Session 7: Morning

ABM Applications in International Studies

Outline

- Part I: Applications of ABM to comparative politics
  - Research Design
  - ABM methods
  - Presentation
- Part II: Applications to international relations

Part I

ABM Applications (I): Comparative Studies

"Comparative" Method

- Comparative politics: *within* states
  - Factors
    - Culture
    - Political Institutions
    - Collective action dynamics
  - Questions
    - Modernization and economic development
    - Political institutional development
- International relations: *between* states

Research Questions

- **Bennett (2008):** effect of direct vs. indirect tactics on insurgencies
- **Bhavnani (2003):** institutional effectiveness and social capital in Italy
- **Geller and Moss (2008):** neopatrimonialism in Afghanistan
- **Lustick et al. (2004):** repression, responsiveness and secessionism

Research Questions

- Notice policy relevance
  - Clan politics in Afghanistan
  - Secessionism in many states
  - Insurgencies in Iraq, Afghanistan
  - Democratization and civil society

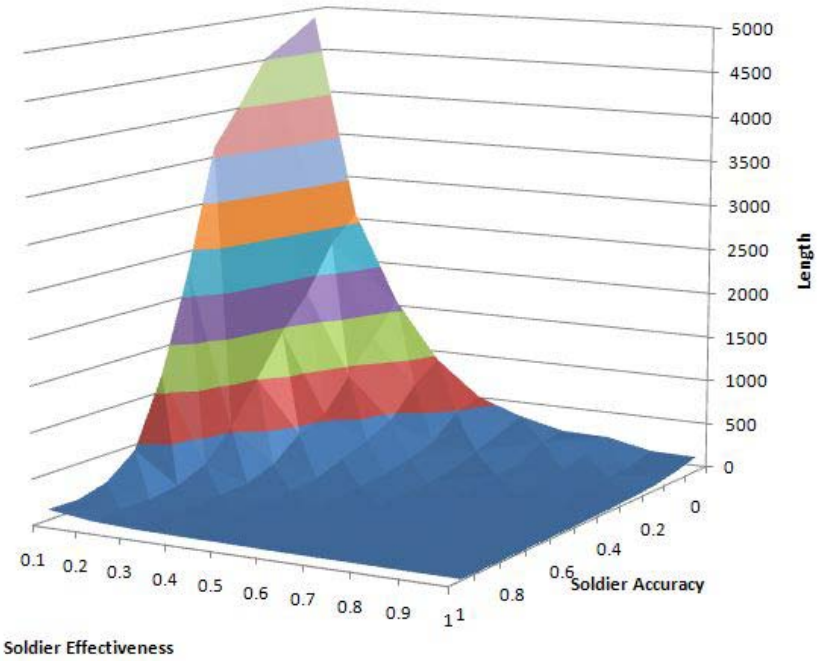
"Emergence"

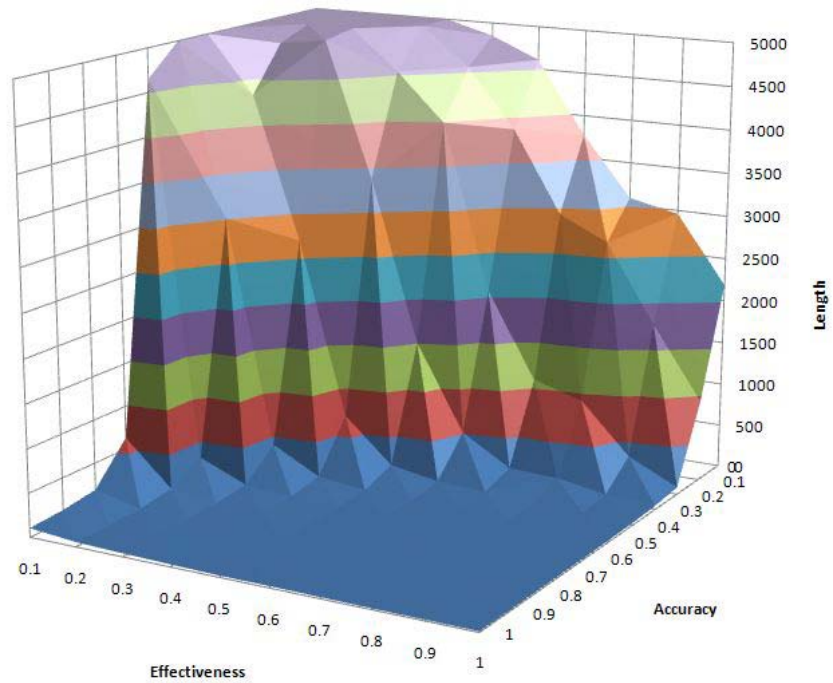
- **Bennett**
  - sustained or total insurgency
- **Bhavnani**
  - social capital or "civicness"
- **Geller and Moss**
  - *qawm* or neopatrimonial networks
- **Lustick et al.**
  - ethnic mobilization, secessionist activity, secessionism

Research Design

- Hypothesis Tests
  - "Fitness landscape" (Bennett)
  - Path history (Bhavnani)
  - Network analysis (Geller and Moss)
  - Statistical tests (Lustick et al.)

