



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**POLICING FOR THE 22ND CENTURY:
A COMPLEXITY THEORY-BASED APPROACH**

by

Brian T. Hollan

March 2021

Co-Advisors:

Glen L. Woodbury
Christopher Bellavita (contractor)

Approved for public release. Distribution is unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE March 2021	3. REPORT TYPE AND DATES COVERED Master's thesis		
4. TITLE AND SUBTITLE POLICING FOR THE 22ND CENTURY: A COMPLEXITY THEORY-BASED APPROACH			5. FUNDING NUMBERS	
6. AUTHOR(S) Brian T. Hollan				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (maximum 200 words) Although many alternatives to the standard model of policing have been proposed, none of them meaningfully engages with the massive social and technological changes that have occurred since the mid-20th century. This thesis asks if complexity theory can serve as a theoretical foundation for a new model of policing. Literature on complexity, complex adaptive systems, and network theory is examined and finds that observed behavior of street robberies in Washington, DC, can be understood as a complex adaptive system. This thesis concludes that it is vital to recognize that the United States is transitioning into an informational, network-based society increasingly governed by nonlinear, dynamic processes. It also concludes that the present dissatisfaction with the state of policing is due to its institutional misalignment with those social dynamics. Several recommendations are offered on how to educate and structure police agencies to function effectively in complex environments.				
14. SUBJECT TERMS complexity, complex adaptive system, network, netwar, policing, cynefin			15. NUMBER OF PAGES 163	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

**POLICING FOR THE 22ND CENTURY:
A COMPLEXITY THEORY-BASED APPROACH**

Brian T. Hollan
Lieutenant, Metropolitan Police Department
BA, Catholic University of America, 2005

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(HOMELAND SECURITY AND DEFENSE)**

from the

**NAVAL POSTGRADUATE SCHOOL
March 2021**

Approved by: Glen L. Woodbury
Co-Advisor

Christopher Bellavita
Co-Advisor

Erik J. Dahl
Associate Professor, Department of National Security Affairs

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

Although many alternatives to the standard model of policing have been proposed, none of them meaningfully engages with the massive social and technological changes that have occurred since the mid-20th century. This thesis asks if complexity theory can serve as a theoretical foundation for a new model of policing. Literature on complexity, complex adaptive systems, and network theory is examined and finds that observed behavior of street robberies in Washington, DC, can be understood as a complex adaptive system. This thesis concludes that it is vital to recognize that the United States is transitioning into an informational, network-based society increasingly governed by nonlinear, dynamic processes. It also concludes that the present dissatisfaction with the state of policing is due to its institutional misalignment with those social dynamics. Several recommendations are offered on how to educate and structure police agencies to function effectively in complex environments.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	PROBLEM STATEMENT	1
B.	RESEARCH QUESTION	4
C.	LITERATURE REVIEW	4
1.	Complexity and Complex Adaptive Systems.....	5
2.	Networks and Netwar	8
3.	Summary.....	16
D.	RESEARCH DESIGN	16
E.	ROADMAP	18
II.	COMPLEXITY THEORY.....	19
A.	LINEAR THINKING	19
B.	COMPLEXITY THEORY AND COMPLEX ADAPTIVE SYSTEMS.....	23
C.	OBJECTIONS TO COMPLEXITY	30
III.	NETWORKS AND NETWARS	33
A.	NETWORKS AND COMPLEXITY.....	33
B.	NETWORKS AND SOCIETY	38
C.	NETWAR—A THEORY OF CONFLICT IN THE INFORMATION AGE	43
D.	COMPLEXITY AND NETWAR	48
IV.	COMPLEXITY, NETWORKS, AND CRIME	53
A.	LINEAR VIEWS OF CRIME	53
B.	A COMPLEX VIEW OF CRIME.....	57
C.	IMPLICATIONS OF A COMPLEX VIEW OF CRIME	70
V.	BUILDING BLOCKS OF COMPLEXITY-BASED POLICING.....	73
A.	POLICING FOR THE INFORMATION AGE	73
B.	THE STANDARD MODEL OF POLICING	75
C.	ALTERNATIVE MODELS OF POLICING	79
1.	Compstat.....	80
2.	Problem-Oriented Policing	82
3.	Community Policing	85
4.	Focused Deterrence.....	88

VI.	SENSE MAKING FOR LEADERS	95
A.	INFORMATION STRUCTURING	95
B.	ORDER AND UN-ORDER.....	97
C.	MOVING WITHIN THE CYNEFIN FRAMEWORK.....	101
VII.	FINDINGS, CONCLUSION, AND RECOMMENDATIONS	107
A.	FINDINGS	108
B.	CONCLUSION: EVOLVING INTO THE INFORMATION AGE.....	110
C.	RECOMMENDATIONS.....	113
	1. Intellectual	114
	2. Workforce.....	115
	3. Organizational.....	116
D.	AVENUES FOR FURTHER RESEARCH	120
E.	FINAL REMARKS.....	121
	APPENDIX.....	123
	LIST OF REFERENCES.....	129
	INITIAL DISTRIBUTION LIST	139

LIST OF FIGURES

Figure 1.	The Cynefin Framework.	20
Figure 2.	Two Versions of the Crime Triangle.	55
Figure 3.	Mafia Organization Chart.	56
Figure 4.	Clustering of Robberies.	67
Figure 5.	The Cynefin Framework.	78
Figure 6.	The Cynefin Framework with Decision Making Models.	100

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.	The Structural View of Information.	96
Table 2.	Application of Cynefin Framework to Police Functions.	101
Table 3.	Cynefin Dynamics.	102
Table 4.	Societal Evolution.	110

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

CAS	complex adaptive system
Compstat	compare statistics
CRAVED	concealable, removable, available, valuable, enjoyable, disposable
DOJ	Department of Justice
FCC	Federal Communications Commission
HRD	human resources development
IT	information technology
MPDC	Metropolitan Police Department of Washington, DC
NASA	National Aeronautics and Space Administration
NGO	non-governmental organization
NYPD	New York Police Department
RAT	routine activity triangle
RICO	Racketeer Influenced Corrupt Organization
SARA	scanning, analysis, response, assessment
T+I+M+N, TIMN	tribes, institutions, markets, networks

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

The dominant model of professional policing in the United States is the so-called “standard model,” which coalesced during the 1960s and 1970s.¹ Weisburd and Eck have identified key characteristics of the standard model of policing as a focus on random patrol, rapid response to 911 calls, and reactive criminal investigations.² Calling it the standard model is a deliberate choice, for it denotes that police operations and services have, in large part, become standardized. The standard model assumes that a reactive template of policing can be applied without regard to the particular circumstances of any given community.³

The standard model of policing is effectively a design for a production-oriented organization. This design is not a surprise, given that it evolved between 1930–1970; a time when American industry was crucial to winning the Second World War and positioning America as not only a global hegemon, but also the embodiment of capitalism during the Cold War. The standard model is industrial in its outlook that directly produces reports, investigations, arrests, and prosecutions with the underlying assumption that if enough of those goods are produced, a profit of public safety will be realized. Kelling observes that the innovators of the Reform Era were following in the footsteps of the principles of Frederick Taylor’s scientific management, a system for increasing productivity through essentially adopting assembly line techniques.⁴ Accordingly, police procedures were standardized, broken down into constituent steps, and police officers trained to perform their specific task efficiently while managers coordinated between different “production units” within the departments.⁵

¹ George L. Kelling and Mark H. Moore, *The Evolving Strategy of Policing*, Perspectives on Policing (Washington, DC: National Institute of Justice, U.S. Department of Justice, and the Program in Criminal Justice Policy and Management, John F. Kennedy School of Government, Harvard University, 1988), 2, <https://www.ncjrs.gov/pdffiles1/nij/114213.pdf>.

² David Weisburd and John Eck, “What Can Police Do to Reduce Crime, Disorder, and Fear?,” *Annals of the American Academy of Political and Social Science* 593, no. 1 (2004): 49.

³ Weisburd and Eck, 44.

⁴ Kelling and Moore, *The Evolving Strategy of Policing*, 6; *Britannica* s.v. “Taylorism,” November 15, 2018.

⁵ Kelling and Moore, 6.

This reductive, production-oriented worldview falls squarely within a linear understanding of problems. Linear problems can be thought of as having three main qualities. First, they react in fixed proportions to various inputs. Secondly, they are constructed out of independent variables that only affect a limited set of known, dependent variables. Thirdly, a linear problem can be understood through reductionist thinking, or breaking it down into small individual parts and tallying the interactions of those atomized parts. Linear problems can be thought of as a strict math equation; the sum of the variables completely describes the problem.⁶

However, since the 1970s, an ongoing revolution in communications technology has occurred, and people are more widely linked and interconnected than ever before in history. These dense webs of connections allow for new, nonlinear types of behaviors. Complexity theory is the study of nonlinear dynamic systems, which are formed when large numbers of elements, such as people, are able to interact with each other.⁷ The most prominent feature of complex problems is that they do not react proportionately or predictably.⁸ Exact predictions about the behavior of complex systems cannot be made because so many circumstances and interactions are occurring that obtaining sufficient knowledge about them to make accurate predictions is impossible.⁹ Variables in complex problems continuously link to each other in ways that can overlap and are not fixed. They can “link and let go and link again” and therefore cannot be neatly classified into categories of independent and dependent.¹⁰ Finally, complex problems do not yield to reductionist thinking because they feature emergent properties, which transcend individual parts of that

⁶ Ben Ramalingam, *Aid on the Edge of Chaos* (Oxford, United Kingdom: Oxford University Press, 2013), 224–25.

⁷ Michael Agar, “Complexity Theory: An Exploration and Overview Based on John Holland’s Work,” *Field Methods* 11, no. 2 (1999): 100; Glenn Walters, *Modelling the Criminal Lifestyle: Theorizing at the Edge of Chaos* (Switzerland: Palgrave Macmillan, 2017), vi.

⁸ David L. Levy, “Applications and Limitations of Complexity Theory in Organization Theory and Strategy,” in *Handbook of Strategic Management*, ed. Jack Rabin, Gerald J. Miller, and W. Bartley Hildreth, 2nd ed. (New York: Marcel Dekker, 2000), 79, http://www.faculty.umb.edu/david_levy/complex00.pdf.

⁹ Friedrich Hayek, “The Theory of Complex Phenomena,” *Emergence: Complexity and Organization* 9, no. 1–2 (2007): 157–59.

¹⁰ Agar, “Complexity Theory,” 100.

whole and are not simply recreating the properties of the constituent parts at scale.¹¹ As linear problems were earlier likened to strict mathematical sums, complex problems are noted for being more than the sum of their parts.

Many of those who investigate complexity across a variety of disciplines are discovering that “at the heart of many—if not most—problems of organized complexity are network problems.”¹² The physicist Albert-Laszlo Barabasi goes a step further in establishing the link between complexity and networks: “One thing is increasingly clear: no theory of the cell, of social media or of the Internet can ignore the profound network effects that their interconnectedness cause. Therefore, if we are ever to have a theory of complexity, it will sit on the shoulders of network theory.”¹³

Some scholars believe that, due to the Information Revolution, networks are becoming the driving force in society. Just as the Industrial Revolution led to industrial society, Manuel Castells believes that the IT revolution is leading to an “informational society.” The informational society is “oriented towards ... the accumulation of knowledge and towards higher levels of complexity in information processing.”¹⁴ Castells acknowledges that people connecting with each other and forming a network is not a new phenomenon, but argues that prior to the IT Revolution, networks were limited in ability and were outperformed by the forces of hierarchy and centralization in human societies.¹⁵ Since the IT revolution, the capabilities of this new technology have allowed network dynamics to explode and overtake the actions of each individual agent within a network.¹⁶

For police agencies practicing the standard model of policing, crime is thought of in linear terms, either the actions of scattered individuals or relatively formal hierarchical

¹¹ Hayek, “The Theory of Complex Phenomena,” 149.

¹² Ramalingam, *Aid on the Edge of Chaos*, 192–93.

¹³ Albert-Laszlo Barabasi, “The Network Takeover,” *Nature Physics* 8, no. 1 (January 2012): 15.

¹⁴ Manuel Castells, *The Rise of the Network Society*, 2nd ed., vol. 1, *The Information Age: Economy, Society, and Culture* (Malden, MA: Blackwell Publishing, 2000), 17.

¹⁵ Manuel Castells, “Materials for an Exploratory Theory of the Network Society,” *The British Journal of Sociology* 51, no. 1 (January 1, 2000): 15.

¹⁶ Castells, *The Rise of the Network Society*, 500.

organizations. However, the technological advancements profoundly altering the nature of civil society are having the same effects on crime and criminals. This thesis applies a five-element framework to a street robbery pattern in Washington, DC, and discovers that these robberies can be modeled as a complex adaptive system (CAS). In this CAS, individual criminals act as decentralized agents, with the cumulative effects of their individual actions self-organizing to form an interrelated system that adapts to changes in the environment around it, to include law enforcement responses to criminal activity. There are also indications that network effects are present, although current police doctrine limits the amount of pertinent information collected by police departments.

There is a growing recognition that the standard model of policing may no longer be effective, but there is as yet little appreciation for why that is so. There is no shortage of alternative models of policing proposed to replace it, but none has been conceived with the changes to the underlying structure and fundamentals of the network society or the Information Age in mind. However, at least some of these models suggest practices that may serve as building blocks or stepping stones to the day-to-day operations of a complexity-based policing model. This thesis examines four of the major alternatives to the standard model and finds that to the extent that they recommend practices that are well suited to a complex environment, it appears to be either accident or narrowly tailored responses to recognized shortcomings of the standard model, and not a coherent, theoretically informed understanding of the modern age. However, adopting complexity as the theoretical underpinning of a model of policing would provide an internally consistent means to integrate elements of these various models and address the shortcomings of the standard model of policing.

It is vital to recognize that society in the United States is transitioning into an informational, network-based society increasingly governed by nonlinear, dynamic processes. The dissatisfaction with the state of policing occurs since it is an institution that is no longer aligned with the dynamics that drive and organize society. Failure to recognize this misalignment makes attempting solutions ineffective or inefficient.

This thesis concludes with recommendations for implementing a complexity-based model of policing. First, it recommends educating law enforcement personnel in

complexity and network theories, and developing the mindset to work in complex environments. Second, it recommends incorporating data analysts into police departments as front-line, operational personnel working side-by-side with sworn officers. Finally, it offers a number of recommendations about operational changes. Departments should avoid structuring themselves around deployment of officers based on geography. Instead, the base unit of organization should be squads of officers with integrated analysts. The primary tasking of these squads should be investigation and intervention in complex networks and systems. Departments need to begin building and formally tracking networks of resources that they can bring to bear when they decide that interventions are necessary. All these recommendations are intended to orient police agencies towards an informational, rather than production-based view of the world.

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

Completing this degree program, as well as researching and writing this thesis, would not have been possible for me without the assistance of a great many people. I would like to thank the command staff of the Metropolitan Police Department for allowing me the opportunity to apply for and participate in this opportunity at the Naval Postgraduate School. I would like to especially thank Commander Ralph Ennis and Deputy Director Jessica Bress for their support and encouragement throughout the entire program. I would also like to thank Commander Stuart Emerman for accommodating the demands of this program on my schedule and for giving me permission to include the Appendix. Along those same lines, I would like to thank all my colleagues at the Third District for picking up the slack during the “in-residence” portions of this program.

I would like to thank the staff of the Center for Homeland Security and the Naval Postgraduate School as a whole for the opportunity to participate in this program; I have found it both incredibly valuable and fulfilling. A special thanks goes not only to the faculty but to the support staff as well—they were incredibly responsive and helped smooth out whatever wrinkles appeared in the experience. I also owe a debt of gratitude to all my classmates in 1905/1906—your insights, arguments, motivation, friendship, and (sadly, due to COVID-19, all too few) conversations at lunches, dinners, and the Trident Room really helped define this experience for me.

I would not have been able to complete this thesis without the help of my committee, Dr. Christopher Bellavita, and Dr. Glen Woodbury. Your assistance and feedback were most appreciated, and the quality of the final product is due to the improvements you both suggested. Any errors that remain are entirely my responsibility.

Finally, the single person to whom I owe the most thanks is my wife, Sarah. Throughout travel, pandemic, riots, the birth of our daughter, more riots, a national emergency, and an Inauguration, she remained steadfast that it was important to finish this program. Despite all the sacrifices it called for, completing this thesis was as great a priority for her as it was for me. I truly could not have done this without her love and support.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. PROBLEM STATEMENT

Speaking in December 2001, Sir John Stevens, former Commissioner of the London Metropolitan Police, described the state of policing at the dawn of the 21st century:

Being a policeman in the 21st Century is like being the man who was standing on the bank of a very fast flowing river. In that river he could see hundreds of people being swept along struggling to stop from drowning. As each moment passes their numbers swell until there are thousands of people all gasping and shouting to the man on the bank to help them.

What do we do as police officers? Go in and help as many as we can? Or do we take a walk upstream and find out who is throwing them all in? I have a feeling that most of the time police have been wading in to the rescue!

And so begins a reactive cycle of uncontrolled demand and equally uncoordinated response. The police become like lifeguards frantically swimming against the tide from one incident to another, employing different tactics in a disjointed and unfocussed manner with little or nothing to show for it at the end of the day.¹

This assessment of the state of policing was made one year into the 21st century; nearly 20 years later, it still rings true as the profession of policing largely remains in the cycle of uncontrolled demand and uncoordinated response of which Sir Stevens spoke. His words came just a few months after the attacks of September 11, 2001, which would see terrorism and homeland security concerns become major areas of strategic responsibility for American police departments, which added yet another sector of demands for police response and attention. The trends towards greater interconnection and globalization have only continued since that time, with the invention of smartphones and the rise of social media. If systems of dynamic connections are coming to drive both societies and the course of global events, will law enforcement strategies rooted in regimented organization still prove effective?

¹ Jerry H. Ratcliffe, *Intelligence-Led Policing* (Cullompton, UK: Taylor & Francis, 2014), 165, ProQuest.

The strategic imperative for policing, which descended from the English tradition, has been devising ways to prevent crime rather than efficiently respond to crime.² However, the so-called standard model of policing is dominated by methods reactive to crimes that have already occurred.³ A number of proposed innovations in policing have been implemented to varying degrees by police departments throughout the country. These innovations are often implemented and utilized in an ad hoc fashion, and often exist in siloes separate from those law enforcement officers engaged in activities prescribed by the standard model. It is also not uncommon for departments to mix and match various approaches even when they have apparently contradictory features or underlying philosophies. In short, the primary tool of police leadership is reactive and thus ill-suited for accomplishing the strategic goal of prevention. To the extent that various preventative measures have been implemented, the situation more closely resembles the frantic lifeguards of Sir Stevens's metaphor than deliberate strategic moves or considered experimentation.

Modern policing was borne out of the effects of the Industrial Revolution on England. The transformation from a rural, agrarian society to an urban, industrial one overwhelmed the traditional law enforcement systems in place because they were unsuited to the nature of the society in which they found themselves situated.⁴ Academics, such as John Arquilla and David Ronfeldt, have begun to examine contemporary society and posit that an Information Revolution has occurred similar in effect and scope to the Industrial Revolution. They argue that threats in the Information Age will be fundamentally different from those of the previous Industrial Age.⁵ This difference raises the possibility that processes and strategies designed for the Industrial Age may inevitably give way, like

² John Dempsey and Linda Forst, *An Introduction to Policing*, 3rd ed. (Belmont, CA: Wadsworth, 2005), 8–9. This imperative was the first of the nine principles enumerated by Sir Robert Peel, generally credited as the father of modern policing.

³ David Weisburd and John Eck, “What Can Police Do to Reduce Crime, Disorder, and Fear?,” *Annals of the American Academy of Political and Social Science* 593, no. 1 (2004): 44.

⁴ Vern Folley, *American Law Enforcement*, 2nd ed. (Boston: Holbrook Press, 1976), 53–56.

