

Why Use Agent-Based Modeling?

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Theory & Tools

- A tool, whatever its form, is not a theory.
- A theory is a set of testable propositions about a phenomenon, and it can be created using a variety of tools including verbal descriptions, mathematical models, and computational models.

Theory & Tools

- The predominant tools used in the development of theories in Political Science are verbal descriptions (or “**mental**” **models**) and **mathematical models** (primarily, game-theoretic).
- There are many reasons to favor one tool over another to create a theory but there is no *a priori* reason to think that one tool is better than alternative tools in all (or even most) situations.

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- The possession of a tool that simplifies the development and refinement of theories concerning complex questions is an important step toward developing a science.
- Part of the motivation for relying on the game-theoretic approach is the perception that the testing of political (or other) phenomena is extremely difficult, and therefore the logical foundations of the model must be fully secure.

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- Arguments about whether “mental”, game-theoretic, or computational models are good or bad are somewhat misplaced.
- Different tools are good for different things.
- Tools need to be judged by their ability to enhance the scientific enterprise; theories need to be judged by how well they are able to improve our understanding of the world around us, and not by what tools we used to derive them.

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- It has been argued (by some) that game-theoretic, or mathematical models more generally, are superior to non-mathematical tools because they can provide additional insight into the underlying processes or provide new theoretical directions in other domains.
- These arguments implicitly assume that no such insights or directions will be forthcoming from other approaches.

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- Usually, such deductive certainty comes at the cost of being willing to sufficiently narrow the problem, so the real issue is what conditions guarantee the outcome.
- If the conditions guaranteeing the outcome are excessively onerous, we may well be willing to accept some inexactness in our predictions in return for more favorable circumstances.

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- If the task we face corresponds with the simplification, then the tool will be of value.
- On the other hand, if it does not, then, regardless of the quality of the tool, the outcome will suffer (even with the best screwdriver, a hammer is a better tool to put a nail in a wall).

Agent-Based Models

Modeling Potential

| Traditional Tools | Agent-Based Models |
|--------------------------|-----------------------|
| Precise | Flexible |
| Little process | Process Oriented |
| Timeless | Timely |
| Optimizing | Adaptive |
| Static | Dynamic |
| 1, 2, or ∞ agents | 1, 2, ..., N agents |
| Vacuous | Spacey/networked |
| Homogeneous | Heterogeneous |

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- This disconnection implies that, within limits, the details of the local behavior do not matter to the aggregate outcome, that is, the aggregate patterns should be immune to reasonable variations in the individual behavior.
- As Anderson (1972) says, “the whole becomes not only more than but very different from the sum of its parts.”

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- What would have happened if people were not vaccinated for smallpox?

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- Choose the right tool for the right problem.
- Learn new tools if necessary (even if it takes a little time).