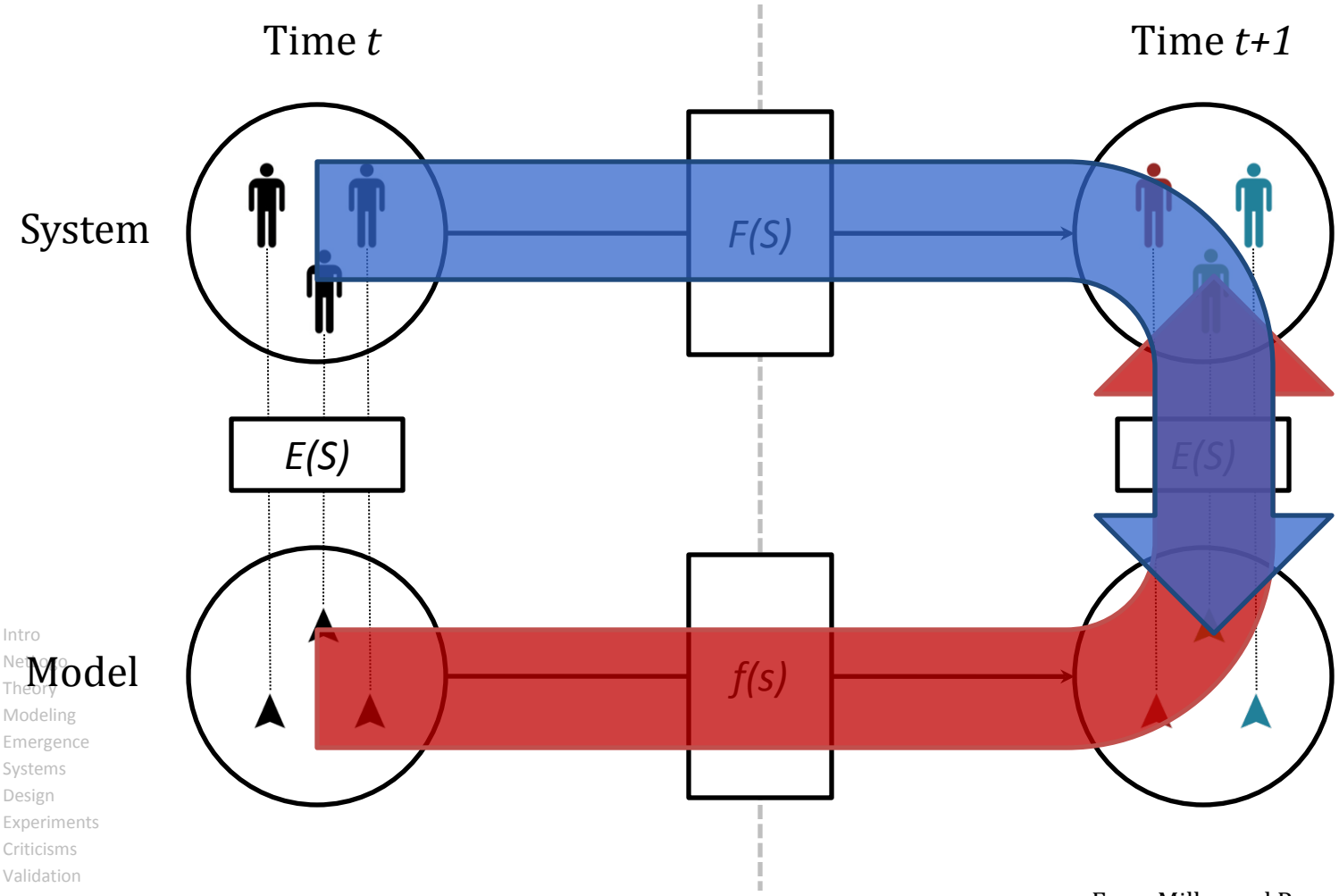
Hypothesis Tests





Bennett 2008, figs. 7 and 10

Model Construction



From Miller and Page, *Complex Adaptive Systems* (2007) p. 38.

Model Construction

- Deductive
  - Bennett
  - Luctick et al.
- Inductive
  - Geller and Moss: "evidence-based model"
  - Bhavnani

Agents

Bennett

Bhavnani

Geller and Moss
Lustick et al.

Number of Simulations

- Bennett: n = 2,750
- Lustick et al.: n = 1,700
- Bhavnani: n = 60
- Geller and Moss: n = 10?

Research Design

- Sensitivity Analysis
  - Explicit (Bennett)
  - Implicit
    - Bhavnani (boundaries vs. none)
  - None (Geller and Moss; Lustick et al.)

Research Design

- Validation
  - Compare to target system
    - Geller and Moss
  - Compare to other findings ("docking")
    - Bhavnani
  - Speculative
    - Bennett
    - Lustick et al.

Simulated Processes (1)

- Recruitment
  - Insurgencies, *qawm*, secessionist movement
- Feedback loops, tipping points
  - Soldiers and insurgents
  - Governments and secessionists
  - Civicness and historical shocks
- "Tag flipping"
  - Geller and Moss: "endorsements"
  - Bhavnani: four cultural features
  - Lustick et al.: twenty identities

Simulated Processes (2)

- Lock-in
  - Insurgencies (Bennett)
  - Social networks (Geller and Moss)
- Interactive effects
  - Accuracy and effectiveness of military operations (Bennett)
  - Repression and representation (Lustick et al.)