⁵ John Arquilla and David Ronfeldt, “The Advent of Netwar (Revisited),” in *Networks and Netwars: The Future of Terror, Crime, and Militancy*, ed. John Arquilla and David Ronfeldt (Santa Monica, CA: RAND, 2001), 2.

traditional English law enforcement before them, to new modes of policing suited to a changing society.

Evidence of friction may have already been seen, in the widely perceived “crisis of police legitimacy.” Sparked by outrage and unrest over police use-of-force incidents in Ferguson, Missouri, and elsewhere, President Barrack Obama commissioned a task force to study perceived “rifts in the relationships between local police and the communities they protect and serve.”⁶ Implementing one of that task force’s recommendations, President Trump formed the President’s Commission on Law Enforcement and the Administration of Justice, which issued its own report on the state of law enforcement in late 2020.⁷ In his remarks while swearing in members of the commission, Attorney General Barr stated the need to examine topics, such as technology, mounting social pressures, distrust between police and communities, recruitment, and police suicide.⁸ In a review of two books with competing diagnoses of the problems with modern policing, Professor Barry Friedman of New York University’s School of Law writes, “Certainty is out of place in policing. . . . What’s also needed is a new spirit of innovation in policing that endeavors to get the job done while respecting constitutional rights and human dignity.”⁹

This legitimacy crisis has not remained confined to political commissions and academic debate. Amidst a society stressed and disrupted by a global pandemic, the summer and fall of 2020 saw sustained civil unrest. A report issued by the Major Cities Chiefs Association found that 8,700 protests occurred in the 68 reporting cities between May 25 and July 31, 2020.¹⁰ Of those protests, 574 were classified as violent incidents that

⁶ President’s Task Force on 21st Century Policing, *Final Report of the President’s Task Force on 21st Century Policing* (Washington, DC: Community Oriented Policing Services, 2015), 1.

⁷ Tom Jackman, “Attorney General Launches Presidential Commission on Law Enforcement,” *Washington Post*, January 22, 2020, <https://www.washingtonpost.com/crime-law/2020/01/22/attorney-general-barr-launches-presidential-commission-law-enforcement>.

⁸ Jackman.

⁹ Barry Friedman, “The Problem with Modern Policing, as Seen from the Right and from the Left,” *New York Times*, June 27, 2016, <https://www.nytimes.com/2016/07/03/books/review/the-war-on-cops-by-heather-mac-donald-and-handcuffed-by-malcolm-sparrow.html>.

¹⁰ Intelligence Commanders Group, *Report on the 2020 Protests & Civil Unrest* (Salt Lake City, UT: Major Cities Chiefs Association, 2020), 3, https://www.majorcitieschiefs.com/pdf/news/mcca_report_on_the_2020_protest_and_civil_unrest.pdf.

resulted in 2,037 injuries to police officers.¹¹ While many of the summer's protests were associated with the political left in the United States, the riot at the U.S. Capitol saw police officers targeted for violence by figures associated with the political right.¹² This legitimacy crisis spans the political divide, is commanding the attention of the highest elected officials in the country, and may itself be a sign that the current institutions of policing are ill-matched to society's current form.

This thesis examines the ability of complexity theory to address these concerns. Complexity theory offers a way for police leadership and policymakers to make sense of modern society and the nature of threats and crime within it. Complexity provides a more useful description of crime and other issues than existing models do and can serve as a basis to compare theories of the changing nature of society. Complexity theory also offers a matrix for strategic decision making and provides a framework for rationally integrating disparate strains of policing thought and techniques. A model of policing based on complexity theory could help policing make the adjustments necessary to adapt to a changing society and implement effective and considered strategic moves.

B. RESEARCH QUESTION

What would a model of policing based on complexity theory look like?

C. LITERATURE REVIEW

This thesis examines how complexity theory can be used to provide a new model of policing better adapted for a changing world than is the current model. Therefore, literature has been examined to establish the current understanding two theoretical areas. The first area examined is that of complexity, and specifically, the study of complex adaptive systems. The second area is modern network theory, which integrates complexity into the study of dynamic networks. Closely related to network theory is the theory of

¹¹ Intelligence Commanders Group, 7–10.

¹² Alexander Mallin, Julia Jacobo, and Meredith Deliso, "Capitol Riot Latest: 2 Alleged Proud Boys Members Indicted on Conspiracy Charges," *ABC News*, January 30, 2021, <https://abcnews.go.com/Politics/capitol-riot-latest-man-accused-stealing-documents-mitch/story?id=75467908>.

netwar developed by John Arquilla and David Ronfeldt, which examines the behavior of networked adversaries in conflict.

1. Complexity and Complex Adaptive Systems

Complexity theory is an inter-disciplinary theory that examines how order and structure can arise out of the interactions of diverse elements. Warren Weaver is generally credited as the father of complexity and his brief paper “Science and Complexity,” published in 1948, is viewed as the foundational text.¹³ Weaver set forth a typology of problems, which noted that science had moved from dealing with a handful of variables to problems dealing with massive numbers of variables. In between the two lay the relatively fertile ground of problems with a middling number of variables, but which displayed indications of the organization of those variables being paramount, a state he called organized complexity.¹⁴ While the terminology has changed and evolved in the 70 years since this paper was published, Weaver’s insight into the existence of organized complexity was the spark for the development of complexity theory.

Economists authored two other foundational papers for the development of complexity in the 1960s. In his 1962 article, “The Architecture of Complexity,” Herbert Simon applied his concept of hierarchy, or interlocking layers of sub-systems nested within other sub-systems to a variety of complex systems in different disciplines.¹⁵ Simon also examined the importance of feedback and information to complex systems.¹⁶ Simon’s emphasis on structure and hierarchy in complexity is not found in more recent complexity literature but has some points in common with the study of networks and complexity. In 1967, Friedrich Hayek published, “The Theory of Complex Phenomena,” in which he examined the nature of patterns formed by the relationships among elements in complex phenomena. Hayek explained that statistical methods were insufficient to offer meaningful

¹³ Warren Weaver, “Science and Complexity,” *American Scientist* 36, no. 4 (October 1948): 536–544.

¹⁴ Weaver, 539.

¹⁵ Herbert Simon, “The Architecture of Complexity,” *Emergence: Complexity and Organization* 7, no. 3–4 (2005): 140.

¹⁶ Simon, 139.

explanations for the behavior of such complex systems because they could not capture the nature of the underlying relationships.¹⁷

The work of physicist Per Bak on his concept of self-organized criticality echoes the work of Simon and Hayek. Bak, in his article with Tang and Wiesenfeld, defined self-organized criticality as the tendency of “dynamical systems with extended spatial degrees of freedom [to] naturally evolve into self-organized critical structures of states, which are barely stable.”¹⁸ The now-standard example used by Bak and Paczuski is that of adding grains to a sand pile one at a time. Once the sand pile evolves into a critical state, it abandons linearity, and adding a single grain may cause a wildly disproportionate avalanche in the pile.¹⁹ Bak’s work on the sand pile shows that detailed predictions about the future states of systems that have achieved criticality are not possible.²⁰

One application of complexity theory was the development of complex adaptive systems in the mid-1980s. Previous research into complexity had focused on how simple elements could form complex structures and exhibit nonlinear and emergent behavior; the study of complex adaptive systems sought to explain how such systems would behave after they had arisen.²¹ The work of computer scientist John Holland was foundational to the development of a theory of complex adaptive systems. Holland’s work focused on what he termed “agent based modeling,” and modeled the behavior of a system of interacting agents, whose accumulated interactions display emergent behavior.²² Holland’s work focused on creating computer models because their processing power allowed for the development of models that could account for greater amounts of complexity.²³ Holland

¹⁷ Friedrich Hayek, “The Theory of Complex Phenomena,” *Emergence: Complexity and Organization* 9, no. 1–2 (2007): 143–165.

¹⁸ Per Bak, Chao Tang, and Kurt Wiesenfeld, “Self-Organized Criticality: An Explanation of 1/f Noise,” *Physical Review Letters* 59, no. 4 (July 27, 1987): 381.

¹⁹ Per Bak and Maya Paczuski, “Complexity, Contingency, and Criticality,” *Proceedings of the National Academy of Sciences of the United States of America* 92 (July 1995): 6691.

²⁰ Bak and Paczuski, 6690.

²¹ M. Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Simon & Schuster, 1992), 148.

²² John H. Holland, *Emergence: From Chaos to Order* (Reading, MA: Perseus Books, 1998), 117.

²³ Holland, 117.

believed that developing computer-based models of complex adaptive systems was necessary to understanding the principles that governed their operation.²⁴ His work, across a number of scholarly articles and books, has already suggested a number of such principles. Other academics have contributed to the understanding of complex adaptive systems. Roy Eidelson has examined both the basic functions of complex adaptive systems, as well as how they interact with both their environment and other complex adaptive systems.²⁵ J. Barkley Rosser Jr. has written on how the concept of self-organized criticality specifically operates within complex adaptive systems.²⁶

Some researchers have already applied complex adaptive systems to law enforcement and related topics. Michael Agar utilized complexity and complex adaptive systems to organize his research into heroin trends.²⁷ Agar found the complex adaptive systems framework useful as a mental model to explain various interactions between agents and to organize his research.²⁸ In the United Kingdom, Richard Leary and Jenny Thomas have examined how complex adaptive systems could be used as a framework to examine criminal organizations and plan operations within the context of police intelligence.²⁹ A lieutenant with the Massachusetts State Police, Robert Leverone, published a master's thesis at the Naval Postgraduate School that looked at applying the complex adaptive systems framework to law enforcement's control of tumultuous crowds.³⁰

²⁴ John H. Holland, *Hidden Order: How Adaption Builds Complexity* (Reading, MA: Perseus Books, 1995), 94.

²⁵ Roy Eidelson, "Complex Adaptive Systems in the Behavioral and Social Sciences," *Review of General Psychology* 1, no. 1 (1997): 42–71.

²⁶ J. Barkley Rosser Jr., "On the Complexities of Complex Economic Dynamics," *Journal of Economic Perspectives* 13, no. 4 (Fall 1999): 169–92.

²⁷ Michael Agar, "Complexity Theory: An Exploration and Overview Based on John Holland's Work," *Field Methods* 11, no. 2 (1999): 99–120.

²⁸ Agar, 103.

²⁹ Richard Leary and Jenny Thomas, "How Complexity Theory Is Changing the Role of Analysis in Law Enforcement and National Security," in *Intelligence Management*, ed. Babak Akhgar and Simeon Yates (London: Springer, 2011).

³⁰ Robert Leverone, "Crowds as Complex Adaptive Systems: Strategic Implications for Law Enforcement" (master's thesis, Naval Postgraduate School, 2016), <http://hdl.handle.net/10945/48549>.

Complexity is not without critics; among the most prominent critics is science writer John Horgan. Horgan's book, *The End of Science*, advances his thesis that no more fundamental "revelations or revolutions" are left for science to discover, and he criticizes the claims of several realms, including complexity, that monumental advances await discovery.³¹ Horgan has coined the neologism *chaoplexity*, combining chaos theory and complexity, as he believes that researchers have yet to devise truly distinctive separations between the two branches.³² He credits chaoplexity research with the creation of "potent metaphors" but believes that practical advancements will result merely in engineering, and theoreticians will keep playing in the realms of what he terms "ironic science."³³ Ultimately, Horgan believes that complexity is self-refuting. Interviews with many of the leading researchers of complexity have led him to believe that they seek to develop a "unified theory" that can explain and predict the behavior of complex systems, despite the fundamental principles of complexity stating that such behavior cannot be perfectly predicted.³⁴

2. Networks and Netwar

Social network analysis is a well-developed field that originated in sociology and has recently seen an influx of interest from physicists involved in the study of complexity. The particulars of how to perform social network analysis are beyond the scope of this work, but John Scott's *Social Network Analysis* is an excellent introductory textbook that illustrates many of the central terms and techniques of social network analysis, written to be accessible by a novice to the field.³⁵ For Scott, social network analysis is a "collection of theoretically informed methods" that "provides a vocabulary and set of measures for

³¹ John Horgan, *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age* (New York: Basic Books, 2015), 11, ProQuest.

³² Horgan, 11.

³³ Horgan, 176.

³⁴ Horgan, 212–13.

³⁵ John Scott, *Social Network Analysis*, 4th ed. (London: SAGE Publications Inc., 2017). The second edition of this book is recommended as further reading on this subject in *Six Degrees* by Duncan Watts.

relational analysis” but it is not in itself a formal body of theory.³⁶ While acknowledging that social network analysis has borrowed some concepts (at least metaphorically) from physics, Scott is ambivalent about the contributions of physicists like Duncan Watts and Albert-Laszlo Barabasi to the field. Scott admits the value of the theoretical work on small-world networks, and the subsequent research into how networks change, performed by Watts, but he is more dismissive of Barabasi’s work and views it as a mathematical confirmation of previous findings by sociologists.³⁷ Overall, Scott seems to think that much of the “discoveries” by physicists in social network analysis are not so much new discoveries as they are retreading ground already covered by sociologists of which the newcomers are unaware.

The major contribution of Watts to the study of networks has been the discovery of the small-world network. Watts first published this discovery in the paper “Collective Dynamics of ‘Small-World’ Networks,” which he wrote with his advisor, Steven Strogatz.³⁸ He later followed that brief paper with the publication of his thesis as a book, *Small Worlds*.³⁹ The small-world phenomenon is a state where one node on a graph can connect to any other via a relatively small number of intermediaries when most nodes are clustered together. Importantly, this phenomenon exists between order and randomness and requires only a small number of links between clusters because they have a non-linear effect.⁴⁰ Both of these works, and a number of other articles published by Watts, are academic in tone, and require the reader to have some familiarity with advanced math to appreciate it fully.

In contrast, Watts published a second book, *Six Degrees: The Science of a Connected Age*, which was written for a popular audience. In that book, Watts describes

³⁶ Scott, 8.

³⁷ Scott, 36–38, 160–61.

³⁸ Duncan J. Watts and Steven H. Strogatz, “Collective Dynamics of ‘Small-World’ Networks,” *Nature* 393 (1998): 440–442.

³⁹ Duncan J. Watts, *Small Worlds: The Dynamics of Networks between Order and Randomness* (Princeton, NJ: Princeton University Press, 1999).

⁴⁰ Watts and Strogatz, “Collective Dynamics of ‘Small-World’ Networks,” 441. Known colloquially as the six degrees effect, as in “The Six Degrees of Kevin Bacon.”

the “science of networks,” which he claims has provided three major insights. First, the small-world phenomenon demonstrates that what appear to be quite large networks are more interconnected than they would first appear; second, these networks behave non-linearly; and third, that multi-disciplinary cooperation will be required to bring the science of networks to maturity.⁴¹ Watts acknowledges the debt owed by physicists to sociologists in developing social network analysis, but he believes that the data driven approach of physics has reinvigorated the study of networks.⁴² Complexity theory is the substrate of this book, although Watts does not spend much time speaking of complexity *per se*. However, he does give a thumbnail sketch of the “complex systems” being mapped as networks as those whose dense interconnections lead to emergent behavior.⁴³

Similarly, Barabasi published a number of academic works describing his discovery of scale-free networks prior to a more mass-market book. Barabasi published the article “Emergence of Scaling in Random Networks” with Reka Albert in which they argued that scale free networks are generated through a self-organized process of preferential attachment, which leads to a relatively small number of highly connected nodes and much larger numbers of nodes with few connections.⁴⁴ Publishing with Albert and Jeong, Barabasi demonstrated empirical evidence of the scale free network model by using a robot to chart links between web pages in “Diameter of the World Wide Web.”⁴⁵ Following on his academic work, Barabasi wrote for a lay audience in his book, *Linked*, which examined how complex systems permeate the modern world and how a study of networks and network dynamics can help make sense of such systems.⁴⁶

⁴¹ Duncan J. Watts, *Six Degrees: The Science of a Connected Age* (New York: W. W. Norton & Company, 2003), 299–306.

⁴² Watts, 28–29.

⁴³ Watts, 24–27. In the further reading suggested for this section of the book, Watts specifically directs the reader to Holland’s *Emergence* as one of a number of suggested texts on complex adaptive systems.

⁴⁴ Albert-Laszlo Barabasi and Reka Albert, “Emergence of Scaling in Random Networks,” *Science* 286 (1999): 509.

⁴⁵ Reka Albert, Hawoong Jeong, and Albert-Laszlo Barabasi, “Diameter of the World-Wide Web,” *Nature* 401 (1999): 130.

⁴⁶ Albert-Laszlo Barabasi, *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*, 2014 ed. (New York: Basic Books, 2002), 9–10.

In their popular works, both Watts and Barabasi illustrate the application of network thinking to a wide variety of subjects in the modern world. The philosopher Manuel Castells has engaged with similar material in an academically rigorous fashion in his three-volume work, *The Information Age: Economy, Society, and Culture*. In the first volume of this work, *The Rise of the Network Society*, Castells sets out his thesis that networks are rising as the fundamental force of social organization, which leads to what he calls alternatively network society or informational society.⁴⁷ Castells describes an Information Technology (IT) Revolution of modern computing and communications devices that achieved a self-sustaining feedback loop that increased their abilities, reach, and importance to society.⁴⁸ Castells believes that society is defined by the relationships of production, experience, and power and his three-volume work examines how those relationships are being altered in the transition to an informational society.⁴⁹

Castells spends much of the first volume examining how the network society is impacting and driving the global economy from a loosely connected industrial economy to a tightly linked informational one.⁵⁰ Next, he branches into more esoteric considerations of how perceptions of both time and space are being redefined by network processes. He develops the concept of “the space of flows,” or how areas dominated by these new networks reshape themselves towards a converging homogeneity despite being physically separated by great distances.⁵¹ These areas stand in contrast to those areas still dominated by “the space of places,” or those whose cultural expression is largely self-referential and not dependent on the interchange of information throughout a global network.⁵² His conception of “timeless time” refers to the effect electronic media has on the perception

⁴⁷ Manuel Castells, *The Rise of the Network Society*, 2nd ed. vol. 1, *The Information Age: Economy, Society, and Culture* (Malden, MA: Blackwell Publishing, 2000), 21. See footnote 31 for additional details. In general, Castells uses network society when describing the organization of society and informational when describing the nature of society.

⁴⁸ Castells, 5–6, 31–32.

⁴⁹ Castells, 14.

⁵⁰ Castells, ch. 2–4.

⁵¹ Castells, 442–48.

⁵² Castells, 453–59.

and ability to perceive differentiation of time and sequence in the network society, which “is a culture at the same time of the eternal and of the ephemeral.”⁵³ Castells observes that the network society is not distributed evenly, nor do all members of society benefit. He warns, “our societies are increasingly structured around a bipolar opposition between the Net and the self.”⁵⁴ In other words, a paradoxical rise is occurring in both the primacy of networks with its attendant interconnectedness and exclusionary identities at the dawn of the informational society, and it is likely to be the cause of much friction and conflict in the years ahead.⁵⁵

The trilogy is a massive and comprehensive work. The first volume deals with the underlying logic of the structure of this new society, while the second and third volumes examine how various elements of the world are reacting to the Information Age. In addition to his analysis of the impact of the Information Age, this work is influential in that many who write on similar topics are forced to react to it (either positively or negatively), as reflected by a number of the scholars referenced for this thesis. Arquilla and Ronfeldt agree with Castells that the increase in the prevalence of networks as an organizational form is salient for addressing strategic and social issues in the coming decades.⁵⁶ Morcol and Wachhaus attribute the interest in the influence of networks in public policy to the recognition of Castells’s ideas.⁵⁷ Scott, on the other hand, does not endorse him. Scott recognizes that Castells has popularized the network society but argues against his dismissal of social network analysis as a useful tool for analyzing networks.⁵⁸

Arquilla and Ronfeldt are national security analysts who have studied and published on the changing nature of conflict in the Information Age. Their article “Cyberwar is

⁵³ Castells, 492.

