Chapter IX
Synthesis Over Analysis:
Towards an Ontology for Volume Crime Simulation

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ABSTRACT

This chapter examines the use of computer simulation, specifically agent-based modeling, as a tool for criminologists and its potentially unique ability to examine, test, refine, and validate criminological theory. It suggests an approach to be taken by those working in this field, through the use of detailed examples of the processes necessary to define, produce, and populate both a simple model of general offending and a more detailed model for domestic burglary. It further suggests methods for evaluating such models, particularly calling for collaborative research and model replication. The authors hope that this chapter will act as a step towards an accepted ontology for volume crime simulation.

INTRODUCTION

In this chapter we will consider the use of simulation—specifically agent-based modeling—as a tool for criminologists. We suggest, from our experience and the research of others, an approach that could be followed by those working in this field, and lay out the beginnings of a framework within which to proceed: an ontology for crime simulation.

The aims of this chapter are: to describe our attempt to create a sufficiently complex and repre-

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sentative simulation that will allow the modeling and evaluation of individual level offender decision-making, thus demonstrating how practical inferences could be drawn from its conclusions; to situate our research within the state of current knowledge; and to propose a structure for further advancement of research in this area.

To this end, we will take the following steps. Firstly, we will consider the three main theories that have informed our research: routine activity theory, rational choice perspective, and crime pattern theory. An overview of these opportunity theories will be provided before we discuss the problems faced when attempting to verify them empirically. We will highlight the gap between the theoretically explained, individual (micro) level decision-making processes and the observed, and thus tested, aggregate (macro) level crime patterns that result from these. We will suggest that one potential method of narrowing this gap is the use of computer simulations of crime, and will show a growing interest in such an approach amongst leading criminologists. We will explain how simulations can be used to test, refine and validate opportunity theories, and the concepts they include, as well as providing an environment for *in silico* experiments. In order to discuss simulation in more detail, we will provide the reader with a brief overview of agent-based modeling and set the scene yet further with a discussion of how this has been, and in the future could be, applied to criminological endeavors. We will specifically focus on how the opportunity theories lend themselves to the decomposition, and subsequent formulism, required by agent-based modeling.

Next, we will turn to the more practical considerations of applying this technique to the theories discussed. In the first instance, we will present a simple model of victimization and detection which is used as an example of theory formalism and model construction. An interactive program will also be provided for the reader. Having laid these foundations, we will introduce the research from which this chapter is born. This will involve a detailed presentation of a bespoke (i.e., custom-made) working agent-based model. We will discuss how to construct and populate the simulation environment and provide an overview of the control paradigm employed and its importance to our approach. We will again show how the theory informing this research is decomposed and formalized into a series of behaviors which determine how the agents in the model perceive, reason and act. In order to do all this, we will highlight a number of assumptions that have to be made. We will explain that, whilst some of these may be unproven, one of the purposes of using simulation techniques is to test the effects such assumptions have on the model output, in order to verify or disprove them.

Having provided sufficient detail about the model we have produced, we will discuss how simulations such as this may be evaluated. We will briefly consider the merits of a replicative approach and make a call for debate in this area. We will then attempt to evaluate, by comparison, our working model, which has been populated with data sets pertinent to domestic burglary. We will describe how the initial output—the pattern produced by an aggregation of individual-level decisions and resulting actions—indicates the presence of spatio-temporal clustering, as observed in analyses of real-world crime data.

Moving away from this specific application, we will finally present a suggested approach to further research in this field, listing a number of considerations which we feel should be followed to best take this method forward. These will be based on what we have learnt from carrying out this research. Specifically, throughout the chapter, we will call for the use of a modular and scalable architecture which allows for the incremental construction of models and efficient sharing and implementation of ideas and relevant research findings. We will detail the steps we intend to take to advance our model, including the use of further datasets and crime schema, and the refinement

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