Other ABM Methods of Note

- Actor heterogeneity
  - Seed values drawn from distributions
- No centralized direction
  - Bennett: no "master insurgent"
  - Geller and Moss: no "clan leader"
  - Lustick et al.: no "secessionist"
- No genetic algorithms
- **You have all the skills**

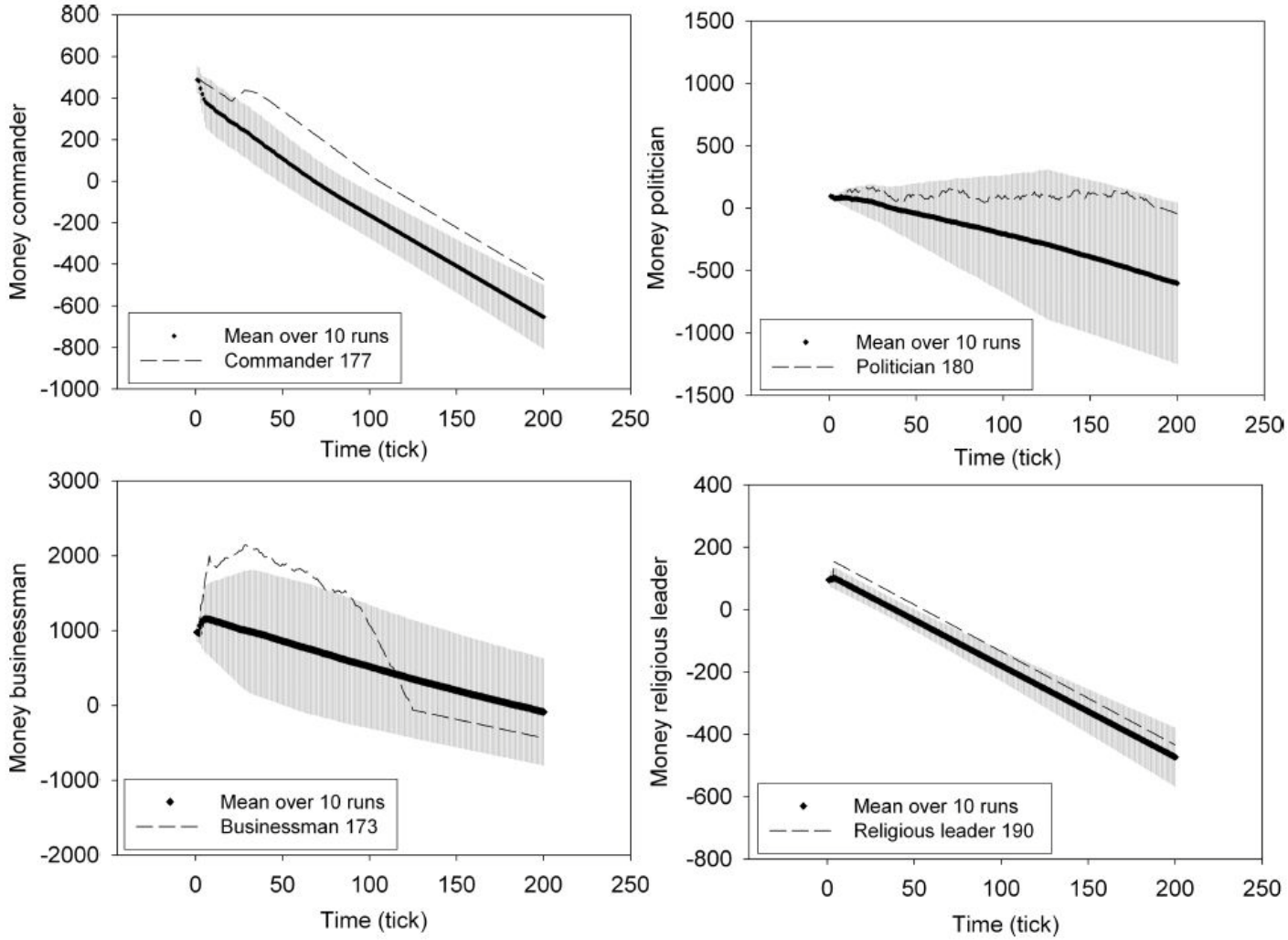
Research Design

- Questions?