⁵⁴ Castells, 3.

⁵⁵ Castells, 21–25.

⁵⁶ David Ronfeldt and John Arquilla, “What Next for Networks and Netwars?,” in *Networks and Netwars: The Future of Terror, Crime, and Militancy*, ed. John Arquilla and David Ronfeldt (Santa Monica, CA: RAND, 2001), 321–322.

⁵⁷ Goktug Morcol and Aaron Wachhaus, “Network and Complexity Theories: A Comparison and Prospects for a Synthesis,” *Administrative Theory and Praxis* 31, no. 1 (March 2009): 44.

⁵⁸ Scott, *Social Network Analysis*, 7–8.

Coming!” introduced their concepts of cyberwar and netwar in 1993.⁵⁹ Both concepts examined how information would become a central axis of both conflict and organization, with cyberwar as an explicitly military doctrine and netwar as a broader category of conflicts involving both state and non-state actors.⁶⁰ Netwar is an extended digression in this article and is mostly focused on actors utilizing new (at the time) communication technologies.

In 1996, David Ronfeldt published, “Tribes, Institutions, Markets, Networks: A Framework about Societal Evolution,” which laid out much of the theoretical background on the effect of the Information Age on society which informs the theory of netwar.⁶¹ Ronfeldt posits that advances in IT have sufficiently empowered the network as an organizational form to become the primary focus of ordering Information Age societies.⁶² Unlike Castells, who focuses on looking forward, Ronfeldt fits the network into a framework with three other organizing principles for society (the titular Tribes, Institutions, and Markets) and briefly sketches how human societies evolve by incorporating each form in sequence that reaches the apogee in a “T+I+M+N” society that has incorporated all four forms.⁶³ In addressing the implications of the rise of network organizations for societal conflict, Ronfeldt briefly describes netwar and directs readers to a book length discussion of the topic.⁶⁴

Also published in 1996, Arquilla and Ronfeldt devoted a book to detailing netwar in *The Advent of Netwar*.⁶⁵ In elaborating on the particulars of netwar actors, they stressed that the primary identifier was a networked form of organization, and not just the methods

⁵⁹ John Arquilla and David Ronfeldt, “Cyberwar Is Coming!,” in *In Athena’s Camp: Preparing for Conflict in the Information Age* (Santa Monica, CA: RAND, 1997), 23–60. Republished in this volume, with the original citation given in the text.

⁶⁰ Arquilla and Ronfeldt, 28–30.

⁶¹ David Ronfeldt, *Tribes, Institutions, Markets, Networks: A Framework about Societal Evolution* (Santa Monica, CA: RAND, 1996).

⁶² Ronfeldt, 11–12.

⁶³ Ronfeldt, 3.

⁶⁴ Ronfeldt, 35.

⁶⁵ John Arquilla and David Ronfeldt, *The Advent of Netwar* (Santa Monica, CA: RAND, 1996).

of communication they use.⁶⁶ In contrast to the detailed analyses of network structures and dynamics found in Scott, Watts, and Barabasi, Arquilla and Ronfeldt limit their network forms to three main archetypes: “stars,” which are a kind of hub and spoke, straightforward chains, and “all channel” designs where every node is linked to all the others in the network.⁶⁷ They identify four main levels of analyses to assess the effectiveness of a network organization in waging netwar: organizational, doctrinal, technological, and social.⁶⁸

In 1997, Arquilla and Ronfeldt edited *In Athena's Camp: Preparing for Conflict in the Information Age*. In this volume, a number of authors contributed chapters about the role of information theory, philosophy, and systems in the future of national security strategy for the United States. Arquilla and Ronfeldt contribute the concluding chapter, “Looking Ahead: Preparing for Information-Age Conflict,” which elaborates on their interest in the role of information in conflict.⁶⁹ Although they do not mention netwar specifically, they introduce the tactic of “swarming,” which they note is most effectively wielded by networked adversaries who have robust communication links.⁷⁰ This concept is the subject of their 2000 book, *Swarming & the Future of Conflict*.⁷¹ They elaborate on the doctrine of swarming as a continual engagement by small units at times and places of their choosing to confound and damage a larger, often clumsier foe.⁷² This book primarily deals with swarming as a tactic in the military end of the spectrum of conflict; however,

⁶⁶ Arquilla and Ronfeldt, vii.

⁶⁷ Arquilla and Ronfeldt, vii. They allow for hybrid designs in their text, but do not analyze any differences such designs would introduce.

⁶⁸ Arquilla and Ronfeldt, 51–52.

⁶⁹ John Arquilla and David Ronfeldt, “Looking Ahead: Preparing for Information-Age Conflict,” in *In Athena's Camp: Preparing for Conflict in the Information Age* (Santa Monica, CA: RAND, 1997), 439–501.

⁷⁰ Arquilla and Ronfeldt, 465, 468.

⁷¹ John Arquilla and David Ronfeldt, *Swarming and the Future of Conflict* (Santa Monica, CA: RAND, 2000), https://www.rand.org/pubs/documented_briefings/DB311.html.

⁷² Arquilla and Ronfeldt, vii–viii.

they do provide examples of non-governmental organizations (NGOs) swarming in social activism and raise the possibility of economic and media swarming tactics as well.⁷³

Arquilla and Ronfeldt returned to a specific treatment on netwar in their 2001 volume *Networks and Netwars: The Future of Terrorism, Crime, and Militancy*. This book is an edited volume, with Arquilla and Ronfeldt contributing the introductory and concluding chapters, and a variety of authors examining aspects and manifestations of netwar. “The Advent of Netwar (Revisited)” is their introductory chapter, and provides an updated introduction and summary to their theory.⁷⁴ Beyond explaining the mechanics of networked conflict, Arquilla and Ronfeldt begin dividing observed netwars between globalist and autonomist in outlook, and placing netwars waged by criminal and terrorist concerns in the autonomist category.⁷⁵ The authors are aware of Castells’s work, and this categorization of netwars mirrors the dynamic he noted of tension between interconnection and relative autonomy. The concluding chapter, “What Next for Networks and Netwars,” looks at various ways the study of netwar may be advanced and how states may adapt to this environment.⁷⁶ Most importantly, they now add a fifth level of analysis, narrative, to the four levels they had identified in their earlier work.⁷⁷ This narrative level is about shaping which interpretive framework will be the dominant one when a given conflict is considered in the popular imagination.⁷⁸ This new emphasis on narrative reflects the increasing dominance of the network society, as the body of literature on netwar has evolved. At the dawn of the network society, the theory only accounted for using networks as an organizational tool; in maturity, the theory recognizes that networked actors are embedded in an even greater societal network, and must therefore, also spread a “story” through the network to achieve societal legitimacy.

⁷³ Arquilla and Ronfeldt, 5. See also Arquilla and Ronfeldt’s first footnote in the text.

⁷⁴ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited).”

⁷⁵ Arquilla and Ronfeldt, 16–19. They admit to an intermediary “mixed” category as well.

⁷⁶ Ronfeldt and Arquilla, “What Next for Networks and Netwars?,” 311–361.

⁷⁷ Ronfeldt and Arquilla, 324.

⁷⁸ Ronfeldt and Arquilla, 328–333.

3. Summary

A serious inquiry into the literature on complexity and complex adaptive systems almost inevitably leads into literature on network theory. Networks are a natural metaphor for the highly interconnected agents of a complex adaptive system, and many researchers (such as Watts and Barabasi) are finding complexity dynamics at work in sufficiently interconnected networks. Both camps of literature are divided between works written for a general audience and highly technical literature that requires some skill in mathematics to follow. It is valuable to examine both kinds of literature; the works written for the general audience are excellent for overviews of the related concepts and vocabulary, while the technical literature demonstrates that substance does underlay the high-level theorizing. As a whole, the literature reviewed assisted with answering the research question by providing an in-depth understanding theoretical concepts needed to understand the changes in society that require a complexity-based model of policing. Additionally, the literature reviewed provided an understanding with how complex systems and networks behave, which provided the ability to recognize similar dynamics in real-world situations and in envisioning future operations of complexity-based policing.

D. RESEARCH DESIGN

This thesis utilizes qualitative analysis to examine existing law enforcement practices and research. Leedy and Ormrod note that qualitative analysis is well suited to both exploratory research and research that “can reveal the complex, possibly multilayered nature of certain situations, settings, processes, relationships, systems, or people.”⁷⁹ As noted previously, the very essence of complexity theory is found in the examination of the relationships and interactions between elements in a system, so qualitative research is well suited to the subject matter. The primary method of research is to employ content analysis to examine existing scholarly research about law enforcement, draw out the elements within it consistent with complexity theory, and explore how those various elements may be assembled into a cohesive whole.

⁷⁹ Paul D. Leedy and Jeanne Ellis Ormrod, *Practical Research: Planning and Design*, 12th ed. (New York: Pearson, 2019), 230.

A major element of the methodology behind selecting research for this thesis is the author's position as a working police officer. This experience as a law enforcement practitioner drove an interest in addressing the author's own perceptions of shortcomings in the standard model of policing to deal with crime and social challenges to law enforcement in the present day. The selection of a street robbery pattern in Washington, DC, came from the author's dual role as both a scholar and practitioner. In his role as middle management in the Metropolitan Police Department of Washington, DC (MPDC), the author was responsible for implementing the prescribed response to the robbery problem; yet as a scholar, the author believed that the standard methods employed to analyze, understand, and respond to crime patterns were insufficient. The author has striven not to allow his role as a practitioner to do more than guide his research, and has made every endeavor to support the arguments found in this thesis rigorously with substantial academic research.

The author was first introduced to complexity theory in Stanley McChrystal's book *Team of Teams*, which presented the topic for a general audience.⁸⁰ Upon deciding to investigate the potential of using complexity theory as the basis for a model of policing, academic literature on complexity was sought out, which quickly led the author to seek out literature on networks. Relatively few sources are available regarding law enforcement and complexity, and none was discovered that dealt with a truly fundamental rethinking and restructuring of law enforcement based upon complexity theory. Thus, it was necessary to explore existing research and extend it into new theoretical grounds.

This thesis goes about this extension by first establishing a grounding in both complexity and network theories. From there, existing frameworks, such as complex adaptive systems, the TIMN framework, and the netwar doctrine were identified as useful tools for both interpreting and putting into practice the theoretical concepts previously identified. With that grounding in place, the existing practice of law enforcement (in the form of a case study and analysis of various models of policing) was examined for

⁸⁰ Stanley McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World* (New York: Portfolio/Penguin, 2015).

congruence with the theories and frameworks identified previously. That examination resulted in the identification of a number of common themes and elements, which have been identified and presented as the answer to the research question posed at the beginning of the thesis.

E. ROADMAP

This thesis begins by establishing an understanding of two major theoretical blocks, which will subsequently be applied to policing and law enforcement. Chapter II provides an overview of complexity theory and complex adaptive systems. Chapter III examines modern network theory and its relation to complexity theory, as well as how networks and the Information Revolution are increasingly dominating societal organization and conflict. Chapter IV examines crime as a complex adaptive system and finds that street robberies in Washington, DC, exhibit hallmarks of complexity. Chapter V examines several alternatives to standard, reactive policing through the lens of complexity and network theories in an attempt to provide a useful synthesis of different alternatives. Chapter VI addresses how police leadership can utilize the Cynefin framework to make sense of complex environments until a complex epistemology is fully articulated. Finally, Chapter VII concludes the thesis with a number of recommendations for implementing a complexity-based model of policing, as well as a brief discussion of avenues for further research.

II. COMPLEXITY THEORY

How people understand or think about a problem greatly influences the ways that they try to solve it. The discovery of rigid physical laws that govern the universe and the ability to reduce complicated phenomena to more simple problems that yield to mathematical analysis has led to powerful advances in science and technology. For many people, the belief that all problems can be broken down and statistically analyzed is the default worldview adopted when seeking to solve a problem. Complexity theory, on the other hand, is the study of problems that must be appreciated as a whole. The relationships between the parts of a complex problem are so important that attempts to reduce it to more simple terms do not yield meaningful results. Studies of complex problems and complex systems call for changes in perspectives and new tools and approaches. This chapter presents a brief overview of complexity theory and examines a particular type of complex system that of the complex adaptive system, which is composed of densely connected agents who can change in response to stimuli.

A. LINEAR THINKING

Investigations of complexity usually begin by sorting problems into different domains and classifying each domain by similar characteristics exhibited by problems or systems of that type. In the seminal work of complexity theory, Weaver sorted problems into three domains: those of simplicity, disorganized complexity, and organized complexity.⁸¹ As research into Weaver's "organized complexity" has advanced since 1948, additional classification schemes have been proposed to consider new discoveries. David Snowden, one of the principal developers of the Cynefin framework (Figure 1), sorts problems into five domains. The domains of simple, complicated, complex, and chaotic surround the domain of disorder.⁸²

⁸¹ Weaver, "Science and Complexity," 540.

⁸² David Snowden and Mary Boone, "A Leader's Framework for Decision Making," *Harvard Business Review*, November 2007, 72. Snowden has modified the terminology over time, and the most recent versions of the framework have replaced "simple" with "clear." This term is alliteratively pleasing and fits well with Snowden's focus on decision making. The author has decided to retain the earlier terminology in this chapter, as it fits better with a discussion of types of problems.

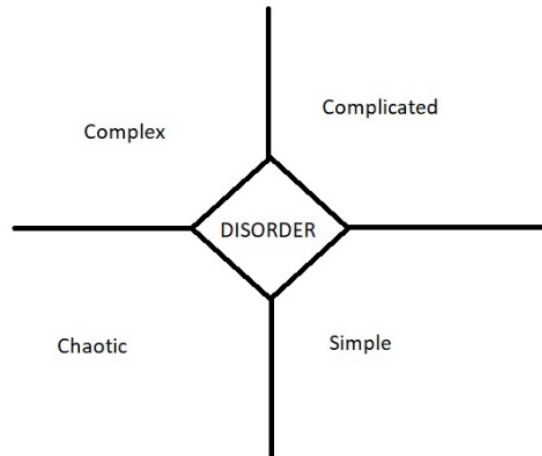


Figure 1. The Cynefin Framework.⁸³

The concept of linearity is often set forth as the boundary between simple and complicated problems on one side and complex problems on the other. Linearity was originally defined in mathematical terms, but its definition has been extended as the study of complexity has been embraced by many disciplines.⁸⁴ Linear problems can be thought of as having three main qualities. First, they react in fixed proportions to various inputs. Secondly, they are constructed out of independent variables that only affect a limited set of known, dependent variables. Thirdly, a linear problem can be understood through reductionist thinking, or breaking it down into small individual parts and tallying the interactions of those atomized parts. Linear problems can be thought of as a strict math equation; the sum of the variables completely describes the problem.⁸⁵

Simple problems are those like Isaac Newton’s “clockwork universe,” where problems can be reduced in scope, and their position fixed in a system governed by rules. Once those rules have been deduced and sufficient observations of the elements in the system made, all possible outcomes can be determined.⁸⁶ Simple problems are stable, with

⁸³ Adapted from Snowden and Boone, “A Leader’s Framework for Decision Making,” 72.

⁸⁴ Ben Ramalingam, *Aid on the Edge of Chaos* (Oxford, United Kingdom: Oxford University Press, 2013) 224–25.

⁸⁵ Ramalingam, 224–25.

⁸⁶ Aaron Pycroft, “Complexity Theory: An Overview,” in *Applying Complexity Theory*, ed. Aaron Pycroft and Clemens Bartollas (Bristol, United Kingdom: Policy Press, 2014), 18–19.

knowable relationships of cause and effect that yield a single best answer.⁸⁷ Simple problems should not be dismissed, just because they are conceptually easier to solve. In *Science and Complexity*, Weaver noted that the science of simple problems had yielded advancements, such as the internal combustion engine, flight, and telecommunications.⁸⁸

Simple problems are generally concerned with just a handful of variables, while complicated problems greatly increase the number of variables involved. Despite the great increase in the number of elements that must be accounted for in a complicated problem, it is still linear because each variable is only linked to a handful of others in known and fixed ways.⁸⁹ Weaver noted that while it was impractical or impossible to determine the exact value for each variable in such a problem, the overall orderliness of the system could accurately be described in terms of average behavior by using statistical mechanics.⁹⁰ Although complicated problems often call for expert knowledge to comprehend the causes and effects between the variables, clear answers can still be found.⁹¹ Since the interactions between the different elements, numerous as they may be, are limited and fixed, complicated problems are still susceptible to reductionism.

Pycroft offers the example of the Apollo 13 space capsule as an example of a complicated problem. After an in-flight emergency occurred during a mission to the moon, an unanticipated mechanical process had to be devised to return the capsule and astronauts safely to the Earth. National Aeronautics and Space Administration (NASA) personnel, working with technical readouts and models of the spacecraft, were able to solve the problem successfully by figuring out how to get the spacecraft to perform the operation. Although composed of a dizzying number of individual pieces, those pieces still interacted in a limited, mechanical fashion.⁹²

⁸⁷ Snowden and Boone, "A Leader's Framework for Decision Making," 70.

⁸⁸ Weaver, "Science and Complexity," 536–537.

⁸⁹ McChrystal et al., *Team of Teams*, 56–57.

⁹⁰ Weaver, "Science and Complexity," 537–538.

⁹¹ Snowden and Boone, "A Leader's Framework for Decision Making," 71.

⁹² Pycroft, "Complexity Theory," 21–22.

Elizabeth Jayanti noted that linear epistemology dominates inquiry into the social sciences, and that academic discussions focused on the function of linear epistemology instead of methodically describing its characteristics.⁹³ She asserts that this worldview is so pervasive that “linear, Newtonian assumptions underlie many HRD [human resources development] models, including those which are superficially systematic, cyclical, or nonlinear.”⁹⁴ She identifies seven key assumptions that form the basis of a linear epistemology:

1. Closed models are adequate for modeling processes occurring in open systems
2. Models can be universally applied and do not need to specify where and when they should be used
3. A system is equal to the sum of its parts
4. Time is reversible
5. Causality is linear
6. Future outcomes—like the future itself—can be predicted
7. That environments are relatively static and tend toward equilibrium⁹⁵

Most of Jayanti’s propositions are self-explanatory, but the fifth and seventh assumptions bear elaboration. By positing that under linear thought time is reversible, Jayanti means that anyone can work backwards, either mathematically or by assuming a desired end state of a process and then reverse engineering the steps to get there.⁹⁶ Bak and Paczuski describe linear equilibrium as the idea that when a system exists in such an equilibrium, small changes will cause only small changes.⁹⁷

⁹³ Elizabeth Bechtel Jayanti, “Through a Different Lens: A Survey of Linear Epistemological Assumptions Underlying HRD Models,” *Human Resource Development Review* 10, no. 1 (2011): 102.

⁹⁴ Jayanti, 103. Although she is writing within the context of Human Resources Development, her linear epistemology is applicable well beyond that field.

⁹⁵ Jayanti, 103.

⁹⁶ Jayanti, 107.

⁹⁷ Bak and Paczuski, “Complexity, Contingency, and Criticality,” 6690.

This epistemology functions well when devising solutions to problems that involve simple and complicated systems. In applying the Cynefin framework as a problem-solving tool, Snowden states that the simple domain is the area in which best practices are applied, functions are automated, and command and control hierarchies are well suited.⁹⁸ While the complicated domain often requires detailed or expert knowledge, it is generally characterized by stable relationships; therefore, Snowden asserts that it too can be reduced and solved piece-meal if someone is willing to invest the effort.⁹⁹ Kurtz and Snowden note that the complicated domain is “the domain of systems thinking, the learning organization, and the adaptive enterprise, all of which are too often confused with complexity theory.”¹⁰⁰ Clearly then, a detailed knowledge of complexity is needed to differentiate it from linear thinking.

