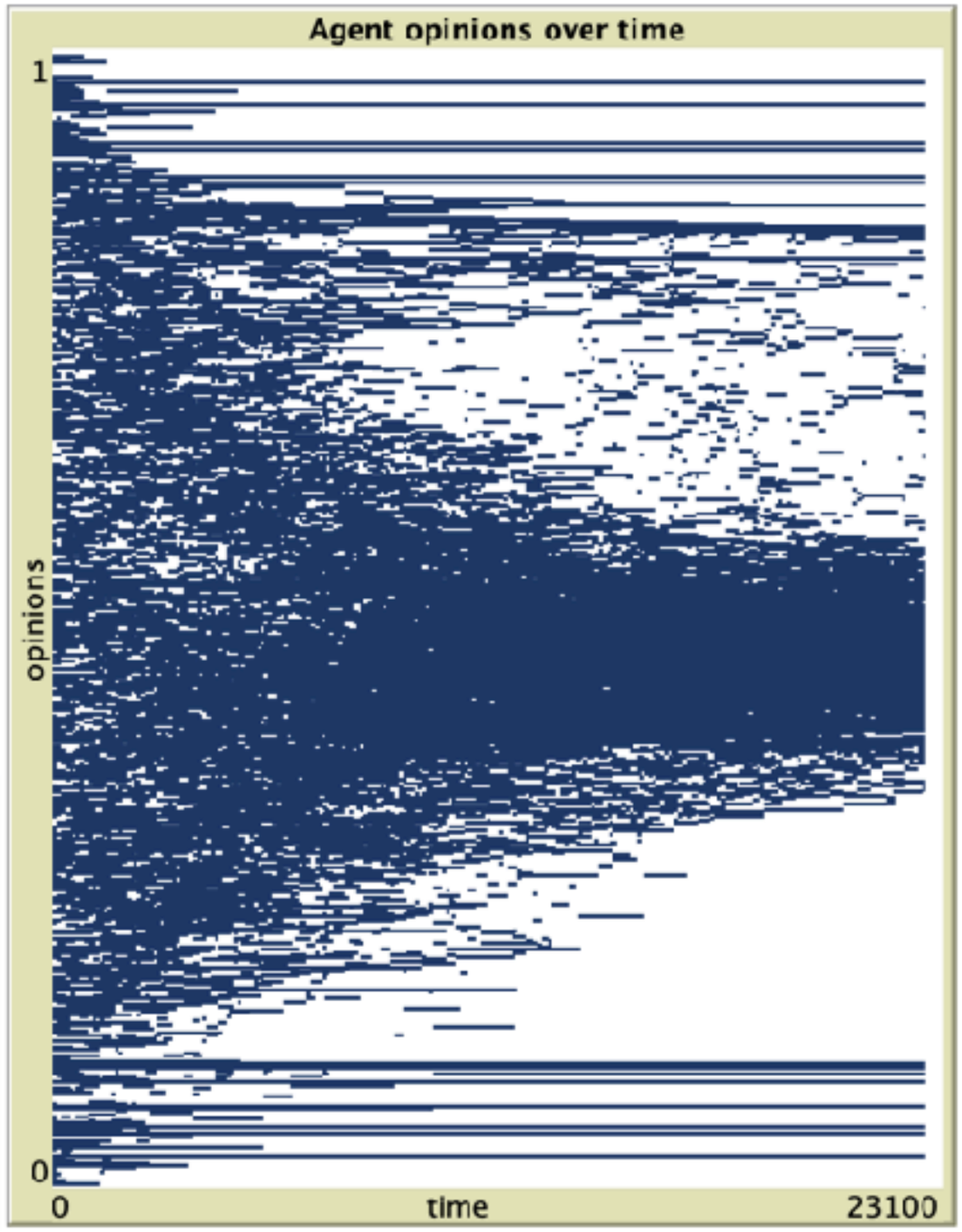
from Deffuant et al. (2000)

Results (spatial)