Presentation (1)

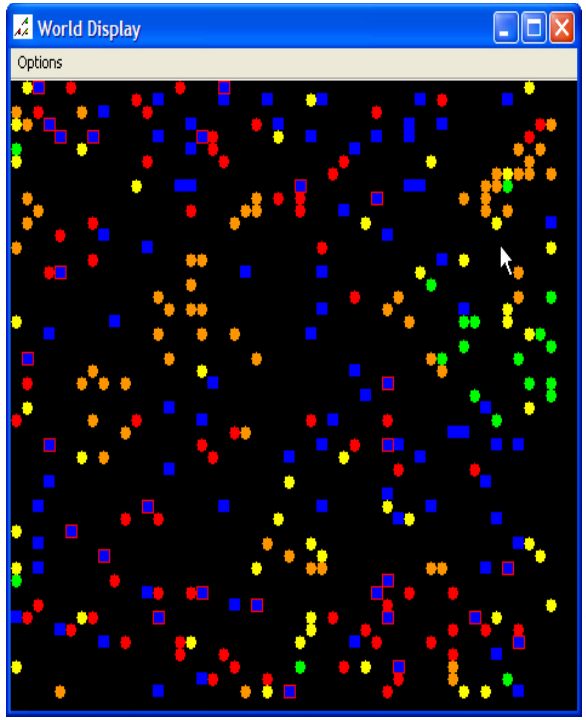
- Figures
  - **Process/flow diagram** (Bhavnani fig. 5)
  - **Screen captures** (Bennett fig. 2; Bhavnani fig. 4; Lustick et al. fig. 1)
  - **Time series** (Bennett fig. 3; Bhavnani fig. 7; Geller and Moss, fig. 4)

Time Series

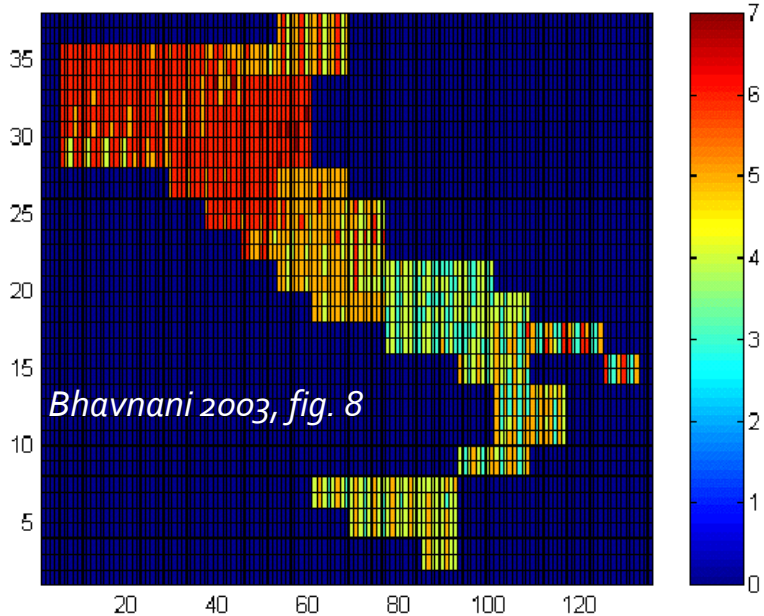


Geller and Moss 2008, fig. 4

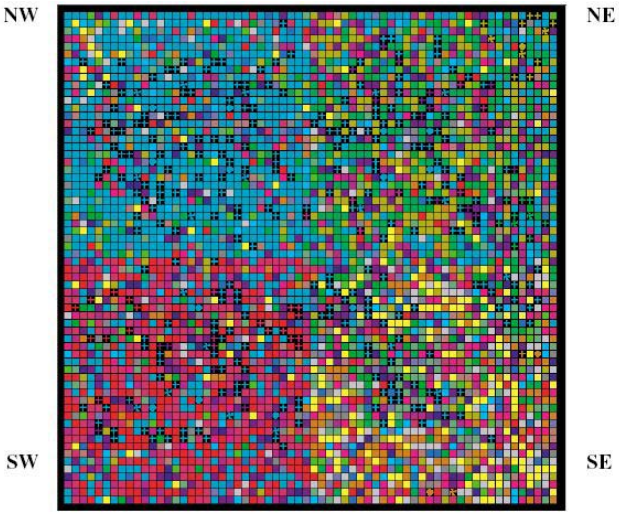
Screen Captures



Bennett 2008, fig. 6



Bhavnani 2003, fig. 8



Lustick et al., fig. 1

Presentation (2)

- Pseudo code
  - In text (Bennett)
  - In appendix (Bhavnani, Lustick et al.)
  - None (Geller and Moss)

Presentation (3)

- Extensions
  - In text (Bennett)
  - In conclusions (Bhavnani, Lustick et al.)
  - None (Geller and Moss)

Random Notes of Interest

- Toolkits
  - RePast
    - Bennett
  - PS-i
    - Lustick et al.
  - Other?
    - Bhavnani; Geller and Moss
- Defense of ABM as a method
  - Lustick et al. are excellent

Questions?