B. COMPLEXITY THEORY AND COMPLEX ADAPTIVE SYSTEMS

Complexity theory is the emerging interdisciplinary, academic study of complex problems. Complexity does not have a definitive formal definition, but it is generally seen as a new type of analysis that builds on previous work done in cybernetics, catastrophe theory, and chaos theory.¹⁰¹ As such, complexity sometimes causes confusion, as it has technical meanings in other fields and is commonly used in a metaphorical sense.¹⁰² As generally used within complexity theory, complexity describes nonlinear dynamic systems.¹⁰³

⁹⁸ Snowden and Boone, Mary, “A Leader’s Framework for Decision Making,” 70–71.

⁹⁹ Cynthia F. Kurtz and David Snowden, “The New Dynamics of Strategy: Sense-Making in a Complex and Complicated World,” *IBM Systems Journal* 42, no. 3 (2003): 468. In this particular article, Kurtz and Snowden use the term knowable for the complicated domain. In the interests of clarity, the author has standardized the terminology.

¹⁰⁰ Kurtz and Snowden, 468.

¹⁰¹ Rosser, “On the Complexities of Complex Economic Dynamics,” 176. For a discussion on the relationship of complexity to the preceding disciplines, see pages 171–176.

¹⁰² Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 42.

¹⁰³ Agar, “Complexity Theory,” 100; Glenn Walters, *Modelling the Criminal Lifestyle: Theorizing at the Edge of Chaos* (Switzerland: Palgrave Macmillan, 2017), vi.

As they involve nonlinear systems, the most prominent feature of complex problems is that they do not react proportionately or predictably.¹⁰⁴ Exact predictions about the behavior of complex systems cannot be made because so many circumstances and interactions are occurring that obtaining sufficient knowledge about them to make accurate predictions is impossible.¹⁰⁵ Variables in complex problems continuously link to each other in ways that can overlap that then are not fixed. They can “link and let go and link again,” and therefore, cannot be neatly classified into categories of independent and dependent.¹⁰⁶ Finally, complex problems do not yield to reductionist thinking because they feature emergent properties. Emergence is when a larger whole possesses general features or properties not found within the individual parts of that whole. These emergent properties are not simply recreating the properties of the constituent parts at scale.¹⁰⁷ As linear problems were earlier likened to strict mathematical sums, complex problems are noted for being more than the sum of their parts.

Complex problems and systems are dynamic instead of fixed. Complex systems are marked by organizing themselves into something “interesting” between the realms of absolute chaos and absolute order.¹⁰⁸ Complex systems fluctuate between states of stability and instability, due to the shifting relationships of the elements within them and the emergent properties generated by their interactions.¹⁰⁹ Weaver described this state as “organized complexity” and stated that because of these properties, statistical measurements of average behavior does not give meaningful solutions to problems in this

¹⁰⁴ David L. Levy, “Applications and Limitations of Complexity Theory in Organization Theory and Strategy,” in *Handbook of Strategic Management*, ed. Jack Rabin, Gerald J. Miller, and W. Bartley Hildreth, 2nd ed. (New York: Marcel Dekker, 2000), 79, http://www.faculty.umb.edu/david_levy/complex00.pdf.

¹⁰⁵ Hayek, “The Theory of Complex Phenomena,” 157–159.

¹⁰⁶ Agar, “Complexity Theory,” 100.

¹⁰⁷ Hayek, “The Theory of Complex Phenomena,” 149.

¹⁰⁸ Jeffrey Kluger, *Simplexity* (New York: Hyperion, 2008), 28–29. As Kluger notes in the text, interest can be in the eye of the beholder.

¹⁰⁹ Leary and Thomas, “How Complexity Theory Is Changing the Role of Analysis in Law Enforcement and National Security,” 61–62.

space.¹¹⁰ Moreover, because a complex system is continually fluctuating, it must be appreciated as a whole. Unlike simple and complicated systems, mapping out the state of a complex system at any single point in time does not indicate a limited set of past and future states.¹¹¹

The framework of complex adaptive systems (CAS) has been developed to model complexity theory in action. As with much of complexity theory, no single authoritative definition of this term is available, but wide similarities exist between the definitions used by practitioners in the field. One of the simplest definitions utilized by researchers at the Santa Fe Institute is a system that retains “coherence under change.”¹¹² John Holland, who was one of the foremost of those researchers, defined CAS as “systems composed of interacting agents described in terms of rules. These agents adapt by changing their rules as experience accumulates. In *cas* ... a portion of any agent’s efforts at adaptation is spent adapting to other adapting agents.”¹¹³ Eidelson gives a general definition of CAS as “a large collection of diverse parts interconnected in a hierarchical manner such that organization persists or grows over time without centralized control.”¹¹⁴ Although none of these definitions individually completely describe the concept of CAS, when taken together, they highlight the majority of the salient features of a CAS.

When describing CAS, the term system is used to indicate a collection of individual agents linked or connected in some fashion. These links make the system complex, and can interlink it with even larger scale complex systems.¹¹⁵ Economist Herb Simon described this interlocking of systems as “hierarchy.”¹¹⁶ Complexity arises out of the interactions of large numbers of agents, and Simon asserted that hierarchy was necessary for complexity because “stable intermediate forms” would lead to a faster development of complex

¹¹⁰ Weaver, “Science and Complexity,” 539–540.

¹¹¹ Agar, “Complexity Theory,” 101.

¹¹² Holland, *Hidden Order*, 4.

¹¹³ Holland, 10.

¹¹⁴ Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 43.

¹¹⁵ Agar, “Complexity Theory,” 102, 107.

¹¹⁶ Simon, “The Architecture of Complexity,” 140.

behavior than pure randomness would.¹¹⁷ He described these subsystems as being formed by elements joined by strong bonds interacting together, and then being linked to other subsystems through weaker bonds to form a larger whole.¹¹⁸ One way to think of it is to examine a person from a systems view; a human being is a “system of systems” while at the same time being a subsystem enmeshed in another system of systems called society.¹¹⁹ When the agents of a CAS are human beings, the linkages can become extremely complex, as humans are capable of belonging to several different systems at once.¹²⁰

John Holland pioneered the field of agent-based modeling. He observed that complex phenomena (in a variety of contexts) could be modeled as a system of interacting agents, whose accumulated interactions displayed emergent behavior.¹²¹ His work on agent-based modeling has set the foundation for much of today’s current understanding of CAS, as it was his belief that developing computer-based models would be necessary to govern their operation.¹²² As Holland was working within the context of computer programs, much of his modeling is very mechanical. He noted that at the early stages of investigating CAS, it was necessary to limit detailed modeling to systems with well-understood laws that could be reduced to mathematical description, but that emergence occurred in political/philosophical systems as well.¹²³

The linked agents in a CAS operate independently and are constantly gathering information from their interactions with the environment and other agents. The agents individually respond to stimuli within the environment, and competition between agents winnows out losing responses.¹²⁴ This competition occurs through a form of problem

¹¹⁷ Simon, 145.

¹¹⁸ Simon, 148.

¹¹⁹ Walters, *Modelling the Criminal Lifestyle*, 3.

¹²⁰ Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 43–44.

¹²¹ Holland, *Emergence*, 117.

¹²² Holland, *Hidden Order*, 94.

¹²³ Holland, *Emergence*, 3.

¹²⁴ Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 43.

solving, with agents reacting to feedback and developing heuristics.¹²⁵ Conceptually, agents are individually modeled, with direct and indirect interactions with other agents affecting their behavior, and the system defined up from the individual agents rather than attempting to populate it with agents fitted to a template from a top-level view of the system.¹²⁶

The CAS as a whole is adaptive through emergent behavior, with changes originating from the agents and propagating throughout the system, rather than being imposed from above. Agents within a CAS must gather and act on information and will each individually introduce various strategies or behaviors. A selection process will occur as some of those various alternatives work better than others do, which leads to an amplification of successful options, as agents seek to increase success and reduce failure. This process of variation, selection, and amplification played out across all the agents in the CAS allows the system as a whole to adapt continually and emergently to changing circumstances.¹²⁷

When seeking to model the process of emergence, it has been useful to develop a simple set of rules that will inform the behavior of each agent.¹²⁸ The rules governing each agent can encompass possibilities for several conditions or actions, and rules are in competition with each other, as agents can adopt or discard rules in the process of adapting to seek advantage. Each rule and agent is linked to, acted on, and influenced by others in the network, which prevents meaningful understanding of the entire system from examining any individual agent.¹²⁹ As the elements of the system constantly interact, new strategies form iteratively, which prevents the system from settling into equilibrium.¹³⁰ Rafe Sagarin explains that this mode of learning from repeated activity is characterized by

¹²⁵ Simon, "The Architecture of Complexity," 144–45.

¹²⁶ Ramalingam, *Aid on the Edge of Chaos*, 179.

¹²⁷ Ramalingam, 181.

¹²⁸ Ramalingam, 146.

¹²⁹ Agar, "Complexity Theory," 107.

¹³⁰ Rosser, "On the Complexities of Complex Economic Dynamics," 181.

scholar Michael Kenney as *metis* and is the key learning mode to success in arenas characterized by constant change.¹³¹

Information generated by the environment and the interactions of various agents in the system must propagate throughout the system. Holland identified “tagging” as a mechanism that allows agents to make distinctions among other agents and environmental elements and categorize the information they have gathered.¹³² Tags provide the mechanism for the “rules” that govern each agent’s behavior, as the agents take action in regards to the tags they display.¹³³ Additionally, tags govern the movement of something (either physically or intellectually) through a CAS, as agents learn from encounters and seek to interact with other agents with favorable tags.¹³⁴ When human beings are the agents in a CAS, they are capable of using various media to spread information nonlinearly, as communications technology allows agents to transcend their environment and transmit information to recipients who are unknown to them.¹³⁵ All these processes cause the CAS to grow and self-organize to a critical point sometimes described as “the edge of chaos.”¹³⁶

This concept was defined by the work of physicist Per Bak, who investigated the concept of self-organized criticality; the tendency of large, dynamic, and interconnected systems to evolve towards a critical state where linear behavior is abandoned.¹³⁷ Bak’s work argued, “dynamical systems with extended spatial degrees of freedom naturally evolve into self-organized critical structures of states which are barely stable.”¹³⁸ Bak’s initial experiment of adding sand, one grain at a time, to a pile has since become the

¹³¹ Rafe Sagarin, *Learning from the Octopus: How Secrets from Nature Can Help Us Fight Terrorist Attacks, Natural Disasters, and Disease* (New York: Basic Books, 2012), 43. Sagarin further explains that Kenney contrasts *metis* with *techné*, which is formal academic learning.

¹³² Holland, *Hidden Order*, 14.

¹³³ Holland, *Emergence*, 163–64. It must be remembered that Holland was describing these functions through the lens of computer programming, so his descriptions are very literally mechanical. However, it is easy to extend the metaphor to organic entities by considering the tags as a kind of heuristic.

¹³⁴ Holland, 23.

¹³⁵ Agar, “Complexity Theory,” 109.

¹³⁶ Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 54.

¹³⁷ Bak and Paczuski, “Complexity, Contingency, and Criticality,” 6690.

¹³⁸ Bak, Tang, and Wiesenfeld, “Self-Organized Criticality,” 381.

standard metaphor to explain this concept. Initially the sand is in a state of pure order, or general equilibrium, being literally flat.¹³⁹ At some point, the pile will reach a point of pure chaos (meaning disorder), as it collapses in a massive avalanche. As the pile grows, each grain of sand becomes connected in a lattice to the other grains of sand in the pile.¹⁴⁰ As sand is continually added, eventually the pile will organize itself into a critical state as the number of connections between each grain of sand increases. Once it becomes critical, the pile becomes non-linear in the sense that adding a single grain of sand may have no effect, start a small- or medium-sized avalanche, or start the giant avalanche that causes the pile to collapse.¹⁴¹

Therefore, the growth of a CAS is limited. Three main factors limit its growth. First, every connection in the system increases the distance that information must travel, and at some point, the distance becomes too far, and the system collapses into chaos.¹⁴² Second, agents must accumulate sufficient resources to offset the additional complexity introduced by adding new connections. If the additional complexity accrued does not result in sufficient benefits to the agents, growth will not continue to propagate throughout the system.¹⁴³ Third, networks that have formed feedback loops that are too dense can fire too fast, which causes an “epileptic fit” in which the network no longer responds to external stimuli.¹⁴⁴

On the other hand, research has suggested that the edge of chaos is not just a limitation on CAS, but may actually be an advantage. Self-organized criticality is thought to be where resilience, or the ability of a system to “maintain functions in the face of stresses and change,” is located.¹⁴⁵ The edge of chaos offers the opportunity not just for a system to persist, but also thrive. Eidelson offers the analogy of a virus existing at the edge

¹³⁹ Bak and Paczuski, “Complexity, Contingency, and Criticality,” 6691.

¹⁴⁰ Rosser, “On the Complexities of Complex Economic Dynamics,” 179–80.

¹⁴¹ Bak and Paczuski, “Complexity, Contingency, and Criticality,” 6690–91.

¹⁴² Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 46.

¹⁴³ Holland, *Hidden Order*, 143–44.

¹⁴⁴ Holland, *Emergence*, 93.

¹⁴⁵ Ramalingam, *Aid on the Edge of Chaos*, 150, 211.

of chaos; the virus must balance between stagnating and therefore succumbing to the host's immune response or self-destruction at the hands of unchecked mutation.¹⁴⁶ The edge of chaos is the state in which the system has evolved enough linkages that it has transcended order to complexity. It now behaves non-linearly and emergent features allow it to respond and adapt to change. In this "goldilocks zone" of complexity, the system is flexible enough not to shatter when challenged as a rigidly ordered system would.¹⁴⁷ Yet, it also retains enough coherence not to collapse into disorganized randomness, as systems, which become completely unstructured do.

C. OBJECTIONS TO COMPLEXITY

Complexity theory is not without its critics and even some advocates point out some shortcomings. Rosser notes that it is difficult to conduct empirical tests of complex phenomena and that most applications of complexity theory validate themselves based on explaining situations that have already occurred, rather than predicting the future.¹⁴⁸ Professor Ralph Stacey views CAS as an analogy for understanding human actions and warns against some of the dangers of developing models. He states that modeling requires an "external modeler" and both an initial design of the system and a conceptual completion of the system. In reality, no outside force is sculpting a beginning to a CAS; rather, it has evolved over time through the actions of the agents who compose it. The CAS does not work towards a modeled end state, but it is continually generated and evolving through feedback and iterative behavior.¹⁴⁹ Levy notes that focusing on modeling complexity runs the risk of going down a rabbit hole; the development of more complex models may not lead to a profitable increase in predictive power.¹⁵⁰

¹⁴⁶ Eidelson, "Complex Adaptive Systems in the Behavioral and Social Sciences," 55–56.

¹⁴⁷ NASA, "Goldilocks Zone," *Exoplanet Exploration—Planets beyond Our Solar System* (blog), accessed October 29, 2020, <https://exoplanets.nasa.gov/resources/323/goldilocks-zone/>. The "Goldilocks Zone" is a term used in space exploration to describe planets that are at just the right distance from their star to support the existence of liquid water.

¹⁴⁸ Rosser, "On the Complexities of Complex Economic Dynamics," 184.

¹⁴⁹ Ralph D. Stacey, *Complexity and Group Processes: A Radically Social Understanding of Individuals* (New York: Brunner-Routledge, 2003), 52–54.

¹⁵⁰ Levy, "Applications and Limitations of Complexity Theory," 79.

Perhaps the most vigorous critic of complexity is science writer John Horgan. Horgan believes that humanity has reached the end of science; a state where knowledge will advance, but no fundamental “revelations or revolutions” are left to be discovered and where scientists employ hyperbole to puff up the importance of what are relatively modest insights.¹⁵¹ He has derisively coined the neologism “chaoplexity” because he contends that the definitions of chaos and complexity are not truly distinct.¹⁵² Horgan further contends that some of the key insights of complexity are repackaged knowledge. He offers the example that emergence would not be foreign to Darwin, whose theory of evolution was not Newtonian.¹⁵³ Ultimately, he posits that the end result of “chaoplexity” has been the creation of “potent metaphors” rather than any true advances.¹⁵⁴

These objections are not persuasive against applying complexity as a way of examining the behavior of social systems. Agar notes that it is true that outside of the physical sciences, complexity is used metaphorically, but that it is a useful metaphor because it suggests questions to ask and how answers to those questions may be organized.¹⁵⁵ Holland argues that metaphors serve a function similar to scientific models by charting a relation between a source and a target that yields new insight.¹⁵⁶ Ultimately, metaphors are powerful tools that human beings can apply to their thinking about the world. When it comes to human behavior, exact mathematical descriptions and predictions remain elusive. Complexity may yet provide a way to provide such an exacting mathematical analysis of highly interconnected social systems. However, even if it cannot, it provides a useful set of tools to recognize a new class of problems, organize thinking about such problems, and guide reactions to them.

¹⁵¹ Horgan, *The End of Science*, 11.

¹⁵² Horgan, 152.

¹⁵³ Horgan, 152–53.

¹⁵⁴ Horgan, 176.

¹⁵⁵ Agar, “Complexity Theory,” 103.

¹⁵⁶ Holland, *Emergence*, 209–10.

THIS PAGE INTENTIONALLY LEFT BLANK

III. NETWORKS AND NETWARS

Recent advancements in complexity have focused on applying complexity theory to networks. Although some theorists working with networks see them as a separate discipline from complex systems, networks have a history of being used to illustrate abstract principles of complexity. Knowledge about one field does help to understand the other, and recently, some complexity theorists have begun to put forth the idea that both fields are really part of one integrated whole. In his book on applying complexity theory to international aid, Ben Ramalingam calls network analysis the “killer-app of complexity science.”¹⁵⁷ This chapter begins with an examination of how physicists studying complexity have contributed to a new network theory, how networks are impacting and reordering society, and closes with a theory of networked conflict in the Information Age. Throughout these sections, the connections and contributions of complexity theory to people’s understandings of network dynamics is highlighted.

A. NETWORKS AND COMPLEXITY

Given a general understanding of complexity as being concerned with the interactions of a system of densely connected and adaptive agents, the network has long been a useful mental model to think about complexity. More recently, a modern take on network theory has arisen that indicates that network models and dynamics are an excellent tool to study and model complex interactions and systems. Many of those who investigate complexity across a variety of disciplines are discovering that the two fields are closely linked and that “at the heart of many—if not most—problems of organized complexity are network problems.”¹⁵⁸ The physicist Albert-Laszlo Barabasi, himself responsible for a key discovery in modern network theory, goes a step further in establishing the link between complexity and networks, “One thing is increasingly clear: no theory of the cell, of social media or of the Internet can ignore the profound network effects that their

¹⁵⁷ Ramalingam, *Aid on the Edge of Chaos*, 197.

¹⁵⁸ Ramalingam, 192–93.

interconnectedness cause. Therefore, if we are ever to have a theory of complexity, it will sit on the shoulders of network theory.”¹⁵⁹

Modern network theory weaves together three different strands of scientific and academic inquiry into an integrated approach: sociology (specifically social network analysis), graph theory, and complexity theory. Prior to the work of the sociologist Jacob Moreno in the 1930s, sociologists had used terms like fabric and web metaphorically when studying society and social interactions. Moreno created the sociogram, which was the first attempt to diagram these relationships physically by representing people as points and relationships as lines connecting the points.¹⁶⁰ Prior to the work of George Homans in the 1940s, sociograms were generally used to map out the relations between a small group of people. Interactions between larger groups were recorded onto matrices, with the results often appearing to have a random distribution. Homans synthesized these techniques by rearranging the order of rows and columns in such matrices until they visually represented significant patterns in the data, such as the existence of one or more cliques (small groups that could then be mapped with a sociogram).¹⁶¹

Researchers made and analyzed sociograms and the sociometric matrices individually. Homans had to perform the reorganization of each sociometric matrix by hand in an attempt to sift out notable patterns. In 1956, Cartwright and Harary introduced an analysis of social networks using the principles of graph theory to analyze the underlying structure and patterns of relationships mathematically between each person.¹⁶² Graph theory is a branch of mathematics borne from the work of Leonhard Euler when he solved the Konigsberg Bridge problem in 1736. The city consisted of four areas of land joined by seven bridges, and the problem asked if it was possible to cross all of the bridges of the city without using a bridge more than once. Euler solved the problem by abstracting the four land areas as four nodes and representing each bridge as a line connecting two

¹⁵⁹ Albert-Laszlo Barabasi, “The Network Takeover,” *Nature Physics* 8, no. 1 (January 2012): 15.