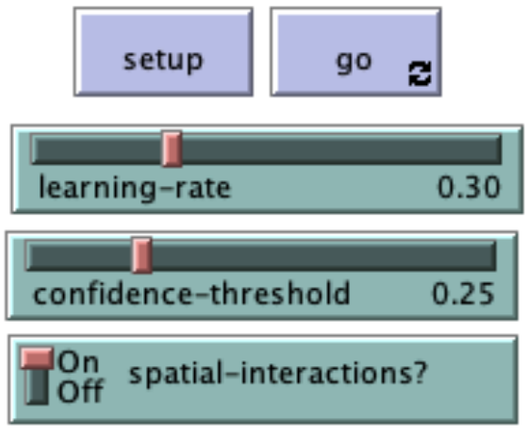


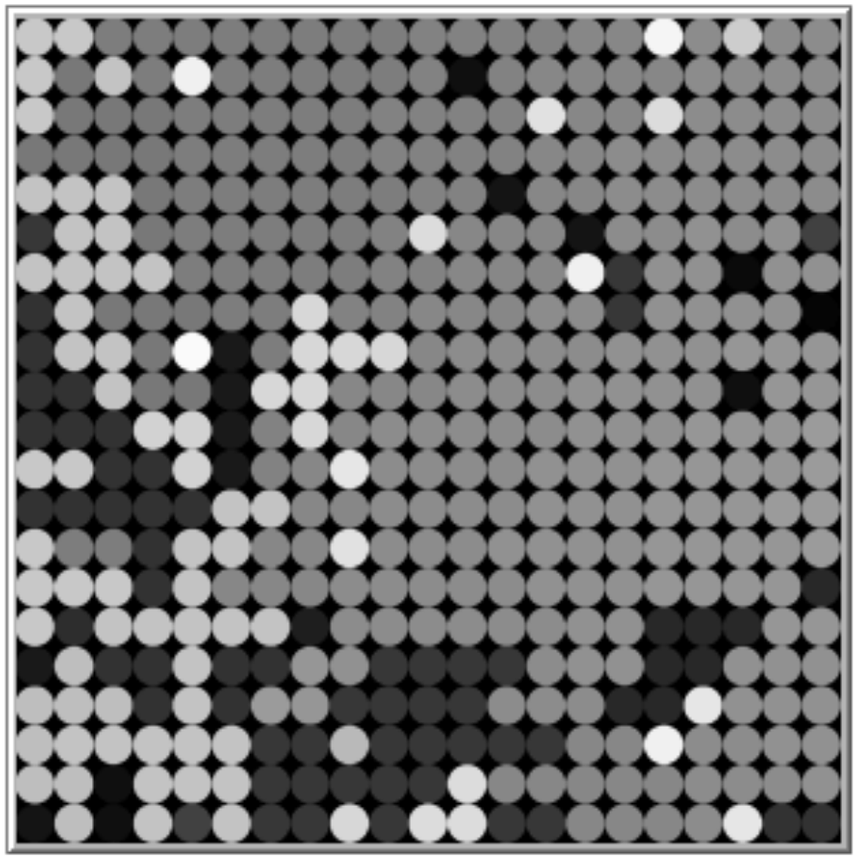


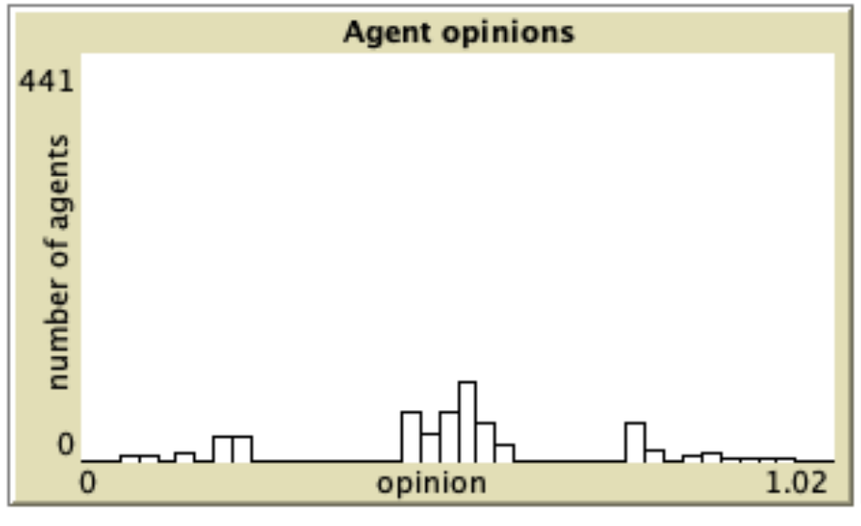


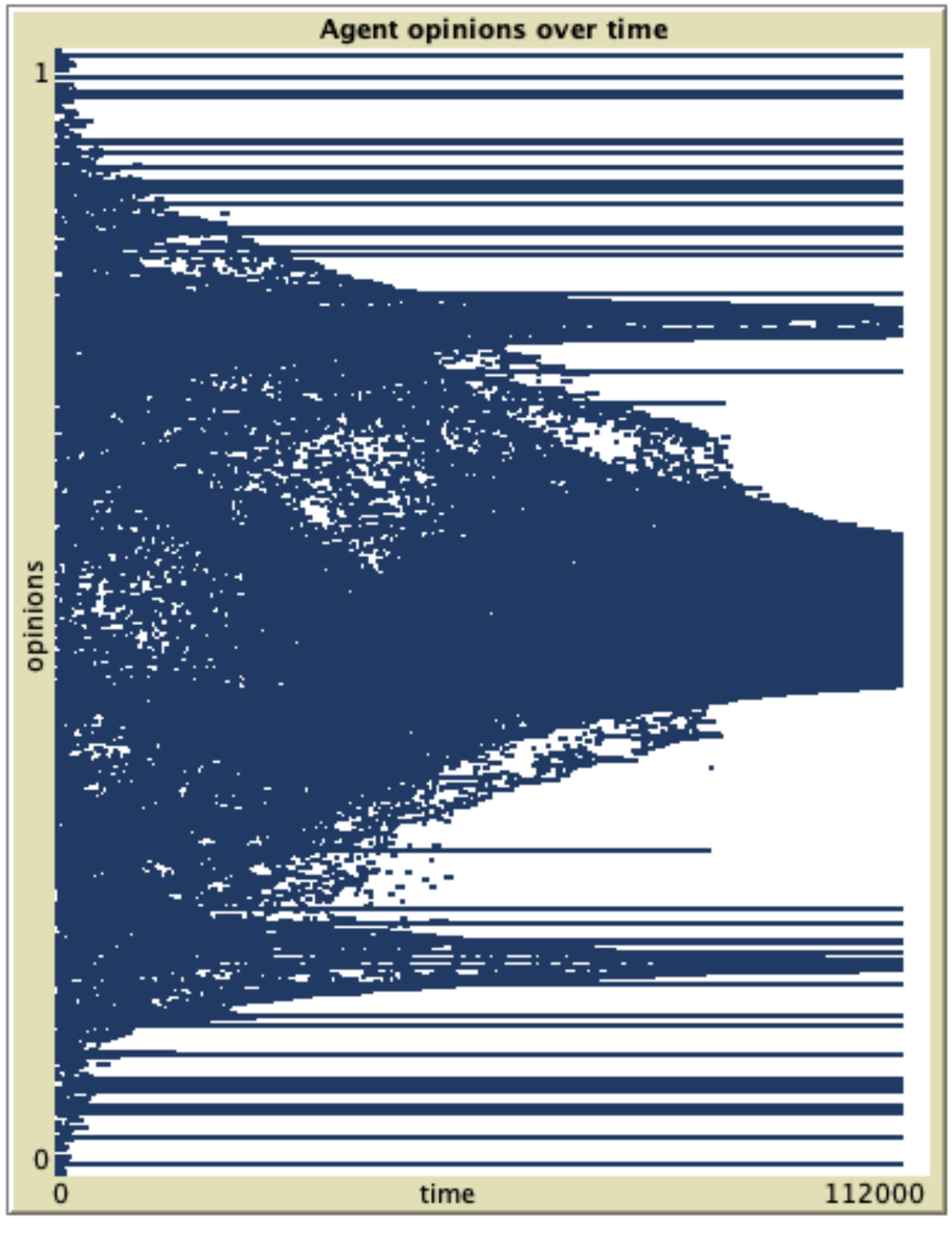


Results (spatial)