Part II

Applications to
International Relations

Research Questions

- **Axelrod and Bennett (1993):** alignments of states
- **Cederman (2003):** size of war
- **Earnest (2008):** the three-choice problem

"Emergence"

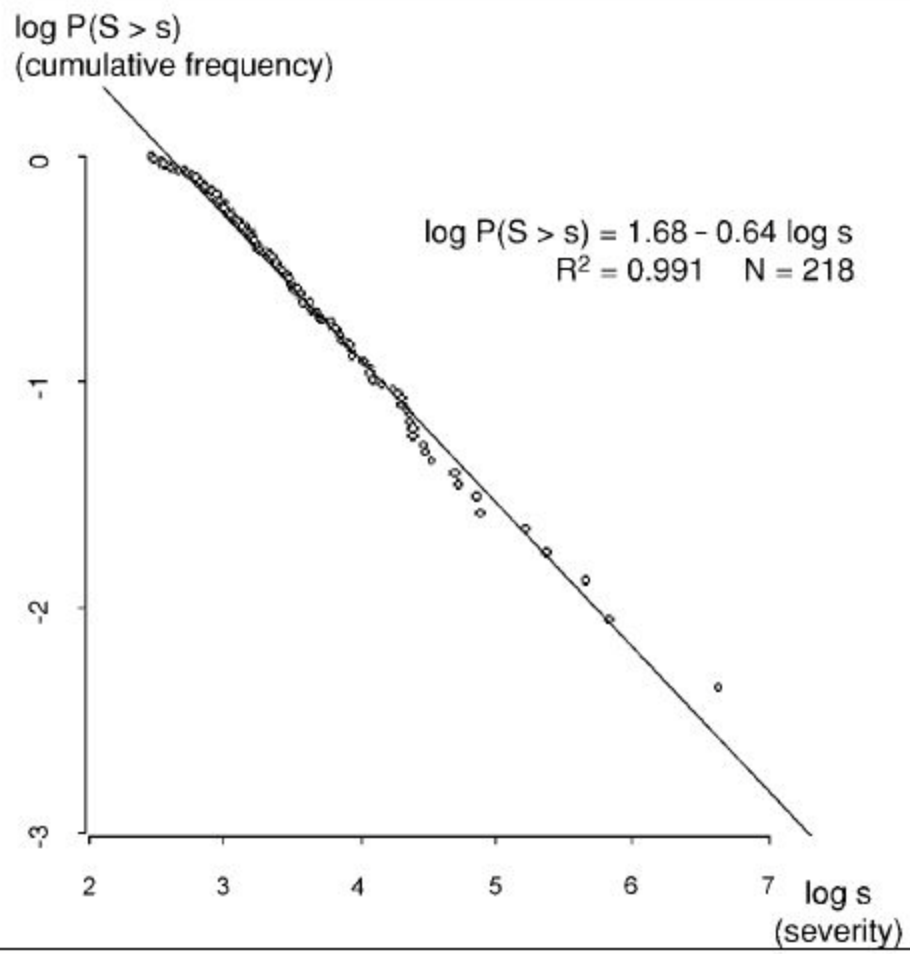
- **Axelrod & Bennett**
  - Stable (i.e. unchanging) alignments
- **Cederman**
  - Frequency of large war
- **Earnest**
  - Cycling majorities

Research Design

- Hypothesis Tests
  - P-values (Axelrod & Bennett)
  - Frequency distribution, goodness of fit (Cederman)
    - Note: no F-tests
  - Genetic algorithm (Earnest)

Hypothesis Tests

FIGURE 6. Simulated Cumulative Frequency Distribution in the Representative Sample Run



Cederman 2003, p. 142

Hypothesis Tests

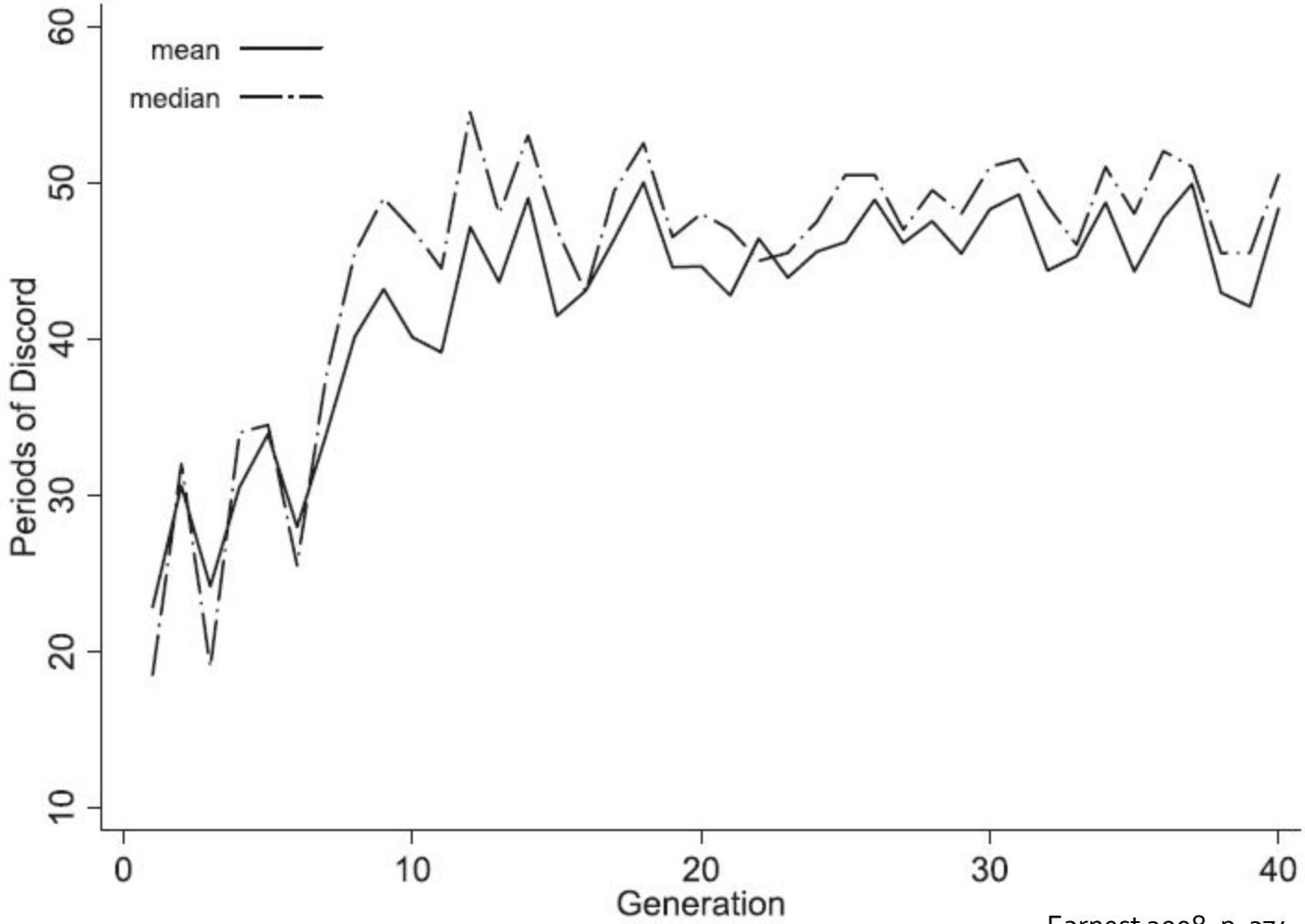
TABLE 1. Replication Results Based on 15 Runs of Each System