¹⁶⁰ Scott, *Social Network Analysis*, 14–15.

¹⁶¹ Scott, 26–27.

¹⁶² Scott, 17–18.

particular nodes. What Euler eventually determined was that it was not possible to solve the problem, because more than two nodes existed with an odd number of links present on the graph.¹⁶³ What was more important than the actual solution to the problem was the method by which Euler solved it by abstracting the physical map of the city onto a simple graph and analyzing the properties of its elements to determine what solutions were possible.¹⁶⁴

Additional mathematicians built upon Euler's insight and developed graph theory. Graph theory is a branch of math utilizing matrix algebra to describe relations among nodes precisely. Unlike more familiar graphs, the graphs generated are merely useful visualizations of underlying properties and their form and shape is not important.¹⁶⁵ However, while the visual layout of the graph is unimportant, graph theory provides a framework to define and measure the direction and weight of relationships, as well as concepts like degree (the number of connections a point has with other points) and centrality (a measure of relative connectedness within a network, as measured by degree).¹⁶⁶ Graph theory provided a mathematical language to describe the structure of a network and analyze the effect of that structure on the behavior of the network itself. Modern social network analysis came into existence when a group of Harvard sociologists led by Harrison White used graph theory to begin modeling the structure of all kinds of social interactions and analyzing the impact of those structures on the interactions.¹⁶⁷

Beginning in the late 1990s, a number of physicists took an interest in networks as tools to model various complex systems. Duncan Watts was trying to analyze how a group

¹⁶³ Barabasi, *Linked*, 12–13. Euler determined this solution because such a path could have only two such nodes, a start point and an end point. This measure of the number of connections a given node has is known as “degree.”

¹⁶⁴ Barabasi, 13.

¹⁶⁵ Scott, *Social Network Analysis*, 75. The utility of these graphs as a visualization can decrease when large data sets are depicted, as the number of nodes and lines can quickly overwhelm the available space to depict them.

¹⁶⁶ Scott, 75–78, 97. Social Network Analysis is a highly developed field, a detailed description of which is beyond the scope of this project. Scott's text is an excellent introduction into the specifics of how social network analysis is performed.

¹⁶⁷ Scott, 34–35.

of crickets come to synchronize their chirping in the absence of any central control when he had the idea of viewing the crickets as a kind of network.¹⁶⁸ His subsequent investigations into network structure mathematically proved that many real-world networks are of a type known as “small world networks,” a phenomenon popularly known as “six degrees of separation.” This concept evolved from the popularization of an experiment conducted by the psychologist Stanley Milgram in the 1970s that demonstrated the average number of links in a chain letter mailed from the Midwest to Boston was six.¹⁶⁹ Watts discovered that the structure of many real-world networks was responsible for this phenomenon. The networks existed between order and randomness; they were relatively tightly clustered into small, interconnected groups but a small number of random links between these groups had a non-linear effect on the structure of the network such that any two nodes could be linked through a small number of intermediaries.¹⁷⁰ Watts further developed his work on small-world networks by studying the effects of dynamic systems that functioned as such networks and observed that they generated emergent phenomena.¹⁷¹

The other major advancement was the discovery of “scale free networks” by Barabasi. These types of networks are characterized by having a few highly connected “hubs” and many more nodes that have only a handful of connections.¹⁷² It is called scale free because the average number of connections does not increase along a bell curve as the network grows, but instead keeps the same structure, following a power law distribution, even as more nodes and connections are added.¹⁷³ Barabasi demonstrated the existence of this model by mapping the connections between pages on the internet and found that the

¹⁶⁸ Watts, *Six Degrees*, 35–36. This phenomenon is referred to as being a synchronized oscillator, and applies to a broad range of independent elements that come to function in time with each other.

¹⁶⁹ Duncan J. Watts, “Networks, Dynamics, and the Small-World Phenomenon,” *American Journal of Sociology* 105, no. 2 (September 1999): 496–97.

¹⁷⁰ Watts, 493; Watts, *Six Degrees*, 87–91.

¹⁷¹ Watts, “Networks, Dynamics, and the Small-World Phenomenon,” 517–19, 524.

¹⁷² Barabasi, *Linked*, 52–53.

¹⁷³ Barabasi, 54.

distribution of links followed a power law.¹⁷⁴ The verification of scale free networks in real world settings has offered mathematical proof of complexity, as research has found them to be self-organized and capable of demonstrating emergent behaviors.¹⁷⁵

Although researchers like Watts and Barabasi are using network analysis in a formal sense to study complexity, there has long been at least a metaphorical link between the two fields. In his 1962 paper, “The Architecture of Complexity,” Simon examined how complex systems often consist of a system-of-systems. When examining this dynamic in complex social systems, Simon proposes the identification of these various systems by measuring the frequency of interactions in a sociometric matrix.¹⁷⁶ In the same paper, Simon posits that each sub-system in a complex system is strongly bound among its components and connected to other sub-systems through weaker bonds.¹⁷⁷ This concept prefigures the discovery by Granovetter in 1974 that weak network ties spread information further throughout a network than strong ties.¹⁷⁸ Complexity researcher John Holland used neural nets as an example of a network that generates complex behavior through the interactions of the nodes of the network.¹⁷⁹ Holland also described “flows” as one of the seven basic elements of CAS and explicitly used the language of networks and network properties to explain this concept.¹⁸⁰

Now, however, a number of complexity researchers are looking to synthesize modern network theory explicitly with complexity, as each can address gaps in the other. It is believed that one of the main advantages complexity offers to networks is an explanation for change over time. Watts identified that “in the past, networks have been viewed as objects of *pure structure* whose properties are *fixed in time*.”¹⁸¹ Much of his

¹⁷⁴ Barabasi, 154.

¹⁷⁵ Barabasi, 154.

¹⁷⁶ Simon, “The Architecture of Complexity,” 141.

¹⁷⁷ Simon, 148.

¹⁷⁸ Scott, *Social Network Analysis*, 35–37.

¹⁷⁹ Holland, *Emergence*, 90.

¹⁸⁰ Holland, *Hidden Order*, 23–27.

¹⁸¹ Watts, *Six Degrees*, 28.

work has focused on modeling networks as dynamic structures in two senses; first, every element represented as a node actually does something, and second, that each link represents an interaction, which causes some kind of change as time passes.¹⁸² Examining the compatibility of networks and complexity, Morcol and Wachhaus note that agent-based simulations offer a method to examine these interactions for network theorists, while network analysis offers insight for complexity theorists about how the structure of the network can impact such interactions.¹⁸³ They believe that complexity provides the conceptual grounding for network analysis to transcend its previous focus on networks as stable structures and examine them as dynamic, changing entities.¹⁸⁴

On the other hand, Barabasi believes that while prior work into complexity provided interesting insights, it failed to deliver any actual tools with which to work.¹⁸⁵ He posits that the key difference in integrating the network approach is the empirical observations of exponentially larger amounts of data regarding the interactions of complex systems than previously possible to collect.¹⁸⁶ This data-driven approach of representing complex systems as networks provides a practical tool to not only map and analyze complex systems but also to test theory against real-world examples of complexity. As Barabasi states, “Networks are by their very nature the fabric of most complex systems, and nodes and links deeply infuse all strategies aimed at approaching our interlocked universe.”¹⁸⁷

B. NETWORKS AND SOCIETY

A school of thought feels that the network effects of the modern age are so profound that they are creating a new form of society. Although precise definitions and timeframes differ, it is common to hear of an Information Revolution that has led to an Information

¹⁸² Watts, 28–29, 54–55.

¹⁸³ Morcol and Wachhaus, “Network and Complexity Theories,” 48–51.

¹⁸⁴ Morcol and Wachhaus, 46.

¹⁸⁵ Barabasi, “The Network Takeover,” 14.

¹⁸⁶ Barabasi, 14–15.

¹⁸⁷ Barabasi, *Linked*, 155.

Age in academic literature, popular literature, and the media. Generally, the Information Age can be understood to track with the maturation of the internet from obscurity to ubiquity, perhaps reaching its current apotheosis with much of the population carrying internet-enabled smartphones every day. Those scholars often use the term “Network Society” when examining how networks increasingly are coming to define the societal order.

The philosopher Castells has offered a comprehensive examination of the network society in his trilogy, *The Information Age: Economy, Society, and Culture*. Castells posits, “networks constitute the new social morphology of our societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power, and culture.”¹⁸⁸ Castells acknowledges that people connecting with each other and forming a network is not a new phenomenon, but argues that prior to the IT Revolution, networks were limited in ability and were outperformed by the forces of hierarchy and centralization in human societies.¹⁸⁹ Since the IT revolution, the capabilities of this new technology have allowed network dynamics to explode and overtake the actions of each individual agent within a network.¹⁹⁰

Castells defines the IT revolution as the ongoing convergence of a number of strains of technology as diverse as telecommunications to genetic engineering, but all concerned with radical advances in the speed, reach, and sophistication of communications and information processing.¹⁹¹ This convergence leads to the creation of feedback loops that allow information processing to continue to grow exponentially.¹⁹² Just as the Industrial Revolution led to industrial society, Castells believes that the IT revolution is leading to an “informational society.” The informational society is “oriented towards ... the accumulation of knowledge and towards higher levels of complexity in information

¹⁸⁸ Castells, *The Rise of the Network Society*, 500.

¹⁸⁹ Manuel Castells, “Materials for an Exploratory Theory of the Network Society,” *The British Journal of Sociology* 51, no. 1 (January 1, 2000): 15.

¹⁹⁰ Castells, *The Rise of the Network Society*, 500.

¹⁹¹ Castells, 29–30.

¹⁹² Castells, 31.

processing.”¹⁹³ While higher levels of physical production are a likely byproduct of the advancements of the informational society, it is no longer the driving rationale; unlike previous re-orderings, such as the Agricultural and Industrial Revolutions.¹⁹⁴

Castells explicitly identifies complexity theory as contributing to the understanding of the network society. In his view, the key advance of complexity theorists has been the focus on non-linear dynamic systems, which has led to the conceptual development of a theory that allows the networking of disparate fields of science.¹⁹⁵ The study of complexity has fostered a mindset well suited to thinking about the network society. Acknowledging the self-organizing character of nature and society could result in the “epistemological value [of complexity]. Not that there are no rules, but that rules are created, and changed, in a relentless process of deliberate actions and unique interactions.”¹⁹⁶

Castells emphasizes that technology is not determinative, but rather demonstrates the flexibility and adaptability of a given society to new circumstances.¹⁹⁷ By way of example, he notes that China possessed both gunpowder and oceangoing vessels before Europe, but did not engage in the Age of Exploration and Colonialism like Europe.¹⁹⁸ The same holds true for the dawn of informational societies, the Soviet Union collapsed despite the presence of IT while America thrived.¹⁹⁹ Thus, something of the individual character and history of a given society must remain even in the face of increasing interconnectedness and globalization and will be changed uniquely in the information age. Expressed in the language of complexity, the network society will exhibit path dependency.

Ronfeldt developed a framework that concisely models the evolution of societies over time and accounts for the network society that he calls tribes, institutions, markets,

¹⁹³ Castells, 17.

¹⁹⁴ Castells, 17.

¹⁹⁵ Castells, 75.

¹⁹⁶ Castells, 74.

¹⁹⁷ Castells, 7.

¹⁹⁸ Castells, 7–8.

¹⁹⁹ Castells, 10.

networks (TIMN).²⁰⁰ Each of the four forms has been present in some degree in society from the beginning, but they have formally developed at different times in different societies, roughly in sequence.²⁰¹ In Ronfeldt's view, societal evolution is a matter of incorporating new forms, not discarding wholesale old ones. Information age society will incorporate networks to have a blend of all four forms present.²⁰² Additionally, he notes that the "pure" archetypes of each form do not exist in the real world, because they coexist and interact with other forms, which influences both forms.²⁰³ The assimilation of each new form, generally spurred by one or more technological advances, leads to greater amounts of complexity in society.²⁰⁴ In some sense, a new form is incorporated when the old forms had reached the level of their incompetence in managing complexity. The successful transition reallocates societal functions among the forms best suited to handle them.²⁰⁵

The first basis of societal organization in the TIMN framework is the tribe. Although exact tribal arrangements have existed in many variations throughout history, the key defining aspect of this form is a kinship-based system of organization.²⁰⁶ The tribe proved effective at providing common identity and bonding for its members, while struggling to manage systems and problems effectively that involve more than a relatively small number of people.²⁰⁷ Top-down hierarchies evolved to handle such situations and allowed for the creation of large-scale institutions.²⁰⁸ Although particular details differ, hierarchies can generally be described as "centralized and built around chains of command; bureaucratization occurs as they become more elaborate and technically oriented. Partly

²⁰⁰ Ronfeldt, *Tribes, Institutions, Markets, Networks*.

²⁰¹ Ronfeldt, 2.

²⁰² Ronfeldt, 3.

²⁰³ Ronfeldt, 27.

²⁰⁴ Ronfeldt, 9. Although Ronfeldt does not appear to be using "complexity" here to refer specifically to complexity theory, such a reading appears to hold true as well.

²⁰⁵ Ronfeldt, 25–26.

²⁰⁶ Ronfeldt, 5.

²⁰⁷ Ronfeldt, 5.

²⁰⁸ Ronfeldt, 6–7.

borrowing from tribal culture, this form thrives on ritual, ceremony, honor, and duty.”²⁰⁹ The weakness of the institutional form is an inability to manage “complex exchanges and information flows” proficiently.²¹⁰ Market forms of organization evolved to allow more complex interchanges to occur, while remaining “competitive and quite atomized.”²¹¹

Every stage of societal development in this framework has required new and more capable technology for processing information, but the technology of the information age has empowered and expanded network beyond the more limited manifestations previously present in society.²¹² The technology of the Information Age erodes centralization, breaches the boundaries of closed systems, and provides the dense flows of information needed for networks to function as a new, fourth form of society.²¹³ Ronfeldt places a particular emphasis on what he terms “all channel” networks where individual agents are widely dispersed and not artificially bounded as the type of networks that are the final form in his framework.²¹⁴ These networks work best without centralized control and when agents “have agendas that are interdependent and benefit from consultation and coordination.”²¹⁵

True Information Age societies must find a way to assimilate all four forms of organization in the framework. This assimilation is not an easy accomplishment, as every incorporation of new forms roils society as existing institutions and actors must seek a new balance.²¹⁶ In the process of seeking this balance, conflict is likely to arise between the proponents and values of both the old and new orders.²¹⁷ While disruptive, ultimately, this

²⁰⁹ Ronfeldt, 7. This description accurately describes many modern American police departments.

²¹⁰ Ronfeldt, 7.

²¹¹ Ronfeldt, 8.

²¹² Ronfeldt, 11–12, 18–19.

²¹³ Ronfeldt, 13.

²¹⁴ Ronfeldt, 4. See also Ronfeldt’s footnote 4 on this page.

²¹⁵ Ronfeldt, 15. Such a description also serves reasonably well as a summary of complex adaptive systems.

²¹⁶ Ronfeldt, 21.

²¹⁷ Ronfeldt, 25.

process provides feedback to older forms; they are spurred to adapt and grow and emerge as more capable organizations within a somewhat smaller sphere of responsibility in society.²¹⁸ Ultimately, Ronfeldt believes that networks will most strengthen civil society actors, who will form networks that function as a newly empowered counterweight to states and markets.²¹⁹

C. NETWAR—A THEORY OF CONFLICT IN THE INFORMATION AGE

Ronfeldt notes that as each form has been fully incorporated into society, an increase in social stratification has occurred; upon the mature integration of network forms into society, stratification is likely to revolve around access to information.²²⁰ In his examination of the dynamics of the network society, Castells observes that networks further the explosion of information processing, grow exponentially, and penalize exclusion from the network.²²¹ Thus, the dynamics of complex networks will have a destabilizing effect, as feedback loops are likely to cause the penalties from being excluded from economic and civil networks to scale non-linearly. Castells warns that “discarded, devalued people” either who are not able to or who fail to connect to the various mainstream networks will connect to illicit, criminal networks.²²² Therefore, an understanding of how networked conflict will function is of critical importance for ensuring the security of society.

National security analysts Arquilla and Ronfeldt have developed a theory of conflict they call “netwar” that builds off the understanding of the power of networks and the Information Age expressed in Ronfeldt’s TIMN framework. According to Ronfeldt and Arquilla:

The term “netwar” denotes an emerging mode of conflict (and crime) at societal levels, involving measures short of war, in which the protagonists use – indeed, depend on using – network forms of organization, doctrine,

²¹⁸ Ronfeldt, 26.

²¹⁹ Ronfeldt, 3, 30.

²²⁰ Ronfeldt, 17.

²²¹ Castells, *The Rise of the Network Society*, 71.

²²² Castells, “Materials for an Exploratory Theory of the Network Society,” 12.

strategy, and communication. These protagonists generally consist of dispersed, often small groups who agree to communicate, coordinate, and act in an internetted manner, often without a precise central leadership or headquarters. Decision making may be deliberately decentralized and dispersed.²²³

This “cross-cutting meta pattern about network forms of organization, doctrine, and strategy” is capable of being used by both those who promote and those who would harm civil society.²²⁴ Therefore, those engaged in netwar do not always need to be opposed by the state; cooperation with NGOs engaged in positive netwars has occurred and can be a valid response.²²⁵

Netwar is inherently non-linear, as victory is divorced from sequentially achieving geographic objectives but is instead secured by accruing advantages throughout an arena not constrained by geographical boundaries.²²⁶ Its effectiveness rests on two trends in the Information Age, the increasing power of small groups and the increasing prevalence of network organizations.²²⁷ As a hierarchy, the state has been slow to adopt aspects of these trends, but a range of groups including terrorists, organized crime syndicates, other criminals (such as street gangs, smugglers, and counterfeiters), and social activists have been adopting netwar qualities.²²⁸ Actors from across these spheres have been observed forming networks that have generally flat structures and the capability for dense communications with some level of unifying ideology or objectives.²²⁹

Arquilla and Ronfeldt have identified five levels of analysis that affect the effectiveness of a network for waging netwar: the organizational, narrative, doctrinal, technological, and social levels.²³⁰ The organizational level examines in detail the

²²³ Arquilla and Ronfeldt, *The Advent of Netwar*, 5.

²²⁴ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited),” 20–21.

²²⁵ Ronfeldt and Arquilla, “What Next for Networks and Netwars?,” 348, 351–353.

²²⁶ Arquilla and Ronfeldt, *The Advent of Netwar*, 108.

²²⁷ Arquilla and Ronfeldt, “Looking Ahead,” 455.

²²⁸ Arquilla and Ronfeldt, *The Advent of Netwar*, 5–6.

²²⁹ Arquilla and Ronfeldt, 9–10.