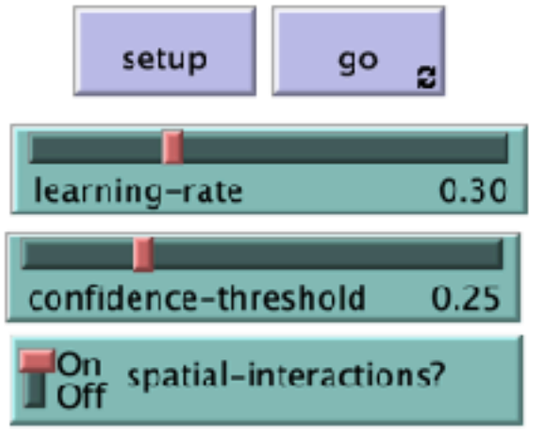


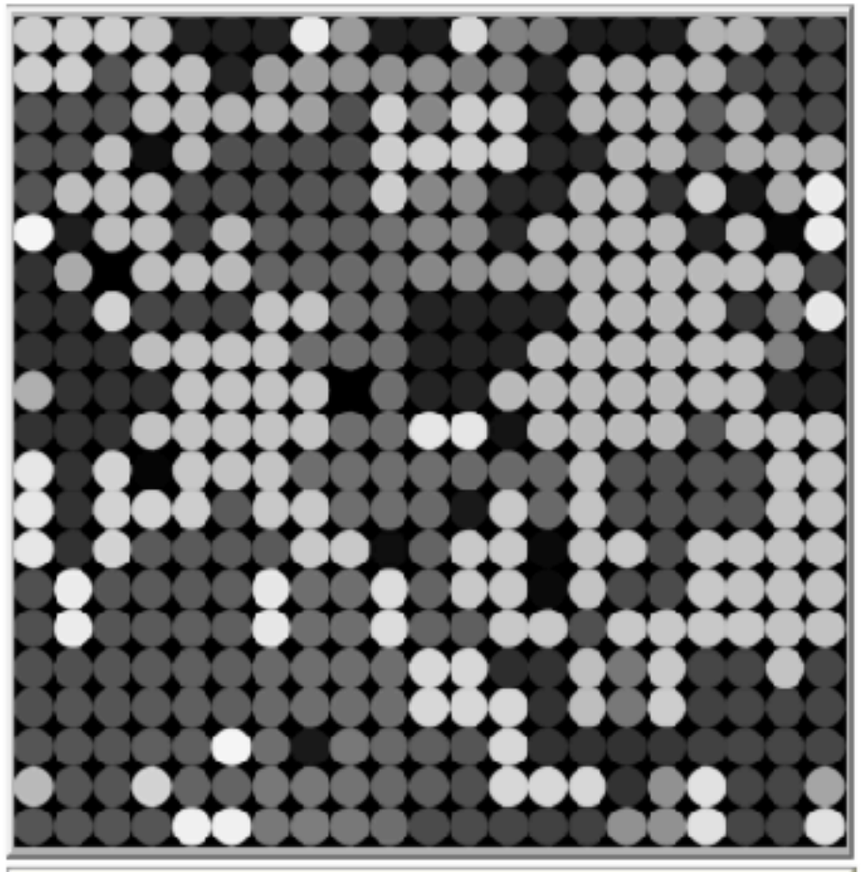


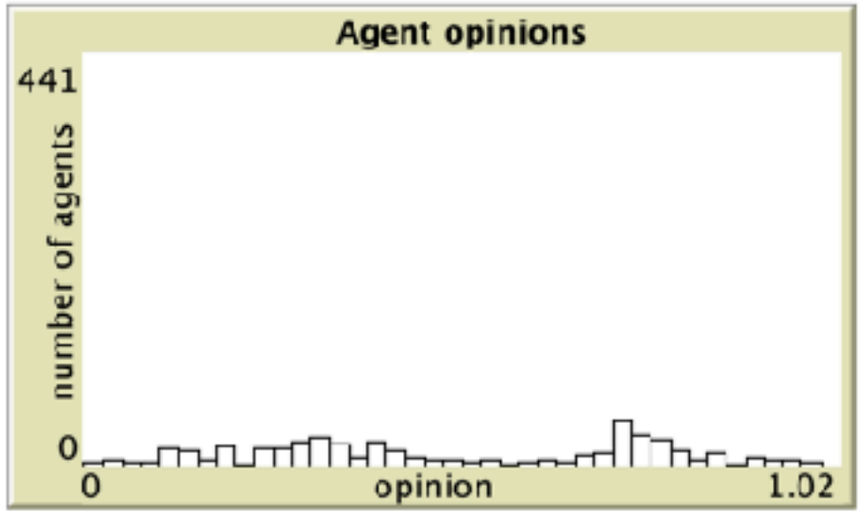


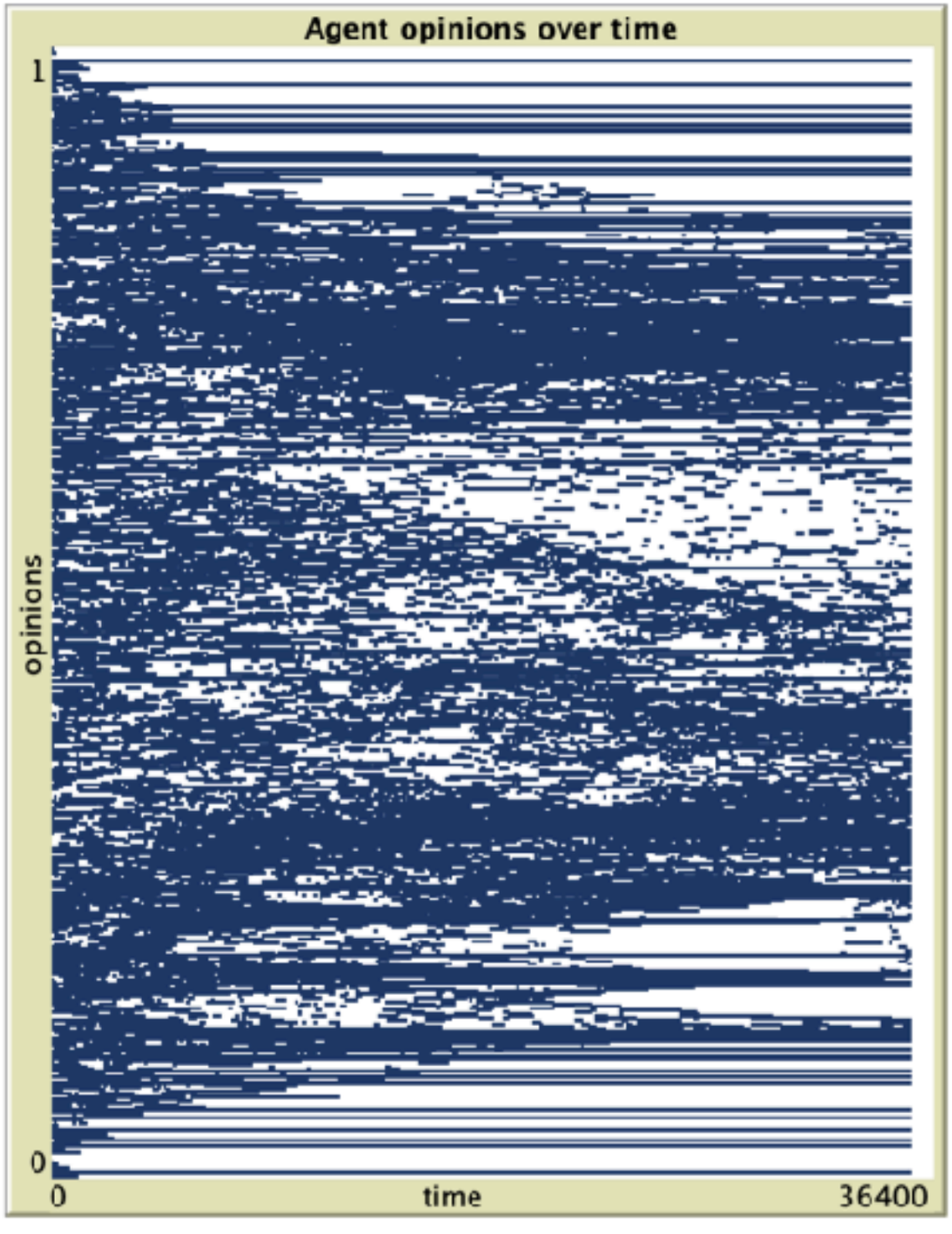


Results (spatial)





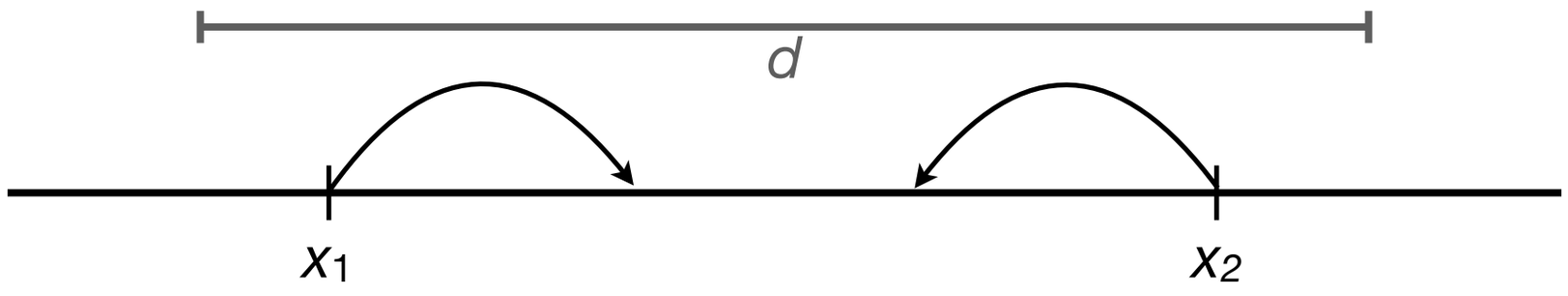




Negative Influence

- Two agents, with opinions x_1 and x_2, interact.
- If $|x_1 - x_2| < d$, they exert **positive influence** on one another.

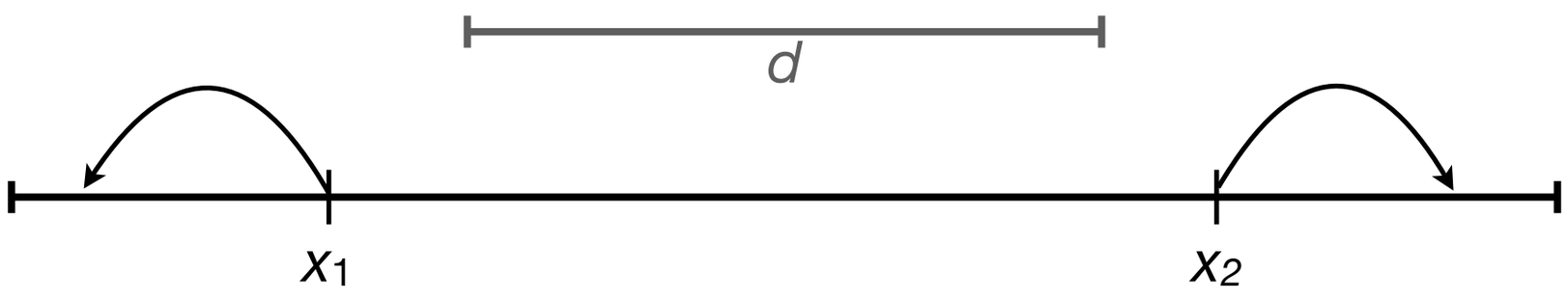
$$x_1 \leftarrow x_1 + k(x_2 - x1)$$
$$x_2 \leftarrow x_2 + k(x_1 - x2)$$