	Slope Coefficient D			R^2			Range	N Wars
	Min.	Median	Max.	Min.	Median	Max.	(Median)	(Median)
Main results								
1. Base runs	−0.64	−0.55	−0.49	0.975	0.991	0.996	4.2	204
2. Smaller shocks[a]	−0.71	−0.62	−0.56	0.968	0.980	0.993	3.7	267
3. No shocks	−1.43	−1.32	−1.17	0.878	0.941	0.975	1.4	132
4. No context activation	−1.52	−1.34	−1.20	0.835	0.882	0.934	1.6	696
Sensitivity analysis								
5. `warShadow=10`	−0.69	−0.60	−0.53	0.966	0.990	0.996	4.2	325
6. `warShadow=40`	−0.60	−0.50	−0.45	0.970	0.989	0.997	4.2	148
7. `supThresh=2.5`[a]	−0.62	−0.53	−0.46	0.965	0.984	0.991	4.3	210
8. `propMobile=0.9`	−0.65	−0.58	−0.53	0.954	0.987	0.992	4.3	250
9. `distOffset=0.2`	−0.72	−0.52	−0.43	0.908	0.990	0.995	4.4	211
10. `distSlope=5`	−0.60	−0.53	−0.46	0.974	0.986	0.991	4.3	217
11. `nx` × `ny`=75 × 75	−0.67	−0.59	−0.54	0.987	0.993	0.996	4.6	502

Note: See Table A1 for explanations of the parameter names.
[a] Based on runs with `shockSize` = 10 instead of 20.

Cederman 2003, p. 143

Hypothesis Tests



Earnest 2008, p. 374

Model Construction

- Deductive
  - Earnest
- Inductive
  - Axelrod & Bennett
  - Cederman

Agents

Axelrod & Bennett
Cederman

Earnest

Number of Simulations

- Axelrod & Bennett: n = 65,536
- Cederman: n = 165
- Earnest: n = 3,200

Research Design

- Sensitivity Analysis
  - Explicit
    - Cederman (manual)
    - Earnest (Miller's ANT method)
  - None
    - Axelrod & Bennett

Research Design

- Validation
  - Compare to target system
    - Axelrod & Bennett
    - Cederman
  - Compare to other findings ("docking")
    - Earnest

Validation

- Axelrod & Bennett, p. 223

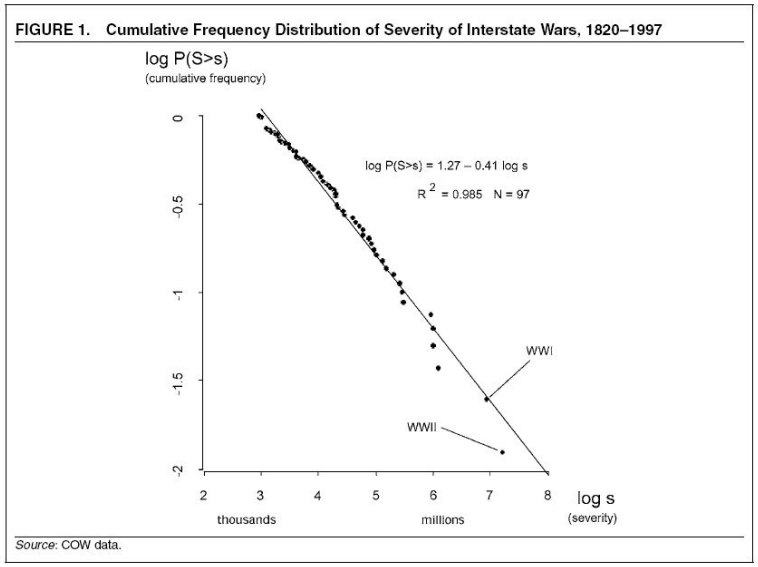
TABLE 1 *The Two Configurations Predicted for the Second World War in Europe**

