Multiplayer Games and the Evolution of Norms

Models and Simulations in Philosophy
May 28th, 2013

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  - ABMs: Network Models
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    - Small-Worlds
    - Bounded degree
    - Dynamic

From Two-Player to Multi-Player Games

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- Examples: Multi-player analogs of two-person games
  - Prisoner's Dilemma: Keeping Munich's streets clean requires the cooperation of many individuals
  - Stag Hung: Rowing the Viking Boat
- So it may be more appropriate to identify norms with behaviors in multi-player games.

Today: How do we model the evolution of norms in multi-player games?

Outline

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In two-person games, recall, Alexander considers two types of models:

- Replicator Dynamics
- Network Models

In multi-player games, he considers only the latter.

Proposal:

- In Alexander's previous network models, agents play the same two-person game with each of their neighbors in the network.
- Analogously, agents should play the same multi-player game with **all** their neighbors in the network.

Problem:

Problem: Agents have different numbers of neighbors. So, in some sense, not all agents can play the exact same game, as some will play two-person games, others three-persons, others 43 person games, etc.

- Note: This is not simply a formal problem. In real-life, residents of Wyoming have far fewer inter-personal interactions that residents of New York city.

Problem 2: In order to consider cooperation, trust, etc. in multi-player games, we'd like the payoff matrices in multi-player games to be "similar" (in some sense) to those of the two-person prisoner's dilemma, stag hunt, etc.

Brainstorm: How do we model the evolution of norms in multi-player games?

Here's how [Alexander, 2007] does it.

For any number n, in an n-person stag hunt (or prisoner's dilemma, etc.):

- Each player has only two actions (e.g. stage and hare), which are those available in the corresponding two-person game.

Alexander's Approach

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  - The proportion of her fellow players that hunt stag (or cooperate, etc.)
- Hence, the games are similar in that they share (1) the same action set, and (2) the same payoff function.

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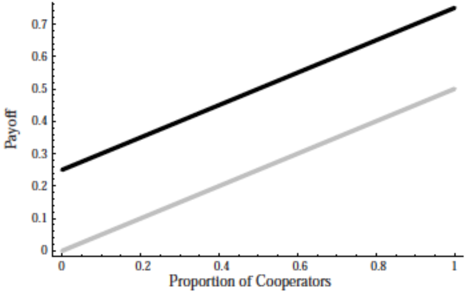

Figure 7.4 A multiplayer prisoner's dilemma. The black line represents the payoff curve for Defect, the gray line the payoff curve for Cooperate ($m = \frac{1}{2}$, $c_i = 0$, and $d_i = \frac{1}{4}$).

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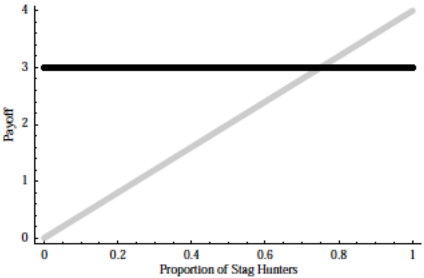

Figure 7.11 A payoff function for the multiplayer Stag Hunt.

Using these payoff functions, we can now simulate agents in a network playing multi-player games.

Note: As in the two-player case, agents employ the same strategy in all multi-player games in which they participate.

In particular, one **could** consider the same types of networks that Alexander considered in the two-person case:

- Lattice
- Small-Worlds
- Bounded Degree
- Dynamic

Types of Networks

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Alexander does not.

Types of Networks

In Chapter 8, Alexander [2007] considers

- Two Dimensional Lattices
- Rings
- One additional type of network that he did not consider in the two-player case . . .

- Some networks represent "proximity" (e.g., often lattice networks);
- Others don't (e.g. co-authorship networks)

To model interactions that are constrained by spatial-proximity, Alexander embeds agents in a grid.

He then defines a network by connecting agents who are close in the spatial grid.

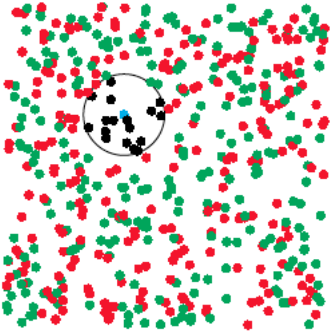

Figure 7.2 A proximity model of local interactions.

Dynamic Networks

To create dynamic networks, he simulates agents moving randomly around the grid, which changes the corresponding proximity network.

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Alexander does not consider analogs of dynamic networks developed in previous chapters.

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- Absolutely not. Books can contain only so much material.
- As you prepare for your final project, you should think about the models you've seen thus far, their virtues and vices, how they might be modified, etc.
- One way to do so is to see whether the models you've learned thus far have been employed in all areas in which they are applicable.

Next Week: We'll discuss

- Why we model,
- Properties of good models
- What the types of models we have encountered thus far can do, and so on.

Come prepared to discuss the questions on the following slides. I will not lecture.

Group discussion questions: What are the virtues and drawbacks of modeling norms and their evolution in this way? In particular:

1. What does the game-theoretic modeling allow one to do that an informal discussion of norms may not?

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2. When one identifies a norm, say trusting, with a particular action in a game, are there any features of the norm that are not captured in the model? If so, do the assumptions matter for explaining the evolution of the norm?
3. When one identifies interaction with playing a game, are there any features of human interactions that are not represented and which may matter for the evolution of norms?

Topics

Topics we'll discuss today:

- Three Types of Agents: Turtles, Patches, and Links
- Accessing agent variables
- Creating Agentsets

References I

Alexander, J. M. (2007). *The structural evolution of morality*. Cambridge University Press Cambridge.