Negative Influence

- Otherwise, they exert **negative influence** on one another

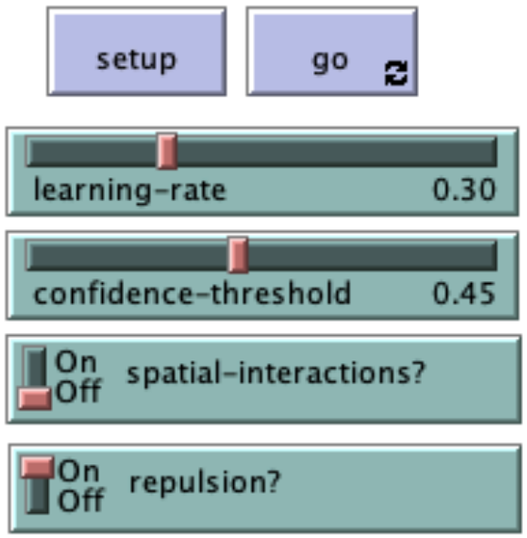
$$x_1 \leftarrow x_1 + k(x_1 - x2)x_1$$
$$x_2 \leftarrow x_2 + k(x_2 - x1)(1 - x_2)$$

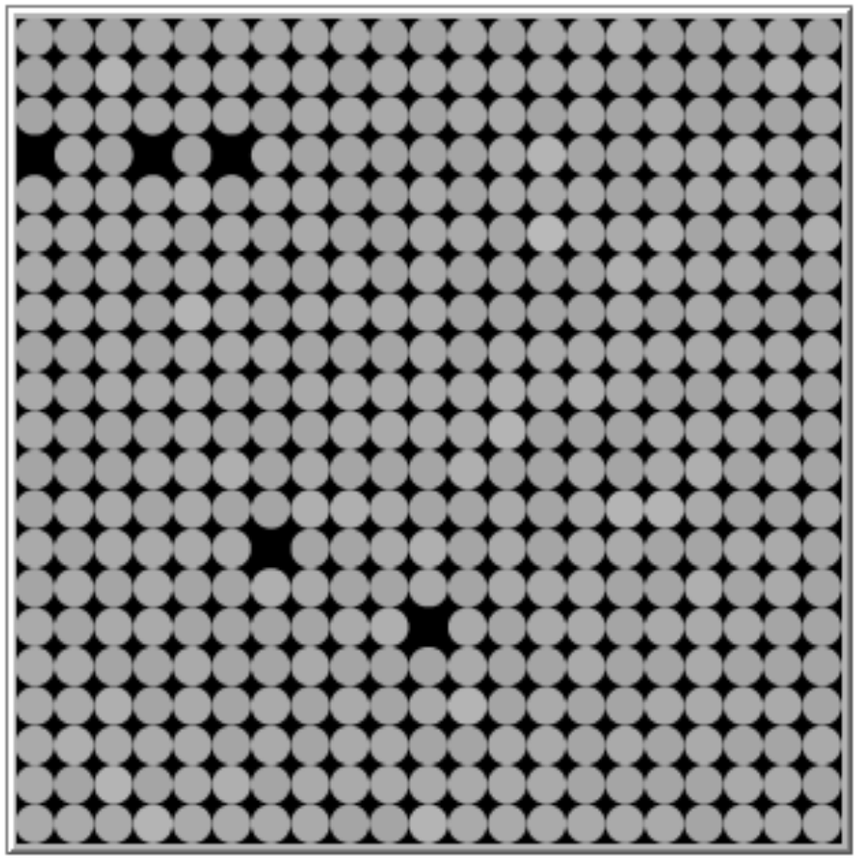


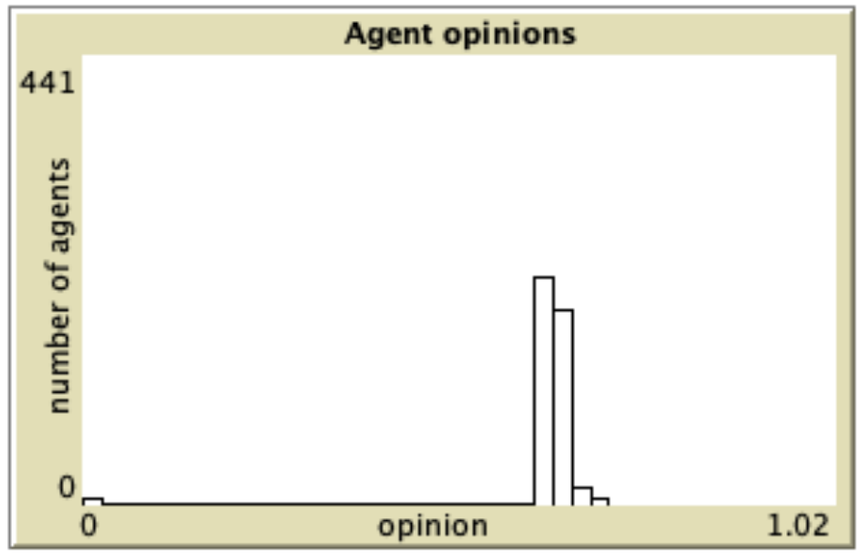
bounded confidence model with negative influence

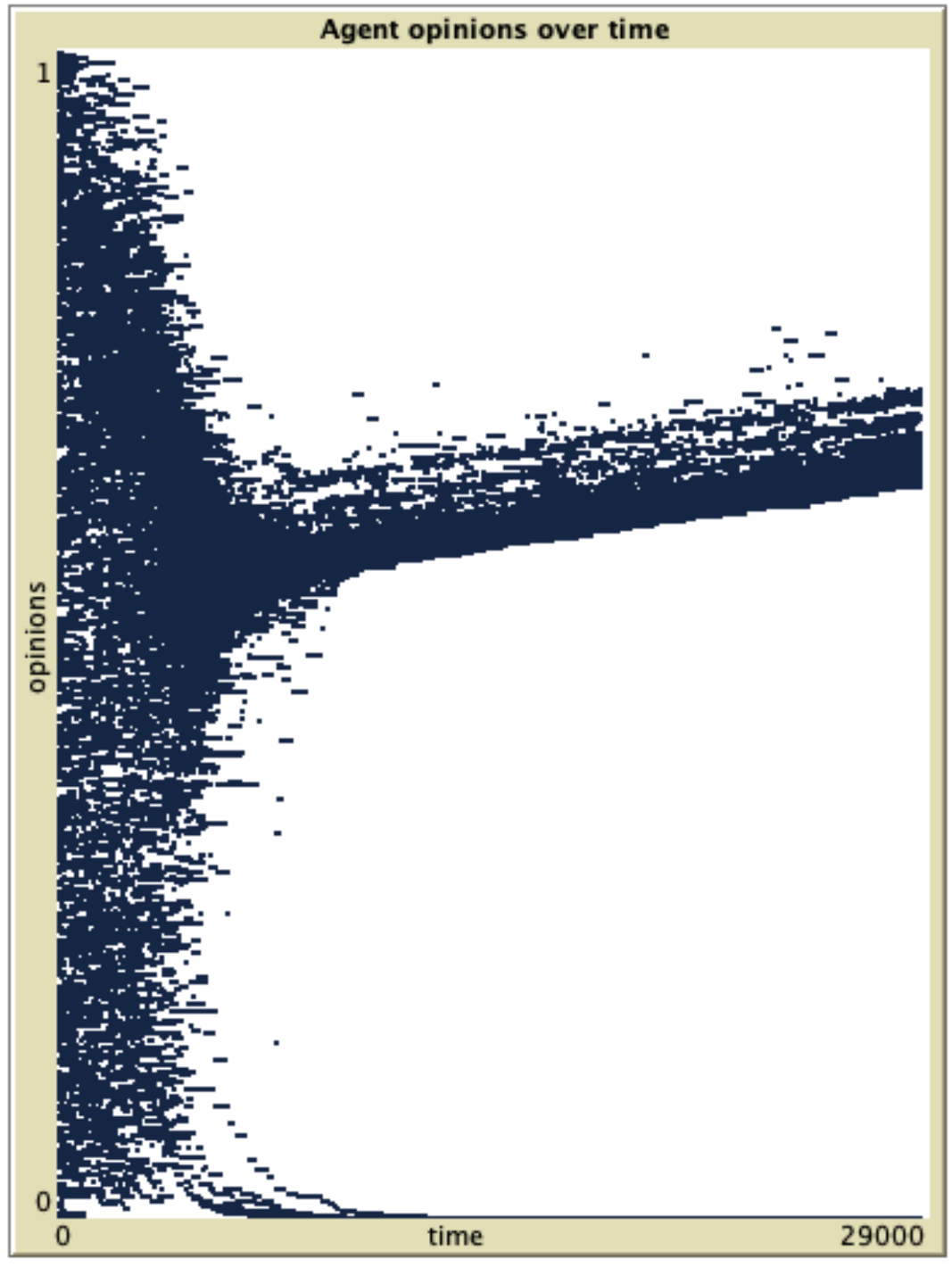
CODE: opiniondynamics_neginfluence.nlogo