²³⁰ Ronfeldt and Arquilla, “What Next for Networks and Netwars?,” 323–324.

structure of the network, as a “meta pattern” netwar admits to many varieties of network forms, so the particular configurations of any given real-world instance will need to be charted and analyzed.²³¹ The second level is the narrative level, which is about the narrative believed by the network and not propaganda. Narratives are used to express a sense of identity and communicate “cause, purpose, and mission,” often in a succinct fashion.²³²

The doctrinal level regards the processes by which networks are able to operate without central direction or the existence of hierarchy. Arquilla and Ronfeldt have identified two major components, decentralized leadership and swarming.²³³ One form of decentralized leadership is consultation and consensus seeking by the individual nodes of the network (be they individuals, cells, or organizations).²³⁴ NGOs engaged in social netwars appear to operate by the doctrinal principles of “collective diversity” (any and all organizations that can discern any connection to their purpose will join in) and “coordinated anarchy” (each NGO will individually decide what action to take, but will work cooperatively with others when it does decide to act).²³⁵ Similar principles would seem to apply to other kinds of actors engaged in different forms of netwar (such as terrorism or crime).

Swarming is perhaps the most well-developed portion of netwar as a theory of information age conflict. Swarming is “the systematic pulsing of force ... by dispersed, internettted units, so as to strike the adversary from all directions simultaneously ... emphasis is placed on forces or fires that can strike at will—wherever they will.”²³⁶ The sustainable pulsing of swarm networks is most effective when carried out by small groups that work in conjunction to pulse and then disperse afterwards, until they decide to pulse

²³¹ Ronfeldt and Arquilla, 325.

²³² Ronfeldt and Arquilla, 328.

²³³ Ronfeldt and Arquilla, 333.

²³⁴ Ronfeldt and Arquilla, 333.

²³⁵ Arquilla and Ronfeldt, *The Advent of Netwar*, 72.

²³⁶ Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 8–9.

again.²³⁷ Although most of their conceptual work on swarming uses the language of military conflict, it is a defining characteristic of netwar in all varieties. The examples of social networks waged by activist groups in Mexico and Serbia in the 1990s shows that pulsing of a swarm need not be acute; it can happen over longer time frames.²³⁸

Swarming, like networks, is held as achieving its ultimate expression in the Information Age despite earlier examples that can be found in history. Arquilla and Ronfeldt propose a four-stage framework of the evolution of conflict; a melee of single combatants that gives way to massed, but rigid groups, supplanted by maneuver units, and finally evolving into swarming.²³⁹ The advancement to each successive form of conflict has required the development of more advanced information processing capabilities.²⁴⁰ Effective swarming requires robustly linked and networked nodes to coordinate action and facilitate information sharing and sensing.²⁴¹ Thus, each node in the swarm not only contributes to the conflict with the antagonist, but also serves as a sensory organ gathering information and communicating it throughout the network for a distributed strategic picture.²⁴²

The final two levels of analysis are the technological and the social. The technological level provides the dense and robust communication links needed to form networks and to carry out operations. The technological advances of the Information Revolution are essential for networks to function at the level necessary to surpass hierarchical structures.²⁴³ The social level is the field of classic social network analysis, though in this sense, it is separated from network dynamics (which function as the organizational level). Successful netwar groups tend to have some sort of group social

²³⁷ Arquilla and Ronfeldt, "The Advent of Netwar (Revisited)," 12–13.

²³⁸ Arquilla and Ronfeldt, "Looking Ahead," 470–71.

²³⁹ Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 7–8.

²⁴⁰ Arquilla and Ronfeldt, 7–8.

²⁴¹ Arquilla and Ronfeldt, "Looking Ahead," 472.

²⁴² Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 22.

²⁴³ Ronfeldt and Arquilla, "What Next for Networks and Netwar?," 339.

identity, and the patterns of how the people in the groups know and interact with each other, will affect the network as a whole.²⁴⁴

As befits Information Age conflict, the conduct of netwar has a strong epistemological dimension, as it is likely to be more about disrupting or undermining society instead of causing destruction or casualties.²⁴⁵ The network will “[try] to disrupt, damage, or modify what a target population ‘knows’ or thinks it knows about itself and the world around it.”²⁴⁶ This conduct can take the form of both direct challenges to the discovery and retention of information, as well as redefining societal narratives and imagery.²⁴⁷ One example of this struggle over societal knowledge is efforts by criminals ranging from urban street gangs to international drug cartels to portray themselves as pillars of the civil society, or as Robin Hood types at worst.²⁴⁸ This scenario is a direct challenge to the ability of the hierarchy to define societal knowledge of who and what a criminal is.

The tendency of netwar operations to cross boundaries, both literal and figurative, presents a challenge for governments to react effectively to, as responsibility is usually apportioned within discrete jurisdictions.²⁴⁹ In response, Arquilla and Ronfeldt suggest that security organizations should adopt hybrids that merge hierarchies with networks, “particularly ... with actors at the low intensity end of the spectrum of conflict and crime.”²⁵⁰ They stress the need to understand and adapt to Information Age dynamics, because many organizations only focus on adding new technology and do not adjust their doctrinal and organizational approaches.²⁵¹ Adding faster and more efficient computers to an organization may speed up data processing, but does not in itself move the form from a hierarchy to a network.

²⁴⁴ Ronfeldt and Arquilla, 341–342.

²⁴⁵ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited),” 14.

²⁴⁶ Arquilla and Ronfeldt, “Cyberwar Is Coming!,” 28.

²⁴⁷ Arquilla and Ronfeldt, *The Advent of Netwar*, 72.

²⁴⁸ Arquilla and Ronfeldt, 14.

²⁴⁹ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited),” 14.

²⁵⁰ Arquilla and Ronfeldt, “Looking Ahead,” 456–57.

²⁵¹ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited),” 4.

D. COMPLEXITY AND NETWAR

Complexity is referenced only obliquely by netwar theory. Arquilla and Ronfeldt differentiate their conception of swarming from an early computer model of complex adaptive systems developed at the Santa Fe Institute because no identifiable shared strategic picture or identity existed.²⁵² They contrast the “flocking” of the CAS model with the swarming carried out by street activists at protests in Seattle and London in 1998, and Washington, DC, in 2000, because the disparate groups of protestors were united by a shared ideology and doctrine, even if their tactical decisions were decentralized.²⁵³ This fact should not disqualify the utility of CAS for understanding the dynamics of a networked organization as much of the early modeling of such systems was done with flocks of animals, such as birds and bees, and complexity theorists recognize that issues of identity and conscious thought pertain to human beings in ways they do not to other animals.²⁵⁴ Models of relatively simple agents are a necessary step to work out general principles and dynamics of CAS prior to attempting to model agents capable of higher level thought like human beings.

Much of the theoretical work on netwar has been performed on areas that come close to military conflict, such as terrorism and insurgency. It is not surprising, as the concept emerged from an analysis of the impact of the Information Age on national security, but even from the beginning, it has been held out as having explanatory power for crime and social activism. When netwar has been applied to crime, it has mostly been applied to transnational criminal organizations.²⁵⁵ These organizations may be more networked and decentralized than previous, but they still share an element of conscious association that generally makes identifying an explicit shared ethos or ideology fairly easy.

²⁵² Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 48–49. Ironically enough, the computer program was called SWARM.

²⁵³ Arquilla and Ronfeldt, 51–52.

²⁵⁴ Stacey, *Complexity and Group Processes*, 50–51.

²⁵⁵ Urban gangs have been held out as other potential netwar participants in the literature, but have not been analyzed in detail.

The principle of self-organization by complex systems provides a mechanism to extend the netwar theory below the level of explicitly organized movements to street crime and activism. This extension is a result of further developments of the information and communication technologies that have accounted for the rise of networks as an increasingly dominant social and organizational form. Much of the work about netwar appeared primarily between 1993 and 2001 and identifies technology like fax machines and peer-to-peer computing (in the form of Napster) as enabling the links necessary for decentralized networks to form and operate.²⁵⁶

Two major technological advances occurred in the intervening years that have made the communication linkages between people even denser and more pervasive, the smartphone and social media. Facebook serves as an instructive example of social media (to say nothing of Twitter, Instagram, TikTok, and a variety of other platforms). Facebook went online in 2004 as a platform for students, and then expanded to anyone over the age of 13 in 2006.²⁵⁷ As of the end of 2019, Facebook claimed a total of 2.45 billion registered users and over 1.6 billion daily users.²⁵⁸ The combination of advanced microprocessors with third generation network technology (sufficient to allow practical video transmission) combined to launch smartphones on the market in 2008.²⁵⁹ The computing power of smartphones, now sufficient to utilize social media themselves fully, has consistently increased to the point that it has not only surpassed the capabilities of earlier computers but is displacing desktops and laptops for increasing numbers of people across the planet.²⁶⁰

The combination of these technologies has made the web of already dense communication flows that exist even richer and more robust than they were when these

²⁵⁶ Ronfeldt and Arquilla, "What Next for Networks and Netwars?," 339; Ronfeldt, *Tribes, Institutions, Markets, Networks*, 17.

²⁵⁷ Mark Hall, "Facebook," *Britannica*, accessed October 11, 2020, <https://www.britannica.com/topic/Facebook>.

²⁵⁸ Mansoor Iqbal, "Facebook Revenue and Usage Statistics (2020)," *Business of Apps*, July 30, 2020, <https://www.businessofapps.com/data/facebook-statistics/>.

²⁵⁹ "A Computer in Your Pocket: The Rise of Smartphones," Science Museum, accessed October 11, 2020, <https://www.sciencemuseum.org.uk/objects-and-stories/computer-your-pocket-rise-smartphones>.

²⁶⁰ Christina Bonnington, "In Less Than Two Years, a Smartphone Could Be Your Only Computer," *Wired*, February 10, 2015, <https://www.wired.com/2015/02/smartphone-only-computer/>.

theories were initially proposed. Castells posits that meaning produces culture, and that meaning is the result of continual interactions between people.²⁶¹ Thus, given the modern state of the Information Revolution, individuals can have exponentially more continual interaction than was possible 20 years ago. As elements within these sorts of densely connected environments have been found to self-organize into complex systems, it seems very possible for these interactions to generate a shared ethos, ideology, or strategic view even without membership in an explicit organization.

Arquilla and Ronfeldt do note that the “small world” type of networks discovered by complexity theorists were observed in the social netwars waged in Seattle and Mexico and seem likely to characterize terrorist and criminal networks.²⁶² Advances in the study of complex networks are likely to provide the robust analysis of the networks called for by the organizational and social levels of analysis. Complexity holds promise for explaining the underlying dynamics of the decentralized operations that have been observed in the doctrinal level of analysis. For example, Arquilla and Ronfeldt note that the chief defense of networks is their resiliency in the face of disruptions by the loss of specific nodes.²⁶³ The concept of the edge of chaos, developed in the study of complex adaptive systems, provides an explanation of how this resilience arises from densely linked nodes within a complex system. Complexity seems well poised to provide conceptual grounding as netwar is extended along the lower end of the conflict scale and more granular analyses of specific instances are performed.

This fusion with complexity is an extension of netwar beyond the original work done on the concept, but it seems to follow the logic of the underlying technological and social developments. It may become even more critical, given how people understand the network society. Arquilla and Ronfeldt note that some states may be more incentivized to start netwars because they have “low connectivity to their own societies as well as others,”

²⁶¹ Castells, “Materials for an Exploratory Theory of the Network Society,” 7.

²⁶² Ronfeldt and Arquilla, “What Next for Networks and Netwars?,” 322–323.

²⁶³ Arquilla and Ronfeldt, “The Advent of Netwar (Revisited),” 13.

which decreases their vulnerability to retaliatory netwar.²⁶⁴ Castells's earlier warning about a class of "discarded, devalued" people who will form their own networks due to low connectivity with the licit network society indicates that a great potential exists for these antagonistic networks to wage a netwar against civil society.

Finally, this section must conclude with a brief commentary about the name "netwar." As a conceptual framework of Information Age conflict, it has value for law enforcement; crime is a conflict between the criminal and his victim. In the current milieu, the suffix of "war" being present in the name of the theory and much of the work expressing concepts in terms of armed conflict is likely to be problematic. A societal argument is being advanced that the police are "militarized" and multiple organizations are lobbying for measures to be taken to reverse this trend.²⁶⁵ Arquilla and Ronfeldt explicitly posit that netwar is about conflicts other than armed conflict and provide multiple examples of social advocacy organizations employing this framework. They also stress that to implement truly the mindset of the Information Age requires a true paradigm shift in thinking that rejects reflexive bellicosity.²⁶⁶ "Netwar" is a pithy, six-character appellation that is much less unwieldy than something like "networked Information Age conflict" and so it has been retained for use in this work. However, given the current controversies regarding American policing, rebranding will likely prove necessary if it is to be applied more widely.

²⁶⁴ Arquilla and Ronfeldt, *The Advent of Netwar*, 46.

²⁶⁵ See (as examples): The ACLU (<https://www.aclu.org/issues/criminal-law-reform/reforming-police/police-militarization>), Campaign Zero (<https://www.joincampaignzero.org/demilitarization>), and The Prison Policy Initiative (https://www.prisonpolicy.org/scans/theconstitutionproject/demilitarizing_americas_police_august_2016_final.pdf). Given the analysis presented in this chapter, the efforts by multiple organizations to redefine society's conception of the police raises the question of if America's law enforcement is currently in the midst of a social netwar.

²⁶⁶ For an elaboration of this concept, see Chapter VI of this work.

THIS PAGE INTENTIONALLY LEFT BLANK

IV. COMPLEXITY, NETWORKS, AND CRIME

The preceding two chapters have laid out a theoretical groundwork in complexity theory and network theory, both of which are concerned with how systems of densely connected agents interact. When the agents in a complex adaptive system are people, it can perhaps best be thought of as a complex adaptive network. Since the Information Revolution, tremendous advances in communications technologies have woven especially dense communication connections between people by sustaining and unleashing the dynamics of complex networks. Scholars, such as Castells and Ronfeldt, have argued that people are now entering a stage where these complex networks are becoming the driving organizational force in society.

Law enforcement is currently a hierarchical organization, competent in the simple and complicated domains and dominated by a linear view of crime. However, if crime is subject to the same forces changing society in the Information Age, it may begin to operate in the complex domain. The proliferation of advanced, portable communications technology may provide dense enough connections for self-organizing complex networks to form and drive crime at all levels, from street crime to international crime. If this is the case, law enforcement will need to adapt to a complexity-based approach to fighting crime.

This chapter is an examination of crime as a complex problem. It begins with an overview of the current, linear understandings of crime. It then proceeds to examine street crime, using street robberies to limit the scope, for evidence of complex behavior. Finally, it concludes with some brief thoughts on the implications of a complex view of crime.

A. LINEAR VIEWS OF CRIME

Much of the current thinking about crime and the resultant strategies is dominated by the linear epistemology set forth by Jayanti. Police officers and the wider law enforcement community as a whole are used to thinking about crime in both simple and complicated terms. As previously noted, the application of Newtonian principles to problem solving has yielded great advancements. As organizations outside the realm of physical sciences have applied those principles, they seek to reduce problems into terms

that are simple, measurable, and solvable.²⁶⁷ However, if crime is a complex phenomenon, it does not operate according to linear principles and strategies devised along reductionist lines will be ineffective.

Many criminologists model crime in terms of the interactions between a handful of variables.²⁶⁸ One of the most common examples of modeling crime as a simple problem is the “crime triangle,” as seen in Figure 2. This triangle conceives of crime as a result of the interaction of three variables: offender, place, and target or victim. This model is seductively linear in thought; if one of three variables can be disrupted, then crime can be prevented.²⁶⁹ Even when allowing for the fact that achieving such disruptions can be more difficult to achieve in reality than in theory, this model accounts for the presumption of linearity outlined previously. Variables are kept to a limited number (even in some variations that superimpose a second triangle over the first), interact in set ways, and output is presented as proportional to input.

²⁶⁷ Ramalingam, *Aid on the Edge of Chaos*, 126–28.

²⁶⁸ Matthew Robinson, “Why Do People Commit Crime? An Integrated Systems Perspective,” in *Applying Complexity Theory*, ed. Aaron Pycroft and Clemens Bartollas (Bristol, United Kingdom: Policy Press, 2014), 72.

²⁶⁹ “The Problem Analysis Triangle,” ASU Center for Problem-Oriented Policing, accessed October 10, 2019, <https://popcenter.asu.edu/content/problem-analysis-triangle-0>. To be discussed shortly, Eck’s work on the crime triangle actually engages more, but not completely, with crime as a complex process. However, the concept is commonly presented solely in linear terms. For examples, see the treatment of the crime triangle by Oak Forest, IL (<http://www.oak-forest.org/176/Crime-Prevention-Triangle>) or North Miami Beach (<https://www.citynmb.com/193/What-is-the-Crime-Prevention-Triangle>).



Figure 2. Two Versions of the Crime Triangle.²⁷⁰

Crime is often thought of in complicated terms as well, such as when outlining an organized crime family or cartel. Although large crime organizations can have many individual members, they are stratified into organized layers, with clearly defined lines of interaction between the different sections of the organization. The classic example of this type of organization is the Mafia.²⁷¹ The trope of the corkboard layout of a mafia organization is familiar to those who have seen any number of television shows and films. Moreover, while the mafia may try to hide many of the relationships from outsiders, those relationships are knowable and understandable to experts, such as dedicated investigators and prosecutors. While the relationships between members of an organized crime syndicate may not be as neat and tidy as an organization chart (such as Figure 3) would suggest, treating individual groups as complicated problems has yielded excellent real-world results. The use of Racketeer Influenced Corrupt Organization (RICO) laws, designed specifically to hold members of hierarchical criminal organizations responsible for the actions of their subordinates, is in large measure responsible for the diminished power and

²⁷⁰ Source: ASU Center for Problem-Oriented Policing.

²⁷¹ “Mafia Org Chart,” Federal Bureau of Investigation, accessed October 11, 2019, <https://www.fbi.gov/file-repository/mafia-family-tree.pdf/view>.

prominence of the mafia.²⁷² Conceive of a trial as experts (prosecutors and investigators) reducing and describing the links and functions of the pieces of a crime syndicate to a general audience (jurors); in other words, investing the effort to move the problem from the complicated domain to the simple one.

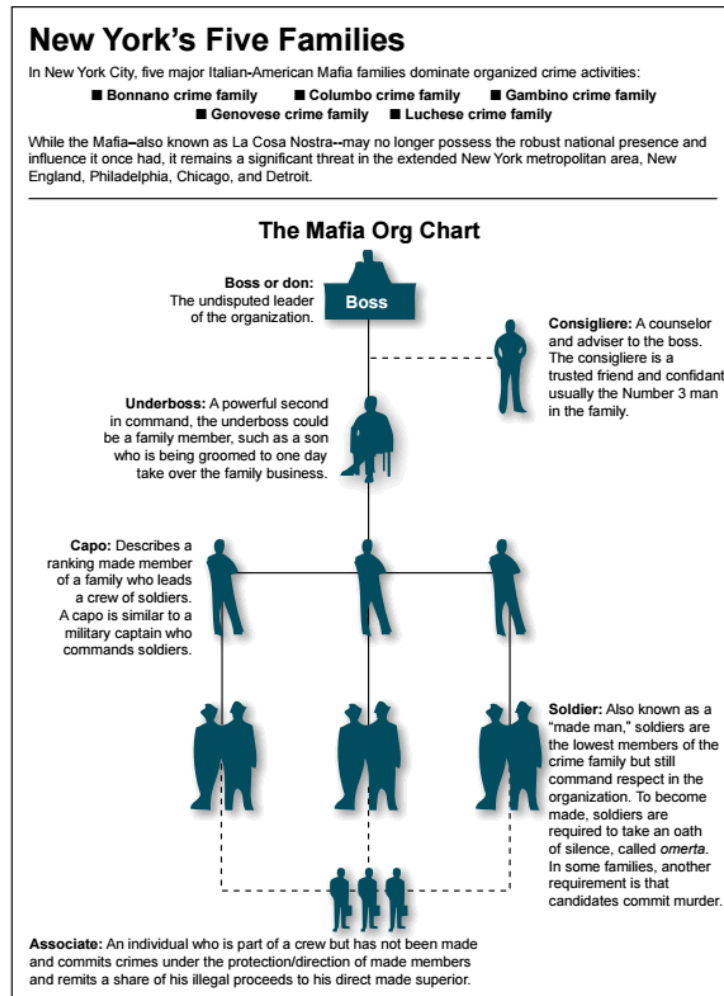


Figure 3. Mafia Organization Chart.²⁷³

²⁷² Peter Reuter, "The Decline of the American Mafia," *Public Interest*, no. 120 (Summer 1995): 95–96; Lesley Suzanne Bonney, "The Prosecution of Sophisticated Urban Street Gangs: A Proper Application of RICO," *Catholic University Law Review* 42 (Spring 1993): 593–98.