		Configuration 1	
		Alignment 1	Alignment 2
Configuration 2	Alignment 1	Britain (7.45) France (5.32) Czechoslovakia (1.15) Denmark (0.20)	Germany (11.49) Italy (4.03) Poland (1.83) Romania (0.78) Hungary (0.45) Portugal (0.27) Finland (0.19) Latvia (0.13) Lithuania (0.10) Estonia (0.06)
	Alignment 2	Soviet Union (15.01) Yugoslavia (0.59) Greece (0.35)	(None)
Nearest empirical match†		Allies (and those invaded by Germany)	Axis (and those invaded by the Soviet Union

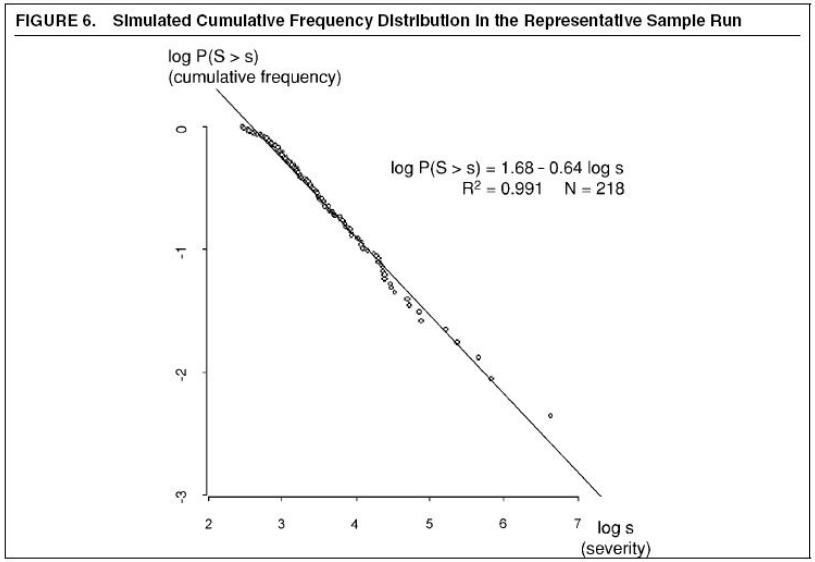
*The size is shown in parentheses, in terms of percentage of world capabilities. The predicitons are based upon 1936 data.
†In Configuration 1, only Poland and Portugal are wrong.

Validation

- Cederman



Cederman 2003, p. 136



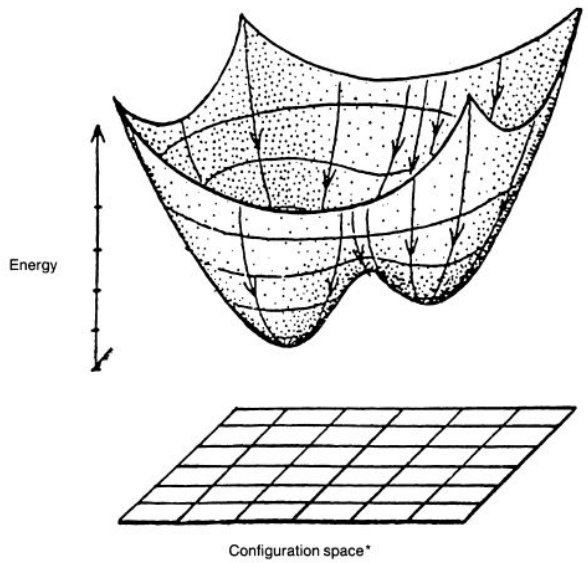
Cederman 2003, p. 142

Simulated Processes (1)

- Aggregation
  - Axelrod & Bennett
  - Cederman: "Self-organized criticality" or SOC
- Recruitment
  - Formation of alliances
- Feedback loops, tipping points
  - Between levels in a two-level game (Earnest)

Simulated Processes (2)

- Lock-in
  - Landscape minima (Axelrod and Bennett)
  - Social choices (Earnest)