Results (non-spatial)



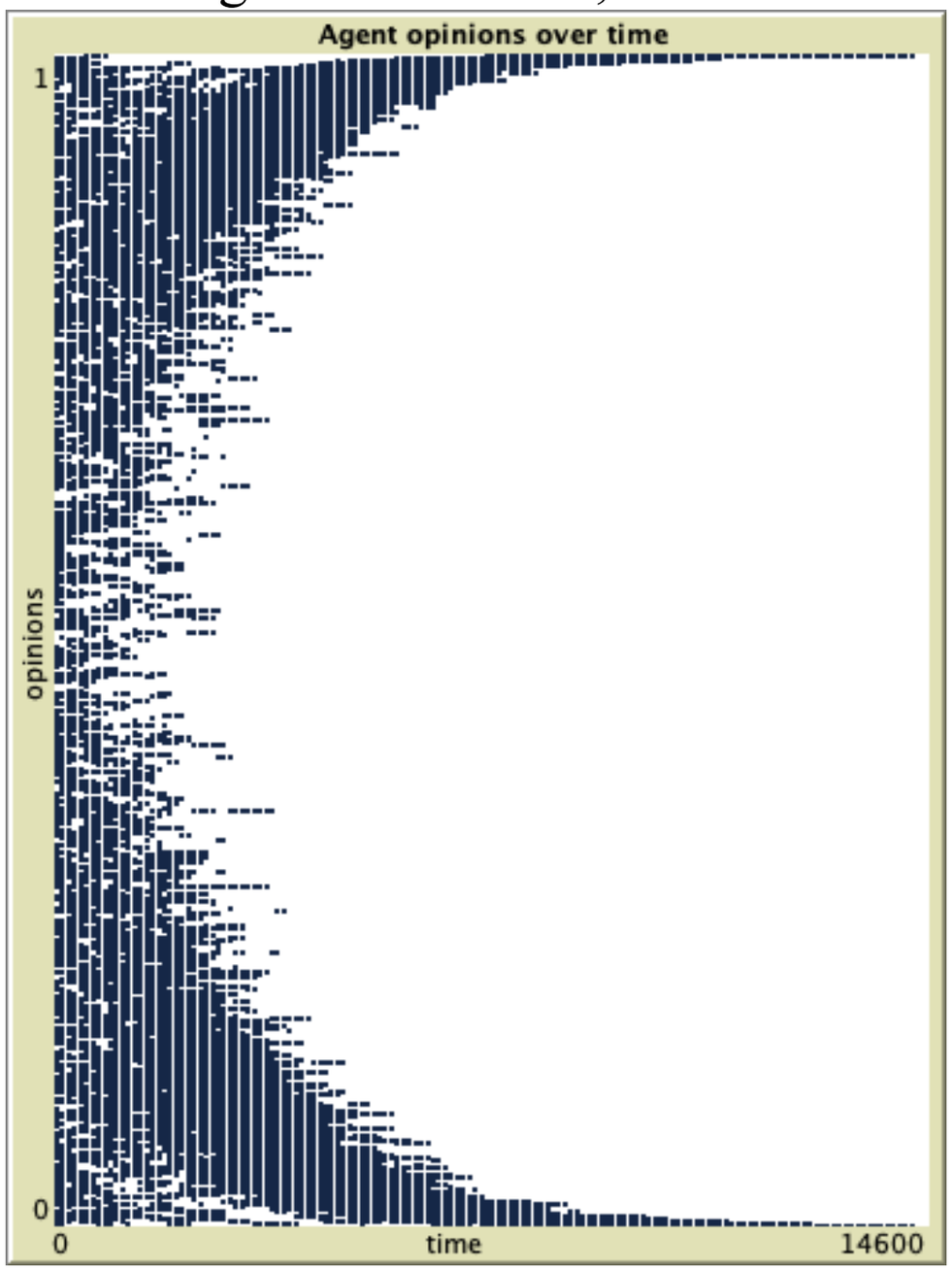




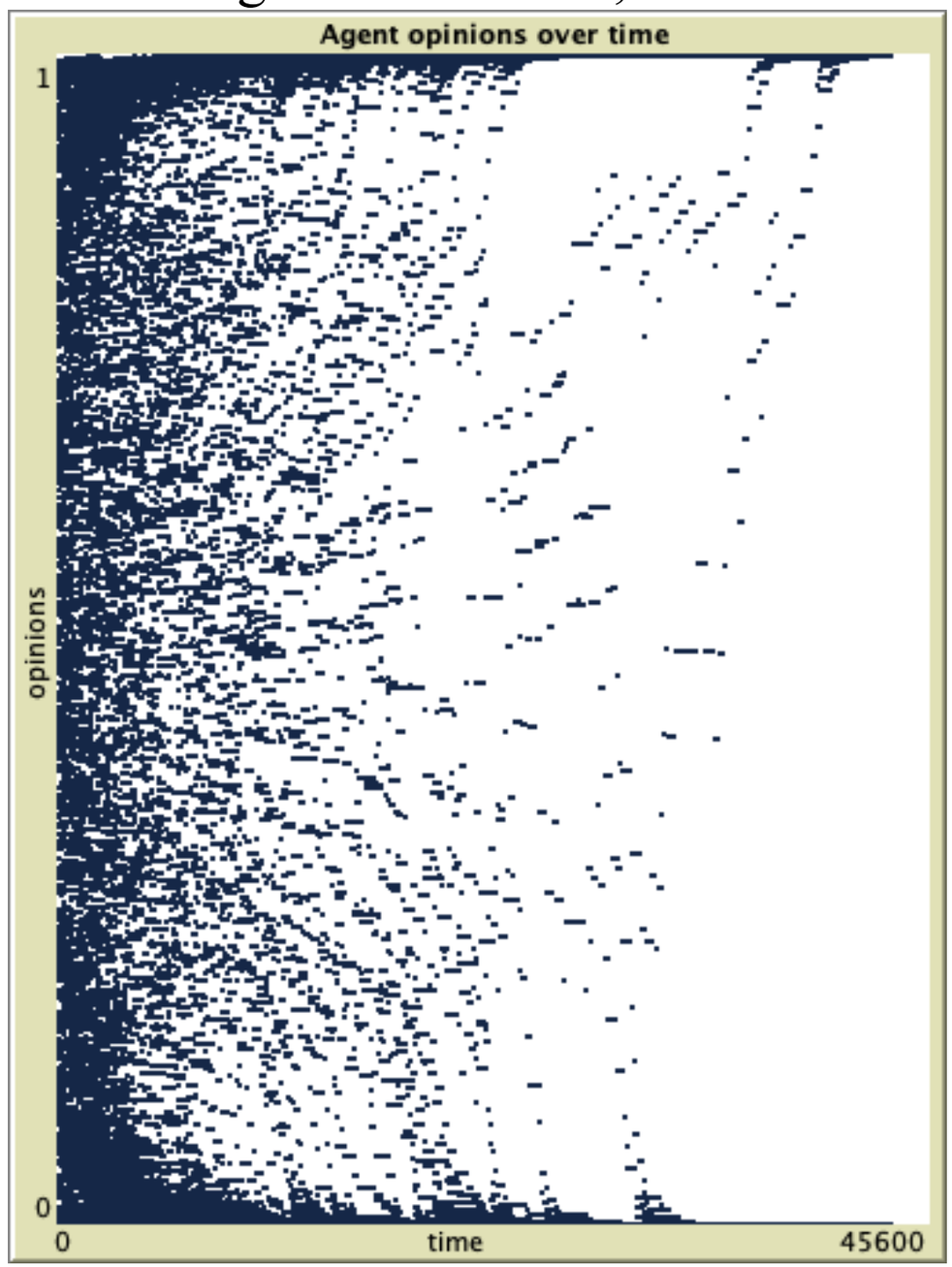


Results (non-spatial)