²⁷³ Source: Federal Bureau of Investigation, "Mafia Org Chart."

Generally, law enforcement breaks crime down into crimes committed by individuals or those committed by organized groups. Typically, crimes committed by individuals (or groups of two and three, who do not have sufficient members to fill out an “org chart” style structure) are usually understood in the terms of a simple problem modeled on the crime triangle. Police officers work on disrupting the interactions of the three variables to solve the problem, via solutions like altering the deployment of officers (the location leg), community outreach (the victim leg), and proactive policing (the offender leg). Organized crimes are often understood in terms of a complicated problem, with investigators and prosecutors working on filling out an organizational chart of the command and control process of the group and how it commits its crimes.

B. A COMPLEX VIEW OF CRIME

Although complexity is not currently widely found in the praxis of law enforcement, some scholars have begun to engage with crime as a complex problem. Matthew Robinson uses the Integrated Systems Theory of Crime as an approach that not only describes crime as the result of continuous interaction between various factors and contexts, rather than the simple intersection of the crime triangle, but as something that can defy accurate predictions.²⁷⁴ Professor Glen Walters has integrated elements of nonlinear dynamic systems into his fourth revision of *Criminal Lifestyle Theory*, to include iteration, sensitive dependence, fractals, and self-organization.²⁷⁵ Melgarejo and Obregon examined a decade’s worth of burglary data in San Francisco in terms of mathematically analyzing the behavior of a complex system.²⁷⁶

Other scholars have begun to use complex adaptive systems and agent-based modeling to examine crime. Richard Leary and Jenny Thomas articulate that organized crime (and conceptually similar activities like terrorism) better fit within the CAS

²⁷⁴ Robinson, “Why Do People Commit Crime?,” 70–71.

²⁷⁵ Walters, *Modelling the Criminal Lifestyle*, 1, 4–7.

²⁷⁶ Miguel Melgarejo and Nelson Obregon, “Multifractal Approach to the Analysis of Crime Dynamics: Results for Burglary in San Francisco,” *Fractals* 25, no. 5 (2017): 1750043–2. Their research does not seem to posit a hard distinction between complexity and chaos theory, and presents much of the results in terms of chaotic behavior detected in the data.

framework.²⁷⁷ They argue that although an almost paramilitary hierarchy has been imposed to model organized crime, crime is actually committed by many criminals who know each other and interact in many different ways, which creates a system actually full of diverse variables that constantly changes and is not constrained to a limited set of past and future states.²⁷⁸ Magliocca and his coauthors developed an agent-based model of a CAS composed of cocaine traffickers and interdiction agents called NarcoLogic to test theories of the ability of narcotics distributors to adapt to government efforts to disrupt their business.²⁷⁹ At the other end of the narcotics distribution pipeline, Agar uses the concepts of complexity and CAS to provide explanations for the trends occurring among heroin users in Baltimore County, Maryland.²⁸⁰

CAS has been used to explain the operations of groups like drug cartels and terror organizations, which all involve individuals consciously associating with each other to some degree in a larger organization (even if that organization is becoming more decentralized). Scholarship on Arquilla and Ronfeldt's netwar concept has focused on these same types of organizations. Based on the tenets of both complexity and netwar theory, it should be possible to extend both concepts to self-organizing systems of street criminals.

Given that CAS lacks central coordination, and noting the unique communications abilities of human beings as agents, particularly in the Information Age, it seems possible that aggregations of street crimes, such as robbery, theft from auto, and burglary could be modeled within the CAS framework. Individual criminals would be the decentralized agents within this framework, with the cumulative effects of their individual actions self-organizing to form an interrelated system that adapts to changes in the environment around it, to include law enforcement responses to criminal activity. The "edge of chaos" in this

²⁷⁷ Leary and Thomas, "How Complexity Theory Is Changing the Role of Analysis in Law Enforcement and National Security," 62.

²⁷⁸ Leary and Thomas, 62–63.

²⁷⁹ Nicholas R. Magliocca et al., "Modeling Cocaine Traffickers and Counterdrug Interdiction Forces as a Complex Adaptive System," *Proceedings of the National Academy of Sciences of the United States of America* 116, no. 16 (2019): 7785, 7788.

²⁸⁰ Agar, "Complexity Theory," 113.

environment would be the balance between a system that is too orderly and therefore subject to stifling control by law enforcement, and a system that becomes too chaotic for any sort of pattern or structure to exist. This CAS would be likely to manifest as a complex network of nodes of actors enmeshed with each other by lines of communication. A self-organized complex network might then display the hallmarks of networked conflict described by the theory of netwar.

This concept is not an entirely new idea. John Eck is one of the leading scholars and proponents of a law enforcement model known as problem-oriented policing.²⁸¹ A pattern of street crimes would meet Eck's definition of a problem, as they are a group of harmful incidents connected in a meaningful way.²⁸² The previously mentioned "crime triangle" is developed in Eck's work as the routine activity triangle (RAT), and he develops a model with a system of feedback between the elements of the RAT that give rise to problems.²⁸³ He specifically denotes "problems as outgrowths of complex adaptive systems."²⁸⁴ He notes that for his rudimentary CAS, learning and adaption are necessary and occurs via communication across networks of similar actors.²⁸⁵

However, it appears that despite these descriptions Eck does not fully engage with the concept of crime as a CAS. As Jayanti noted previously, some explanations can appear "superficially" nonlinear while still being dominated by linear epistemology.²⁸⁶ Eck calls out as a line of enquiry the conundrum that some problems appear stable while others appear chaotic.²⁸⁷ However, with an understanding of self-organized criticality, this conundrum would not be surprising; CAS will be expected to ride the "edge of chaos"

²⁸¹ An excellent collection of literature and resources about this approach can be found at Arizona State University's Center for Problem Oriented Policing at <https://popcenter.asu.edu/>.

²⁸² John Eck, "Police Problems: The Complexity of Problem Theory, Research and Evaluation," in *Problem-oriented Policing: From Innovation to Mainstream*, ed. Johannes Knutsson, vol. 15, Crime Prevention Studies (Monsey, NY: Criminal Justice Press, 2003), 82.

²⁸³ Eck, 89–91.

²⁸⁴ Eck, 96.

²⁸⁵ Eck, 93–94.

²⁸⁶ Jayanti, "Through a Different Lens," 103.

²⁸⁷ Eck, "Police Problems," 95. As always, terminology is somewhat at issue when different authors are writing about complexity. Here, Eck does not appear to be using chaotic in the formal sense.

between stability and disorder. Eck states that it is possible to begin with a solution to a problem and work backwards to figure out how to get there.²⁸⁸ This approach is a direct application of Jayanti's fourth characteristic of linear epistemology, namely that time is reversible. Moreover, he expects a mature version of problem-oriented policing to be able to recommend best practices and develop a problem-solving protocol to be applied by individual officers.²⁸⁹ Best practices are suited to the linear domains of complicated and simple problems. His belief that the manifestations of a problem have the same root cause and that problems can be classed in a hierarchical scheme to drive appropriate responses is another demonstration of the prevalence of reductionism in his model.²⁹⁰ He describes his CAS as a network of communicating criminals, but he uses the term as a casual descriptor. He does not engage with any of the dynamics or behavioral influences suggested by network theory.

What is needed then is to not only recognize aspects of complexity in street crime, but to fully embrace it as a CAS without then trying to impose linear thought on top of it. In a 2016 thesis at the Naval Postgraduate School, Leverone examined if crowds (within a crowd control context for law enforcement) could be considered as complex adaptive systems. Leverone proposed a series of five questions that captured various markers of a CAS to be used in testing crowds:

1. Does the crowd contain multiple, independent elements, devoid of a central authority?
2. Are the interactions between elements characterized by nonlinearity?
3. Does self-organization result from applying simple, unwritten rules?
4. Do emergent behaviors begin to appear over time?
5. Does the crowd adapt its behavior through metis?²⁹¹

²⁸⁸ Eck, 97.

²⁸⁹ Eck, 97.

²⁹⁰ Eck, 82, 105.

²⁹¹ Leverone, "Crowds as Complex Adaptive Systems," 42.

Leverone's questions capture the essential properties of a CAS, even when not used within the context of examining crowds. As this analysis proceeds by examining street crime, the author would simply replace "crowd" with "system" when applying these questions to the question of street crime. Additionally, some theorists have proposed that the "simple rule requirement" for a CAS with humans as the agents does not necessarily apply. Stacey explains that the classic example of the simple rule requirement is the ability of three rules to explain the behavior of flocks of birds and that birds can be treated as identical agents in a way human beings cannot be. Stacey notes that other theorists who model CAS with agents who express differences with each other model those interactions without any sort of master set of instructions.²⁹² Snowden and Boone argue that human beings demonstrate the unique abilities of being capable of switching between multiple identities, consciously calculating the outcomes of previous efforts when making choices about the future, and sometimes deliberately seeking to change a system to obtain a desired result.²⁹³ Levy notes that physical laws govern models of scientific systems, but social systems consist of agents capable of changing or even disobeying governing laws.²⁹⁴ Here an understanding of Holland's mechanism of tagging is useful to recall as a means of generating rules. Each agent will develop a set of behavior guided by associating feedback with metaphorical tags, which will lead to the development of individualized rule sets. As street crimes are not linked as tightly in time and space as a crowd at a demonstration, self-organization is more likely to result from individual agents testing and applying their own rule sets, which will express itself in the resiliency of the system as a whole.

A second level of analysis is to take the agents within a CAS and see if they exhibit network structure and behavior. This analysis is problematic for law enforcement, as they will rarely have complete knowledge of all the agents within the CAS. If they did, they would probably have been able to shut down the system before it could reach self-criticality. However, law enforcement can begin mapping and exploring network connections among those agents it is able to identify. Additionally, the presence of netwar

²⁹² Stacey, *Complexity and Group Processes*, 50–51.

²⁹³ Snowden and Boone, "A Leader's Framework for Decision Making," 71.

²⁹⁴ Levy, "Applications and Limitations of Complexity Theory," 76.

markers would serve as an indication of networked conflict. Swarming is the most developed of those concepts; secondary concepts include collective diversity and coordinated anarchy.

For the purposes of this inquiry, street robberies will be the specific lens used to look for indications that street crimes are complex problems. Street robberies are examined as both general and particular phenomena by applying Leverone's framework. When examining street robberies in the general sense, robbery is defined using the definition of a street robbery from the Department of Justice's (DOJ's) *Problem-Oriented Guide for Police* on the subject. A robbery is a crime where "the offender targets a victim; the victim is a pedestrian and a stranger; the offender attempts or completes a theft of cash or property; the offender uses force or the threat of force against the victim; and the offense occurs in a public or semipublic space."²⁹⁵ For the purposes of limiting the subject of inquiry, this definition excludes robberies of commercial establishments, robberies committed in a context of domestic violence, and carjackings or hijackings. As a particular case study, this thesis examines a robbery plan utilized by the Metropolitan Police Department's Third District in Washington, DC, in September 2019 to show the behavior of a robbery system in the real world (see Appendix). The examination of the case study focuses on the definition and understanding of a robbery problem by the Metropolitan Police Department.

The first question is if street robberies are committed by a multiplicity of independent actors or if a guiding authority is directing their actions. Although he is a fascinating literary figure, street crimes are generally not organized by a central, Moriarty-

²⁹⁵ Khadija Monk, Justin Heinonen, and John Eck, "Street Robbery," *Problem-Oriented Guides for Police, Problem-Specific Guides Series* (Tempe, AZ: Center for Problem-Oriented Policing, 2010), 1.

like figure.²⁹⁶ In 2016, 3,149 robberies were committed and 496 adults arrested for robbery in Washington, DC.²⁹⁷ Putting aside that the clearance rate (percentage of cases “solved”) is not 100% and that not all arrests are made for an offense that occurred that same year, even a population of approximately 500 individuals committing street robberies all operating under the control of a single, central authority would be an extraordinary development with no supporting evidence. Some criminals do organize into gangs, which provides for some guided decisions about committing crimes. The 2011 National Gang Threat Assessment stated that 1.3 million criminals separated into 33,000 gangs are responsible for an average of 48% of crime in the United States for the period of that report.²⁹⁸ Thus, even when allowing for some formalized command and control among the criminal element, a great diffusion of decision making still occurs but with no truly centralized control over criminal activity.

The second question is if elements in the system interact non-linearly. Given the parameters of linearity set forth earlier in this paper, the first question is if robbery behaves proportionally and predictably. A 2018 study from a complexity scholar at the Santa Fe Institute demonstrates that robbery appears to literally (in the mathematical sense) scale nonlinearly when compared with city populations. Specifically, the study found that the total number of robberies and the number of offenders per robbery both increased greater

²⁹⁶ Arthur Conan Doyle, “The Memoirs of Sherlock Holmes, by Arthur Conan Doyle,” Project Gutenberg, accessed November 23, 2019, <https://www.gutenberg.org/files/834/834-h/834-h.htm#chap12>. “For years past I have continually been conscious of some power behind the malefactor, some deep organizing power which forever stands in the way of the law, and throws its shield over the wrong-doer... He is the Napoleon of crime, Watson. He is the organizer of half that is evil and of nearly all that is undetected in this great city. He is a genius, a philosopher, an abstract thinker. He has a brain of the first order. He sits motionless, like a spider in the centre of its web, but that web has a thousand radiations, and he knows well every quiver of each of them. He does little himself. He only plans. But his agents are numerous and splendidly organized. Is there a crime to be done, a paper to be abstracted, we will say, a house to be rifled, a man to be removed—the word is passed to the Professor, the matter is organized and carried out. The agent may be caught. In that case money is found for his bail or his defence. But the central power which uses the agent is never caught—never so much as suspected.”

²⁹⁷ “Statistics and Data,” MPDC, accessed October 12, 2019, <https://mpdc.dc.gov/page/statistics-and-data>. The category for “robbery” utilized for these reports is broader than that used in this paper. For the adult arrest data, the author has filtered out actual charges of arrest that indicate the offense did not meet the definition of street robbery being used (i.e., bank robbery, carjacking).

²⁹⁸ National Gang Intelligence Center, *2011 National Gang Threat Assessment* (Washington, DC: Bureau of Justice Assistance, 2011), 9, https://permanent.access.gpo.gov/gpo90495/2011_NationalGangThreatAssessment.pdf.

than a linear progression of increasing city population would suggest.²⁹⁹ The fact that robbery exists as a problem is a function of its inherent unpredictability. Knowing the averages of when robberies occur does not give accurate short-term predictions.

Another characteristic of linearity is neat divisions between dependent and independent variables. This is not the case with street robberies, as no universal pool of constant, full-time robbers and designated victims exists. The pool of robbers itself can fluctuate, as not all individuals who will commit robbery are always operating in a mode where they are seeking to do so. The linkages to potential victims can fluctuate, be destroyed, or reform due to any number of factors from the behavior of the potential victim, a patrol car randomly turning into the block, the robber spotting a more tempting target (or even a more attractive activity than the impending robbery), or random chance. Thus, no fixed, dependent relationship exists between any given robber and a specific victim or victims.

The final characteristic of linear interaction is susceptibility to reductionism. While the street robbery as a whole can be broken down into the individual cases, those individual cases do not explain the phenomenon as a whole. For law enforcement, closing a robbery by making an arrest is the most complete understanding that can be gained of an individual instance. All the human elements involved are known and interviewed, and all the surrounding details and circumstances are known and documented. The entire event is then carefully arranged and explained in a prosecution report presented to the judicial authorities. Should the event go to trial, these accounts are tested by being subject to cross-examination in an adversarial proceeding. All this is to say that any individual instance of robbery can be known in great detail. However, the facts and circumstances in that one robbery are not the same for, and do not explain, all robberies that occur.

Leverone's third question regards the existence of self-organization. The case study of late summer robberies in Washington, DC's Third District suggests that robbery self-organizes into both smaller sub-systems, as well as a larger CAS. Sixty-six percent of the

²⁹⁹ V. Chuqiao Yang, Andrew V. Papachristos, and Daniel M. Abrams, "Modeling the Origin of Urban-Output Scaling Laws," *Physical Review E* 100, no. 3 (September 16, 2019): 1, 5, <https://doi.org/10.1103/PhysRevE.100.032306>.

robberies committed in the 30-day period addressed by the plan were committed by more than one offender working in concert, with group sizes of two and three being the most common.³⁰⁰ In his analysis of CAS, Eidelson observes, “creating subsystems within an organization may produce ‘pockets of collaboration’ that can spread throughout the system.”³⁰¹ These “pockets of collaboration” seem to be present in the case study, formed by the small, self-organized groups of offenders committing robberies together. The larger system has self-organized to the “edge of chaos” and demonstrates resiliency in two ways. First, the system has endured despite the “shocks” of the arrest of 43 individuals for robbery within the Third District between July 12 and September 9, 2019.³⁰² An arrest for robbery at least temporarily disables the offender, provides negative feedback regarding their actions, and increases the costs of participating in crime. Secondly, the system adapted to the deployment of resources along the U Street corridor by moving west and north.³⁰³ The deployment of police resources did not shut down (by either arresting or deterring) the robbery CAS, which adapted by shifting the physical location of its operation.

Indications demonstrate that robbery behavior could be modeled by drawing up a number of simple rules or conditional statements for agents to obey. In their book, *Armed Robbers in Action*, Wright and his coauthors interviewed 81-armed robbers in Saint Louis, MO. Although they are not engaged in attempting to model criminal behavior when describing their findings, the information they report illustrates possible rules that may be generated to govern agent behavior in a CAS view of robbery. They note that 80 out of 81

³⁰⁰ Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

³⁰¹ Eidelson, “Complex Adaptive Systems in the Behavioral and Social Sciences,” 46.

³⁰² Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

³⁰³ Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019. See the heat maps for the clustering of robbery locations. U Street is a commercial and nightlife hub and is the rough center of the high-density areas of the July 12 to August 10-heat map. U Street turns into Florida Avenue, NW, which begins to run southeasterly and accounts for the “dip” in the physical layouts of the robberies on the heat map.

individuals reported committing robbery because they felt an acute need for money.³⁰⁴ Describing robbers who chose to target law-abiding individuals, their subjects reported performing an assessment of the danger posed by any given target.³⁰⁵ Finally, outward signs of prosperity displayed by the victims (expensive clothing, jewelry, possession of luxury items) were used to assess how lucrative a potential robbery would be.³⁰⁶ These parameters can be taken to suggest three rules to be used as an example of possible agent-based rule sets that can be developed. It suggests that an agent may not be in the mode to commit a robbery without requiring an imminent acquisition of cash, agents will seek to rob only those individuals who do not appear to pose a threat to the agent, and agents will seek to rob those who display some reasonable, articulable sign of possessing valuables.

Leverone's fourth marker, emergent behavior will occur due to the self-organization of the system as the agents constantly test various rules, repeating rules that lead to success, and discarding ones that lead to failure. One example of emergent behavior is the targeting of individuals in possession of what the DOJ calls CRAVED (concealable, removable, available, valuable, enjoyable, disposable) electronic items.³⁰⁷ In particular, targeting individuals with smartphones for robbery enjoyed rapid growth. In a joint press release with the chairman of the Federal Communications Commission (FCC), the mayor of Washington, DC, noted in 2012 a 54% increase in the number of robberies where smartphones were taken between 2007 and 2011, and in 2012, smartphone robberies comprised 38% of all robberies committed in Washington, DC.³⁰⁸

³⁰⁴ Richard T. Wright, Scott H. Decker, and Neal Shover, *Armed Robbers in Action: Stickups and Street Culture* (Boston: Northeastern University Press, 2011), 31, ProQuest. It is also possible to pose several common sense, hypothetical "rules," such as "do not commit a robbery if you see a police car" and "avoid police officers after committing a robbery." Wright and his colleagues have made a particularly valuable contribution because their information comes from active robbers themselves, not third parties.