Axelrod & Bennett, p. 215

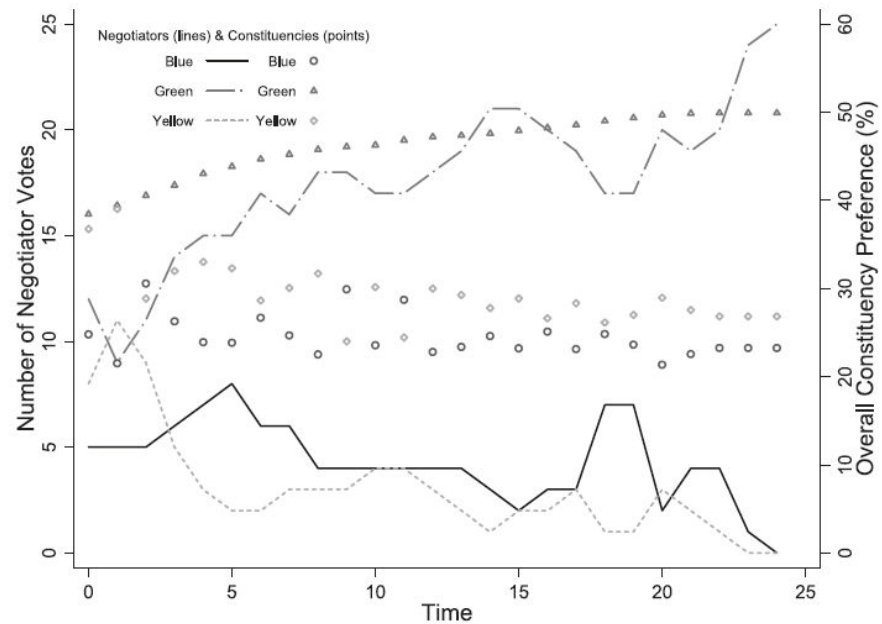


FIG. 4. An Example of a Coordinated Social Choice at $t = 24$

Earnest 2008, p. 376

Other ABM Methods of Note

- Actor heterogeneity
  - Seed values drawn from distributions (Cederman)
  - Functional differentiation (Earnest)
- No centralized direction
  - No hegemons or "great powers" in any of the three models

Research Design

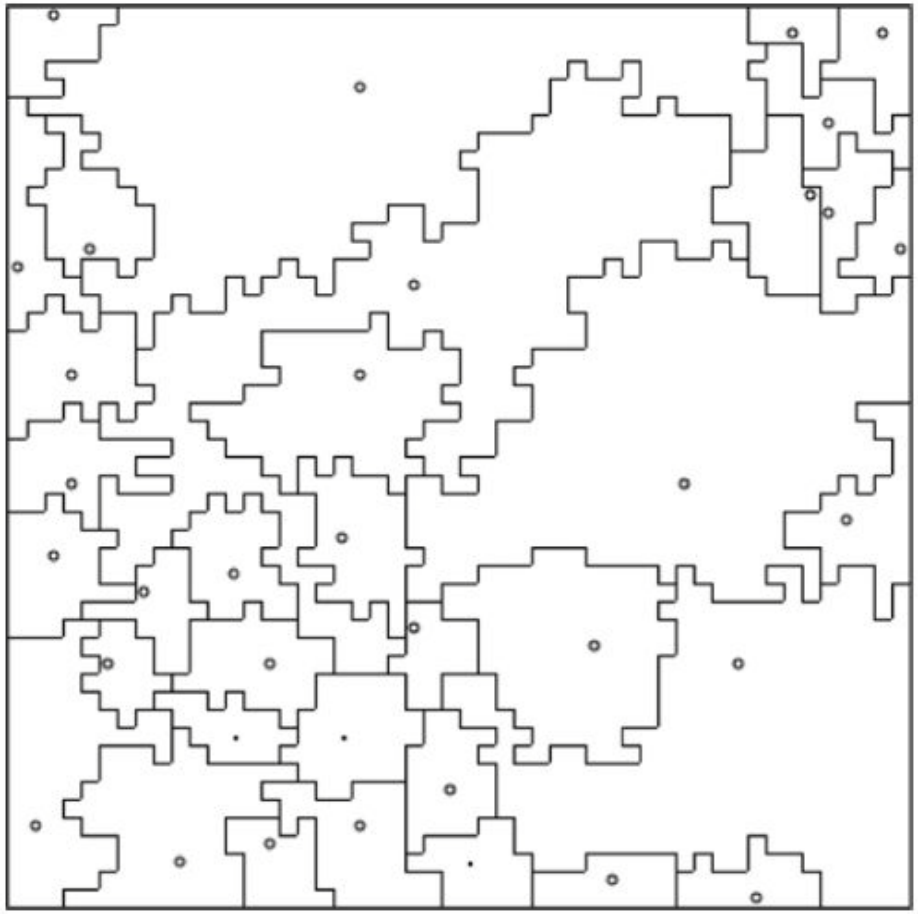
- Questions?

Presentation

- Figures
  - **Process/flow diagram** (Earnest fig. 1)
  - **Screen captures** (Cederman, figs. 3 and 4)
  - **Time series** (Earnest figs. 2 and 3)
  - **Distributions** (Cederman figs. 7 and 8)

Screen Captures

FIGURE 5. The Final State of the Sample Run at Time 10,500



Cederman 2003, p. 142

Presentation (2)

- Metacode
  - In text (Earnest)
  - In appendix (Cederman)
  - None (Axelrod and Bennett)

Presentation (3)

- Extensions
  - In text (Axelrod and Bennett)
  - In conclusions (Cederman, Earnest)

Random Notes of Interest

- "Boundary effects" (Cederman)
- Toolkits
  - RePast
    - Cederman
  - NetLogo
    - Earnest
  - Other
    - Axelrod & Bennett

Final Questions?