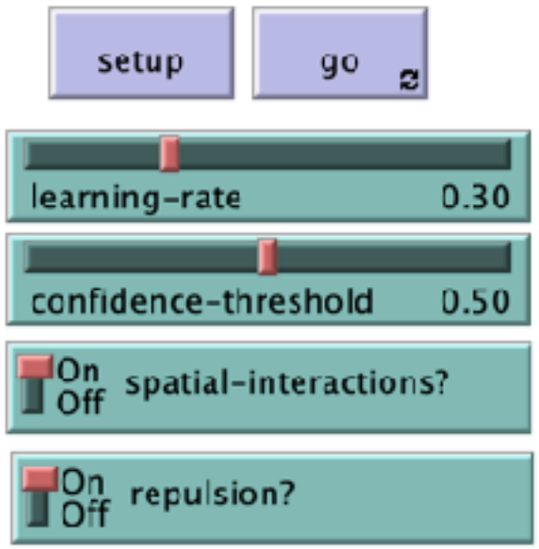
negative influence, $d = 0.4$

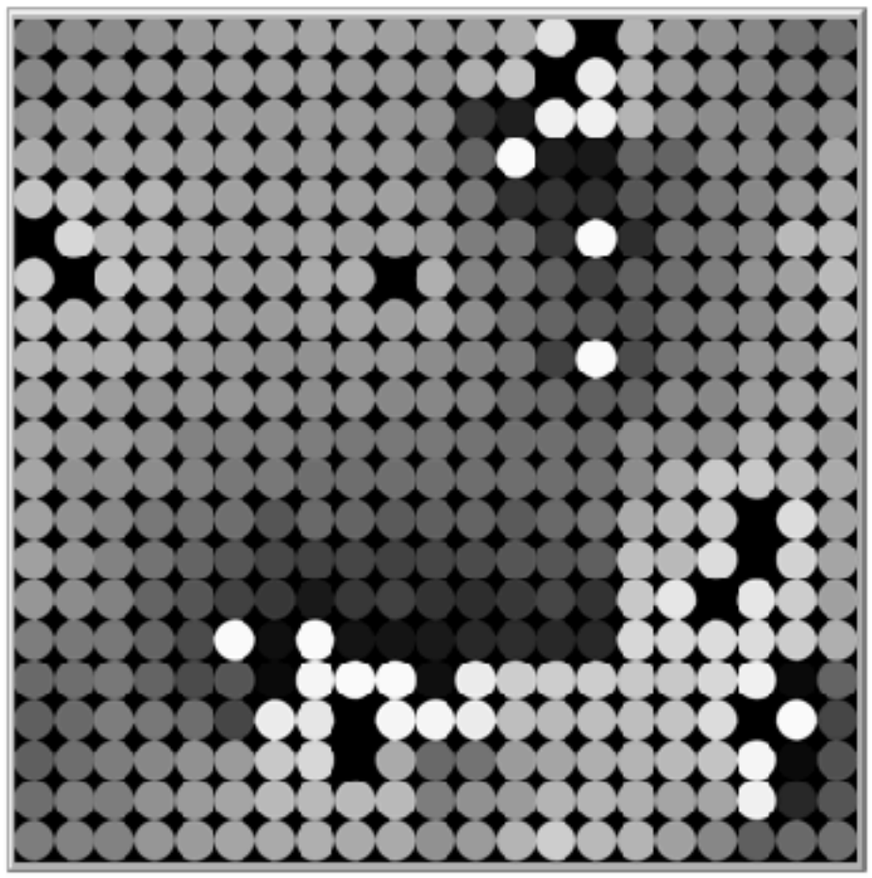


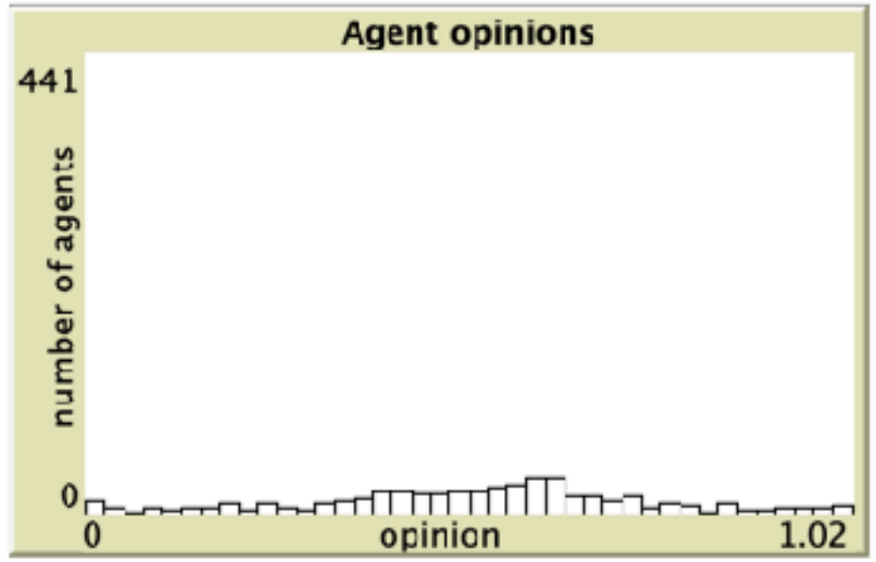
negative influence, $d = 0.1$

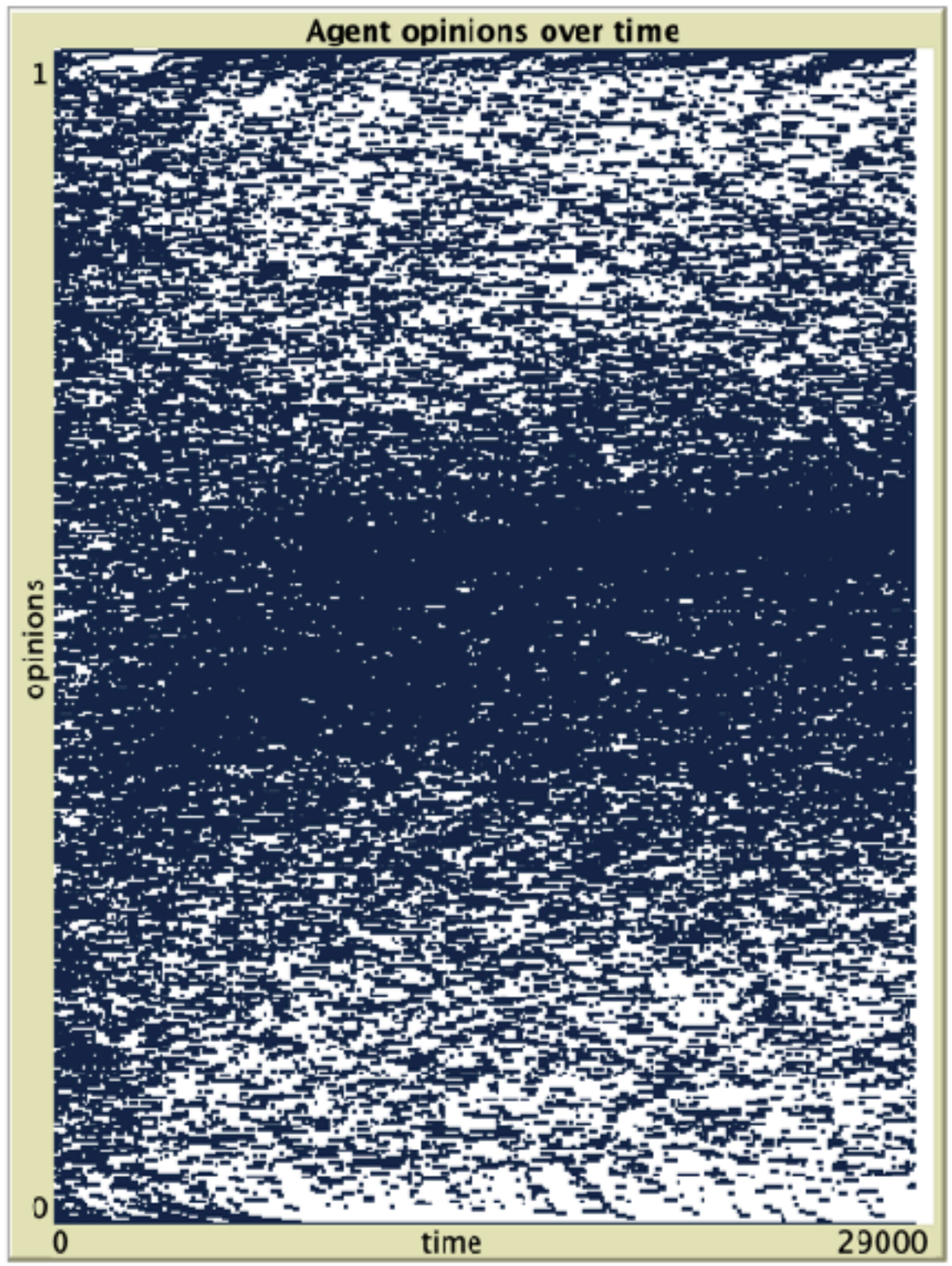


Results (spatial)



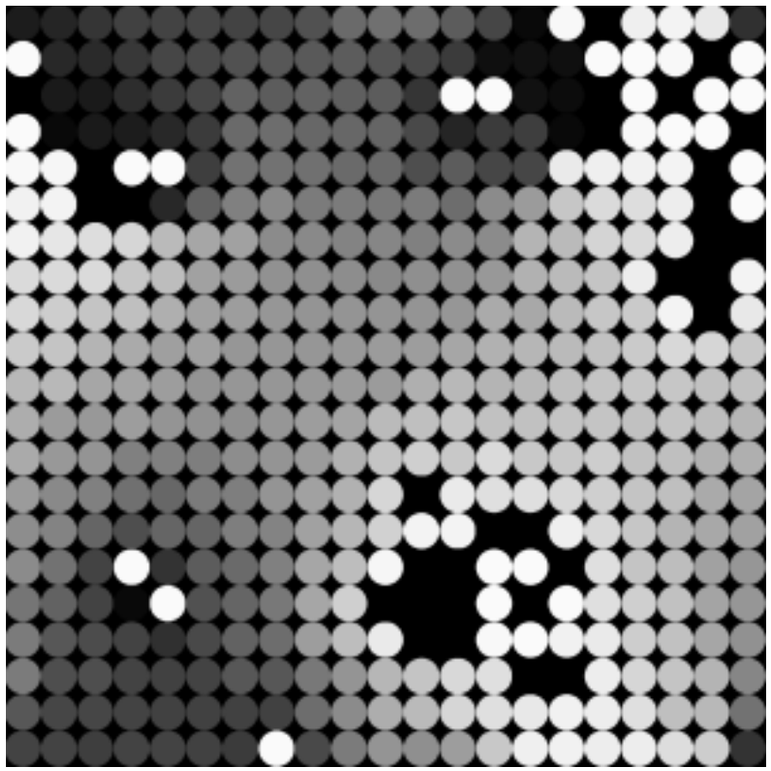




