# Modeling Schelling: A Demonstration of the Value of Agent-Based Modeling

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**Abstract:** The aim of this paper is to demonstrate the usefulness of agent-based models for formalizing the notion of emergent orders. The method by which it will do so is to attempt to capture each of the models offered in Thomas Schelling’s *Micromotives and Macrobehavior* in an agent-based model. We will demonstrate how these models can serve as formal proofs (or disproofs) of the correctness of Schelling’s (mostly verbal) reasoning.

**Keywords:** Schelling, emergent order, agent-based modeling

### Introduction

The aim of this paper is to demonstrate the usefulness of agent-based models for formalizing the notion of emergent orders. The method by which it will do so is to attempt to capture each of the models offered in Thomas Schelling’s *Micromotives and Macrobehavior* in an agent-based model. We will demonstrate how these models can serve as formal proofs (or disproofs) of the correctness of Schelling’s (mostly verbal) reasoning.

### I. Agent-Based Models and Emergent Orders

Schelling:

“To make that connection [between individual’s intentions and aggregate outcomes] we usually have to look at the system of interaction between individuals in their environment, that is, between individuals and other individuals or between individuals and the collectivity. And sometimes the results are surprising. Sometimes they are not easily guessed. Sometimes the analysis is difficult. Sometimes it is inconclusive.” (2006: 14)

Axtell comments upon how agent-based models fit into the broader world of models as follows:

One such use — the simplest — is conceptually quite close to traditional simulation in operations research. This use arises when equations can be formulated that completely describe a social process, and these equations are explicitly soluble, either analytically or numerically. In the former case, the agent model is merely a tool for presenting results, while in the latter it is a novel kind of Monte Carlo analysis. A second, more commonplace usage of computational agent models arises when mathematical models can be written down but not completely solved. In this case the agent-based model can shed significant light on the solution structure, illustrate dynamical properties of the model, serve to test the dependence of results on parameters and assumptions, and be a source of counter-examples. Finally, there are important classes of problems for which writing down equations is not a useful activity. In such circumstances, resort to agent-based computational models may be the only way available to explore such processes systematically, and constitute a third distinct usage of such models. (Axtell, 2000)[[1]](#footnote-1)

### II. The Models

#### Schelling’s Segregation Model

As Schelling pointed out, it is not necessary for all or even most individuals to want to live in a largely segregated neighborhood for such neighborhoods to arise: all that is needed is for most people not to want to be “too small” a minority in their neighborhood. We have implemented this model, and it indeed plays out as Schelling saw: once a “tolerance” threshold is set somewhat below 50%, neighborhoods will tend to become almost completely segregated.

This model also demonstrates our ability to experiment with these constructs: one of my students has been creating groups with different tolerance levels, adding additional groups, and so forth, with interesting results.

By making the tolerance level a range, rather than a single scalar, we see neighborhoods that are “ragged at the edges”: instead of clean divides when we reach equilibrium, like we got with a single tolerance number, there are a scattering of highly tolerant agents “hanging around” the edges of neighborhoods where they are a distinct minority.

An interesting finding of our work, showing the value of formalizing verbal reasoning, is the Schelling added an unnecessary condition: that the new neighborhood to which an agent moves most be acceptable, since merely random moves suffice to produce the phenomenon he describes. Furthermore, that unnecessary condition can cause our model to run forever: it is quite possible that there is no acceptable neighborhood for some combination of parameters, so that an attempt to randomly move to one, with no check on the number of attempts, will never terminate.

### Conclusion

### Bibliography

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1. See also Downey (2012: 43-44) for another discussion of this same topic. [↑](#footnote-ref-1)