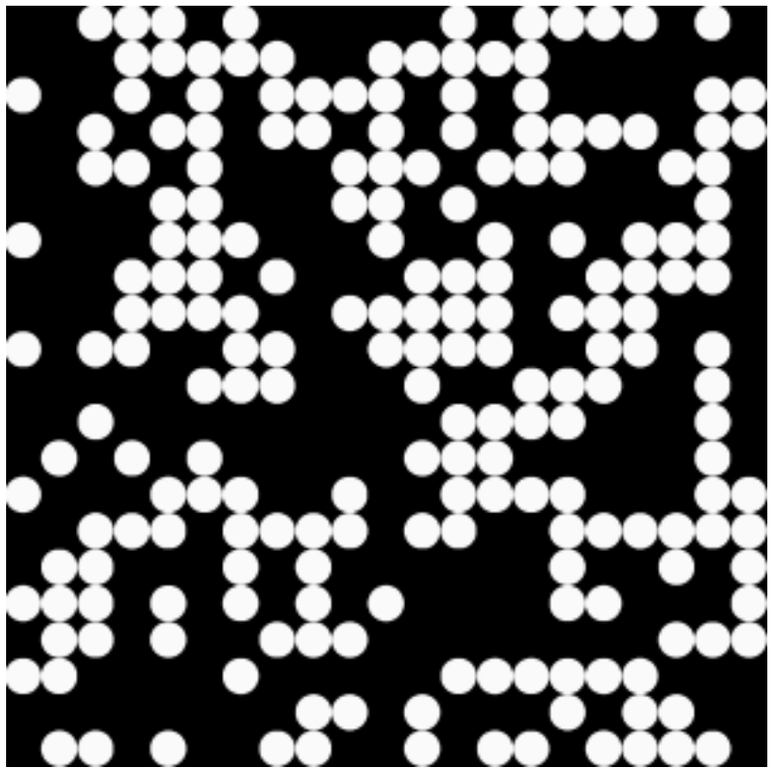


Results (spatial)

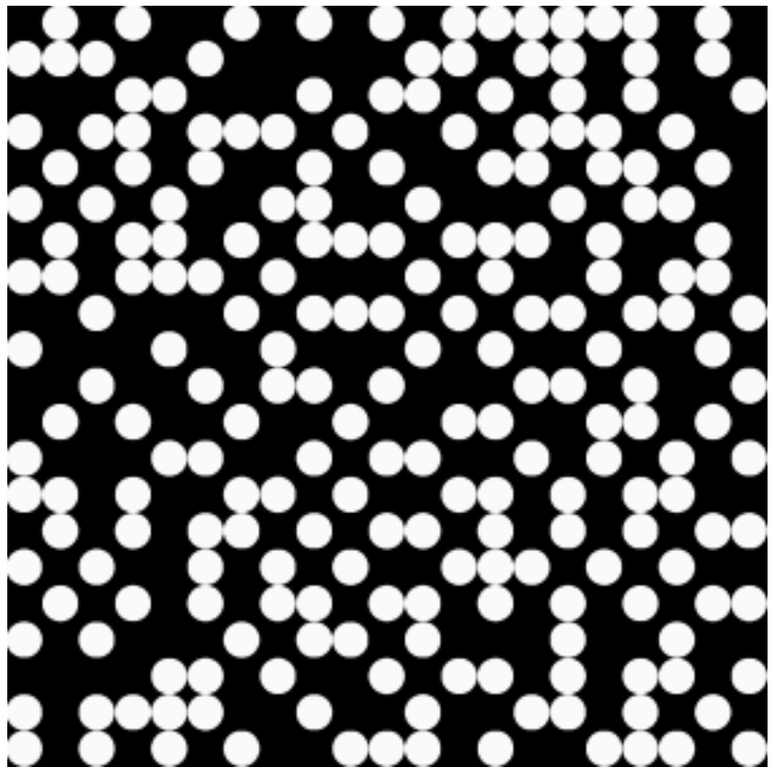
$d = 0.5$, $t = 70{,}000$



$d = 0.35$, $t = 25{,}000$



$d = 0.1$, $t = 25{,}000$



Opinion dynamics: a young field

Further directions

Differentiation

JASSS

Gérard Weisbuch (2015)

From Anti-Conformism to Extremism

Journal of Artificial Societies and Social Simulation 18 (3) 1
<http://jasss.soc.surrey.ac.uk/18/3/1.html>

Received: 06-Jan-2015 Accepted: 19-Mar-2015 Published: 30-Jun-2015

Abstract

We here present a model of the dynamics of extremism based on opinion dynam
emergence and development in large fractions of the general public. Our model
evolution of initially anti-conformist agents to extreme positions. Numerical analy
large fraction of conformists agents to their position provided that they express t
influential parameter controlling the outcome of the dynamics is the uncertainty
higher is the influence of anti-conformists. Systematic scans of the parameter sp
following the conformists uncertainty parameter and the other one following the

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Research

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http://dx.doi.org/10.1098/rsos.140437

Received: 11 November 2014
Accepted: 11 February 2015

Subject Category:
Psychology and cognitive neuroscience

Subject Areas:
theoretical biology/computer modelling and simulation/behaviour

Keywords:
optimal distinctiveness, social influence,

Social conformity despite individual preferences for distinctiveness

Paul E. Smaldino[1,2] and Joshua M. Epstein[2]

[1]Department of Anthropology, University of California, Davis, CA 95616, USA
[2]Center for Advanced Modeling in the Social, Behavioral, and Health Sciences, Johns Hopkins University, Baltimore, MD 21209, USA

1. Summary

We demonstrate that individual behaviours directed at the attainment of distinctiveness can in fact produce complete social conformity. We thus offer an unexpected generative mechanism for this central social phenomenon. Specifically, we establish that agents who have fixed needs to be distinct and adapt their positions to achieve distinctiveness goals, can nevertheless self-organize to a limiting state of absolute conformity. This seemingly paradoxical result is deduced formally from a small number of natural assumptions and is then explored at length computationally. Interesting departures from this conformity equilibrium are also possible, including divergence in positions. The effect of extremist minorities on these dynamics is discussed. A simple extension is then introduced, which allows the model to generate and maintain social diversity, including multimodal distinctiveness distributions. The paper contributes formal definitions, analytical deductions and counterintuitive findings to the literature on individual distinctiveness and social conformity.

Further directions

Multiple interacting opinions

The Dissemination of Culture

A MODEL WITH LOCAL CONVERGENCE AND GLOBAL POLARIZATION

ROBERT AXELROD
School of Public Policy
University of Michigan

Despite tendencies toward convergence
in beliefs, attitudes, and behavior. An agen
convergent social influence. The actors are
an actor is to a neighbor, the more likely that
models of social influence or cultural chang
account the interaction between different fea
global polarization. Simulations show that
number of features, increases with the numb
interaction, and (most surprisingly) decrease

CULTURE AND COMPETITION: HOMOPHILY AND DISTANCING EXPLANATIONS FOR CULTURAL NICHES

NOAH P. MARK
Stanford University

Why do different kinds of people like different kinds of culture? Two answers to this question are formally analyzed and empirically tested: the homophily model and the distancing model. Computer simulation demonstrates that these models are alterna-
stes and practices are con-
f society. Conflicting impli-
nodels predict that cultural
rce on which cultural forms
y model in that the distanc-
forms compete for people,
distancing model, the larger
the smaller is the proportion
l form. The homophily
rms. Instead, it predicts a
y in which a cultural form
ment of society who like
Social Survey data sup-
ompete for people. The
further empirical support
g model's prediction of a
dual ecology.

Layered social influence promotes multiculturality in the Axelrod model

Federico Battiston[1], Vincenzo Nicosia[1], Vito Latora[1] & Maxi San Miguel[2]

Despite the presence of increasing pressure towards globalisation, the coexistence of different cultures is a distinctive feature of human societies. However, how multiculturality can emerge in a population of individuals inclined to imitation, and how it remains stable under cultural drift, i.e. the spontaneous mutation of traits in the population, still needs to be understood. To solve such a problem, we propose here a microscopic model of culture dissemination which takes into account that, in real social systems, the interactions are organised in various layers corresponding to different interests or topics. We show that the addition of multiplexity in the modeling of our society generates qualitatively novel dynamical behavior, producing a new stable regime of cultural diversity. This finding suggests that the layered organisation of social influence typical of modern societies is the key ingredient to explain why and how multiculturality emerges and thrives in our world.

Further directions

Network structure

Small Worlds and Cultural Polarization

Andreas Flache
Department of Sociology–ICS, University of Groningen, Groningen, The Netherlands

Michael W. Macy
Department of Sociology, Cornell University,

Building on Granovetter's theory of the "strengt "small-world" networks suggests that bridges betwe (long-range ties) promote cultural diffusion, hom show that this macro-level implication of network micro-level assumptions. Using a computational m we find that ties between clusters facilitate cu micro-level assumptions of assimilation and attract these assumptions also have negative counterpa phobia. We found that when these negative possib away, the effect of long-range ties reverses: Even between highly clustered communities sharply incr lation level.

Paths to Polarization: How Extreme Views, Miscommunication, and Random Chance Drive Opinion Dynamics

Matthew A. Turner and Paul E. Smaldino

Cognitive and Information Sciences, University of California, Merced, USA

Correspondence should be addressed to Matthew A. Turner; mturner8@ucmerced.edu

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Guest Editor: Martin Hilbert

Understanding the social conditions that tend to increase or decrease polarization is important for many reasons. We study a network-structured agent-based model of opinion dynamics, extending a model previously introduced by Flache and Macy (2011), who found that polarization appeared to increase with the introduction of long-range ties but decrease with the number of salient opinions, which they called the population's "cultural complexity." We find the following. First, polarization is strongly path dependent and sensitive to stochastic variation. Second, polarization depends strongly on the initial distribution of opinions in the population. In the absence of extremists, polarization may be mitigated. Third, noisy communication can drive a population toward more extreme opinions and even cause acute polarization. Finally, the apparent reduction in polarization under increased "cultural complexity" arises via a particular property of the polarization measurement, under which a population containing a wider diversity of extreme views is deemed less polarized. This work has implications for understanding the population dynamics of beliefs, opinions, and polarization as well as broader implications for the analysis of agent-based models of social phenomena.

Further directions

Scientific beliefs

PNAS

Persistence of false paradigms in low-power sciences

George A. Akerlof[a,1] **and Pascal Michaillat**[b,1]

[a]McCourt School of Public Policy, Georgetown University, Washington, DC 20057; and [b]Economics Department, Brown University, Providence, RI 02912

Contributed by George A. Akerlof, October 31, 2018 (sent for review September 24, 2018, reviewed by Carl Bergstrom and Joshua Graff Zivin)

**We develop a model describing how false paradigms r
hindering scientific progress. The model features two
one describing reality better than the other. Tenure
display homophily: They favor tenure candidates wh
their paradigm. As in statistics, power is the probabi
any bias) of denying tenure to scientists adhering t
paradigm. The model shows that because of homop
power is low, the false paradigm may prevail. The
increase in power can ignite convergence to the true
Historical case studies suggest that low power comes
lack of empirical evidence or from reluctance to b
decisions on available evidence.**

scientific progress | paradigms | tenure | homophily | power

Do as I Say, Not as I Do,

or,

Conformity in Scientific Networks

James Owen Weatherall, Cailin O'Connor

Department of Logic and Philosophy of Science
University of California, Irvine

Abstract

Scientists are generally subject to social pressures, including pressures to conform with others in their communities, that affect achievement of their epistemic goals. Here we analyze a network epistemology model in which agents, all else being equal, prefer to take actions that conform with those of their neighbors. This preference for conformity interacts with the agents' beliefs about which of two (or more) possible actions yields the better outcome. We find a range of possible outcomes, including stable polarization in belief and action. The model results are sensitive to network structure. In general, though, conformity has a negative effect on a community's ability to reach accurate consensus about the world.

Next up:

Cooperation