³⁰⁵ Wright, Decker, and Shover, 52–53.

³⁰⁶ Wright, Decker, and Shover, 58.

³⁰⁷ Monk, Heinonen, and Eck, *Street Robbery*, 7.

³⁰⁸ "Chairman Genachowski Joins Senator Schumer, D.C. Mayor Gray, State Police Departments, and Wireless Carriers to Announce New Initiatives to Combat Massive Smartphone & Data Theft," Federal Communications Commission, April 10, 2012, <https://www.fcc.gov/document/announcement-new-initiatives-combat-smartphone-and-data-theft>.

When robberies cluster, it too is an emergent behavior as the cluster is emerging from the individual actions of agents. As shown in Figure 4, robberies initially clustered along the U Street corridor, then moved west and north.³⁰⁹ The new clusters emerged without any central direction and as a result of the actions of individual agents (or individual “pockets of collaboration”). The existence of robberies outside the cluster areas shows other viable “hunting grounds,” so the new cluster areas are not necessary consequences of increased enforcement along U Street. Both the targeting of individuals with smartphones and the clustering of robberies in geographic areas are emergent because they are larger patterns or structures that exist within the system, but they are not a necessary consequence of observing any single robbery. Robberies occur outside of the cluster area and some people are robbed who do not have smartphones.

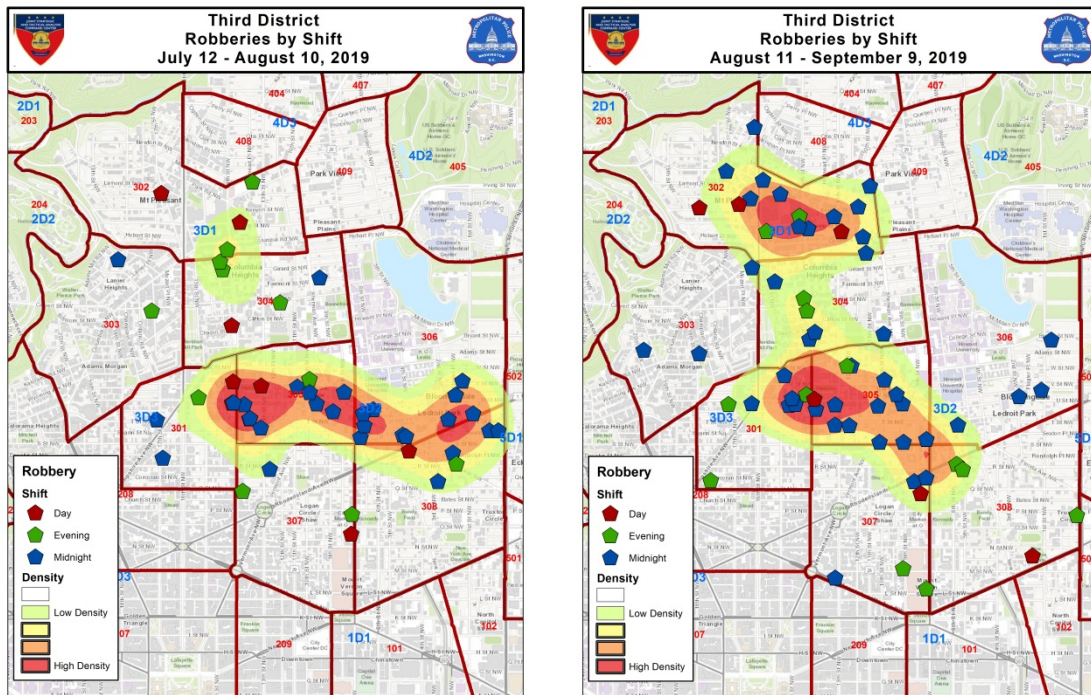


Figure 4. Clustering of Robberies.³¹⁰

³⁰⁹ Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

³¹⁰ Source: Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

Leverone's final marker was experiential learning. As with central control, this point seems somewhat self-evident. While police officers obtain formal educations and training, nascent robbers have not attended any academy. Evidence for learning due to feedback can be found in Wright's study of armed robbers, 35% of the robbers interviewed estimated that they had committed between 10 and 49 robberies over the course of their lifetime and 36% estimated that they had committed more than 49. Wright notes that these are estimates, as their subjects were unable to provide exact details, but that 21% were committing more than one robbery a week.³¹¹ This information suggests that robbers are fairly active, and thus, every robbery and every contemplated (but not consummated) robbery provides feedback to robbers from which they learn.

Thus, an identified pattern of street robberies is possible that satisfies all five of Leverone's proposed markers of a CAS. The behavior of the CAS observed in the case study also exhibits the main feature of networked conflict described by Arquilla and Ronfeldt, swarming. The crime maps show a pulsing of robberies occurring in the emergent clusters, continuing for two months, and then occurring across all times of day. In fact, the "sustained pulsing" of those robberies in the concentrated areas drew the attention of the police to the robbery problem to begin with. The majority of the robberies during the time period were carried out by groups of two and three suspects able to strike and then disperse back into the population.³¹² These groups are able to serve the sensory function of swarming through the generation and testing of "rules" and their propagation throughout the CAS, which spreads information throughout the system.

This situation creates a powerful suggestion that the netwar dynamic may be in play, but it cannot be conclusively proven from the data available. Currently, law enforcement's view of these situations tends to be reductionist, focused on decomposing the problem down into its individual instances, rather than taking a network or systemic view of the problem. Thus, the kinds of data needed to be collected currently only allow for a thorough analysis of one of the five levels of analysis for determining the presence of

³¹¹ Wright, Decker, and Shover, *Armed Robbers in Action*, 19–21.

³¹² Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

a netwar. The detection of a clear swarming function indicates that a key doctrinal pillar of netwar is present. Rudimentary data is gathered about three of the other four levels of analysis, although the current absence of a clear theoretical framework often means that this data lies scattered in individual case files instead of providing a systemic picture.

The development of suspects (and, hopefully, their eventual arrest) provides starting points for an analysis of the organizational and social levels. The recognition of the markers of a CAS in operation provides an indication that a structure has self-organized, but it is still necessary to attempt to map the full structure of the system. Suspect identities are a first step in this process, but it is necessary to then attempt to discern how those isolated data points fit into a larger complex network. It is also a rudimentary insight into the social level of analysis, but too often police departments instead resort to noting overlapping suspects and odd coincidences and do not perform a rigorous social network analysis. Law enforcement is currently the most advanced at the technological level, as the usefulness of smartphones (and the variety of apps they can access) as evidence repositories is widely recognized. Only a slight change in perspective is required to move from the position of a focus on recovering evidence to be used in individual prosecutions to using lawfully gathered evidence to analyze a network structure. The narrative level of analysis may be the most difficult level for law enforcement to gather data on, as it requires more sociological than detective work.³¹³ In their study of armed robbers, Wright and his coauthors described the difficulties in locating interview subjects and note that convincing them information would not be shared with the authorities was a primary concern.³¹⁴

Taken in whole, this scenario appears to be an identified instance of crime operating as a complex problem for law enforcement. It appears then that crime is evolving along with society in the Information Age and is beginning to be governed by network dynamics and complexity theory. Similarly, law enforcement will need to adapt itself to operate in the complex domain and begin thinking in terms of complex systems and dynamic

³¹³ Anecdotally, the author began noticing similar cultural totems when serving search warrants in a narcotics enforcement unit, which suggests that even in a self-organized complex network, the sorts of narratives envisioned by Arquilla and Ronfeldt can be generated and spread.

³¹⁴ Wright, Decker, and Shover, *Armed Robbers in Action*, 22–25.

networks; insisting on a linear and reductionist approach to handling crime will prove futile.

C. IMPLICATIONS OF A COMPLEX VIEW OF CRIME

Law enforcement practitioners will still need to understand individual robberies (and other street crimes) on a tactical level. Every reported robbery still has a victim who has suffered, and the amount of evidence required to support the arrest and conviction of suspects remains high. The power of modeling street robberies as a CAS occurs on the strategic level. When planning law enforcement activities to both prevent and respond to street robberies, leaders need to think of street robberies not as aggregations of single acts but as an integrated, living whole.

A complexity-based approach to law enforcement is a matter of not only adopting new practices and techniques, but also establishing a real grounding in theory. It is necessary to recognize the markers of complexity and to transcend linear thinking when approaching complex problems. Although the linear epistemology is almost reflexive for many people when attempting to solve problems, the approaches it suggests cannot effectively deal with the operations of complex systems and networks. Failing to integrate theory truly will result in merely superficial changes, which are unlikely to perform much better than the models and tactics they are replacing.

Law enforcement operating according to a complexity-based model will need to examine any CAS it interacts with as an organic whole and recognize the nonlinear dynamics that govern it. Bak notes that when dealing with systems that have reached the state of self-organized criticality, “no ‘quick-fix’ solutions [that] can stabilize the system and prevent fluctuations.”³¹⁵ Those same dynamics make it impossible to develop accurate and detailed predictions of future states for the system.³¹⁶ Rather, law enforcement must abandon the linear idea of a single fix and itself adopt an iterative approach to interacting with the system. Those interactions will cause change in the system, as the extraction of

³¹⁵ Bak and Paczuski, “Complexity, Contingency, and Criticality,” 6698.

³¹⁶ Bak and Paczuski, 6698.

information and resulting law enforcement action will provide feedback that will lead agents to modify their behavior.³¹⁷

Therefore, while law enforcement must be vigilant for the changes in the system, this mutability can also be harnessed with careful analysis and deliberate action. Insufficient connections between agents impair the ability of a CAS to adapt and self-organize.³¹⁸ The strategic response of law enforcement needs to focus on taking actions and gathering information to identify the linkages in the CAS so that considered, targeted disruptions can be made. Detailed and knowledgeable analysis of the CAS should be performed to try to identify possible iterative strategies and rule sets that have spread throughout the system so that efforts can be made to disrupt those particular aspects. This process will be ongoing, as the CAS will be changing in response to law enforcement's actions, as well as environmental changes over time. Integration of network theory provides the intellectual framework to map and analyze these CAS, interpret the results of probes by law enforcement, and identify key structural linkages needed for the CAS to function.

In the current state of affairs, an arrest for a crime, such as a street robbery, is usually considered the end of an investigation, save for some tidying up for prosecution (or perhaps closing out other cases for statistical purposes). Complexity-based policing would view an arrest as a launch pad, as law enforcement now has a window into the CAS and its associated network. Examining the linkages of any given arrested robber will uncover other nodes and provide more information about the actors in the system and how they are linked. A broader implication is that it calls for breaking down silos, as analysts will be just as much on the front lines of policing as the sworn officers. As detailed knowledge is gained

³¹⁷ Leary and Thomas, "How Complexity Theory Is Changing the Role of Analysis in Law Enforcement and National Security," 63.

³¹⁸ Eidelson, "Complex Adaptive Systems in the Behavioral and Social Sciences," 46.

as to how individuals are linked into complex systems, experts in fields outside of law enforcement may become valuable employees and partners to police officers.³¹⁹

Agar states “Policy is built on linearity: change this regulation and that will result.”³²⁰ Increasingly, crime seems to be built on complexity instead of linearity. Law enforcement must come to embrace complexity and expand its competencies beyond the simple and complicated domains into the complex domain. Solid grounding in complexity theory is needed to break out of a linear epistemological frame and begin thinking and acting in nonlinear terms, and to advocate for and explain the need and value of such an approach.

³¹⁹ In *Science and Complexity*, Weaver described the “mixed team approach” of dealing with the complex problem of arranging the passage of troop convoys across the Atlantic. Weaver notes that the teams that performed the best contained experts in fields outside of math and engineering; indeed, one of the best British teams contained an endocrinologist. See pages 540–542.

³²⁰ Agar, “Complexity Theory,” 100.

V. BUILDING BLOCKS OF COMPLEXITY-BASED POLICING

The revolution in IT has enmeshed everyone in webs of communication that grow ever denser. These effects are birthing a networked civilization that is altering all aspects of society, including crime. The lifeblood of this new form of civilization is dense flows of information that connects people as nodes in vast, complex networks. Complexity can be thought of as a kind of informational physics that provides the language and theory to study the behavior of densely connected systems. The complexity dynamics that drive crime can now be better identified, understood, and analyzed. Law enforcement must adapt to a complex environment; institutions and practices designed for a linear, predictable environment will perform poorly in a world defined by nonlinear, dynamic principles.

It is important to remember that the procession of society through Ronfeldt's TIMN network is an evolution that incorporates and renegotiates the role of previous elements that still function and provide value while integrating new, dominant modes. While law enforcement must evolve to a complexity-based model, that does not mean that all current forms and practices must be abandoned. This chapter looks ahead to see what currently exists in law enforcement's tool kit that can serve as a foundation for complexity-based policing. It begins with a brief exploration of the role of information in organizations that are adapted to the Information Age. Next, it establishes what the current "standard model" of policing looks like, to serve as a point of comparison. The chapter concludes with an examination of some of the alternatives proposed to the standard model and analyzes the extent to which they are compatible with complexity.

A. POLICING FOR THE INFORMATION AGE

Adapting to Information Age society will require changes to both the doctrines and organizations of police departments and other law enforcement agencies. Arquilla and Ronfeldt delineate two views of information within organizations, processing versus structural.³²¹ The processing view is more common and tends to focus on adding

³²¹ Arquilla and Ronfeldt, "Looking Ahead," 446.

technology to inputs and outputs of data faster and more efficient.³²² The structural view of information is about the “identity, meaning, and purpose” of an organization.³²³ Put another way, the structural view is about the information (often subconsciously) embedded in an organization so that “people know (and are trained to know) what to do and why, in an organized manner.”³²⁴ It is common to attempt to adapt to new circumstances by simply adding new technology to an organization, but does not effect any fundamental change in the nature of the organization or in what it “knows.”³²⁵

Many police departments have added cutting-edge computers and communications technology to their arsenals, but only use them to speed up or extend their prior modes of carrying out operations. The mere possession of modern IT does not mean that an organization is aware of, or is operating in, the complex domain. Both Castells and Ronfeldt note that technology is a necessary, but not sufficient ingredient for the formation of the network stage of society.³²⁶ As strong hierarchies exercising control via onerous bureaucracy can characterize most police departments, they are capable of instituting a governing structure over operations. This structure is often rigid enough that it is able to limit the formation of the dense, adaptable webs needed for complex behaviors to begin to manifest.

Ronfeldt notes that thanks to the Information Revolution, society is on the cusp of developing sensory apparatuses of unprecedented size and scope.³²⁷ As information processing surpasses productive capacity as the primary metric of organizational effectiveness, Information Age organizations and networks will be about sensory functions that gather, exchange, and process information. These kinds of organizations will be

³²² Arquilla and Ronfeldt, 446.

³²³ Arquilla and Ronfeldt, 446.

³²⁴ Arquilla and Ronfeldt, 466.

³²⁵ Arquilla and Ronfeldt, 446.

³²⁶ Castells, *The Rise of the Network Society*, 10; Ronfeldt, *Tribes, Institutions, Markets, Networks*, 19.

³²⁷ Ronfeldt, 35.

fundamentally different from production-oriented ones, and the future requires that innovation stop looking backwards at production.³²⁸

Arquilla and Ronfeldt posit that Information Age conflict will no longer be a matter of attrition or annihilation, but of information dominance that leads to disruption, which prevents effective resistance.³²⁹ Their language is that of military analysts, but it is easy to extend their vision to law enforcement as crime falls elsewhere on the spectrum of conflict.³³⁰ Law enforcement agencies must adapt to become sensory organizations that seek information dominance of their environments. Arrests will still be necessary to combat crime, but they will be targeted to disrupt complex adaptive networks instead of blindly chasing after suspects in every individual instance of crime. This information centric view of law enforcement will require agencies to adapt both their processing and structural views of information.

B. THE STANDARD MODEL OF POLICING

Before exploring the possibilities for the future, the current state of policing should be defined. The modern institution of the police dates back to the mid-19th century in America, during a time when policing (like other government services) was closely associated with the dominant political machines of the era.³³¹ The Reform Era succeeded this time, when a concerted effort was made to professionalize policing; this era reached its height in the 1960s and early 1970s.³³² What has become known as the “standard model of policing” is the practices generally in use at the end of the Reform Era. The increasing number of scholars criticizing the effectiveness of this model and proposing alternatives to

³²⁸ Ronfeldt, 35–36.

³²⁹ Arquilla and Ronfeldt, *The Advent of Netwar*, 101.

³³⁰ Crime is conflict. It can be a conflict of resources, between myself and the mugger who wants my wallet. It can also be a conflict between an individual or group who wants to engage in a behavior that the society at large has placed off limits.

³³¹ George L. Kelling and Mark H. Moore, *The Evolving Strategy of Policing*, Perspectives on Policing (Washington, DC: National Institute of Justice, U.S. Department of Justice, and the Program in Criminal Justice Policy and Management, John F. Kennedy School of Government, Harvard University, 1988), 2, <https://www.ncjrs.gov/pdffiles1/nij/114213.pdf>.

³³² Kelling and Moore, 2.

it since the middle of the 1970s has further cemented Reform Era policing as the current baseline of police practices.³³³

Weisburd and Eck have identified five key characteristics of the standard model of policing:

1. Increasing the size of police agencies
2. Random patrol across all parts of the community
3. Rapid response to calls for service
4. Generalized investigations of crime
5. Generally applied intensive enforcement and arrest policies³³⁴

Calling it the standard model is a deliberate choice, for it denotes that police operations and services have, in large part, become standardized. The standard model assumes that a reactive template of policing can be applied without regard to the particular circumstances of any given community.³³⁵ Weisburd and Eck note that use of the standard model often leads to a greater concern with the administration of police service, measured through metrics, such as the number of cars in service, average response time to calls, than on actual improvements to public safety.³³⁶ Indeed, they note that limited demonstrated evidence is available concerning the effectiveness of each individual prong.³³⁷ Perhaps the most well-known example is the Kansas City patrol experiment that showed random patrols exerted little impact on crime rates in studied areas.³³⁸

The standard model of policing is effectively a design for a production-oriented organization. This is not a surprise, given that it evolved between 1930–1970, a time when

³³³ Weisburd and Eck, “What Can Police Do to Reduce Crime, Disorder, and Fear?,” 43.

³³⁴ Weisburd and Eck, 49.

³³⁵ Weisburd and Eck, 44.

³³⁶ Weisburd and Eck, 46.

³³⁷ Weisburd and Eck, 49–51.

³³⁸ George L. Kelling et al., *The Kansas City Preventative Patrol Experiment: A Summary Report* (Washington, DC: The Police Foundation, 1974), 2–3, <https://www.policefoundation.org/publication/the-kansas-city-preventive-patrol-experiment/>.

American industry was crucial to winning the Second World War and positioning America as not only a global hegemon, but also the embodiment of capitalism during the Cold War. The standard model is industrial in its outlook, directly producing reports, investigations, arrests, and prosecutions with the underlying assumption that if enough of those goods are produced, a profit of public safety will be realized. Kelling observes that the innovators of the Reform Era were following the principles of Frederick Taylor's scientific management; a system for increasing productivity through essentially adopting assembly line techniques.³³⁹ Accordingly, police procedures were standardized, broken down into constituent steps, and police officers trained to perform their specific tasks efficiently while managers coordinated between different "production units" within the departments.³⁴⁰

An industrial, production modeled organization is well suited to the realms of both simple and complicated problems (Figure 5). Taylorism is explicitly reductionist that breaks any process down into a series of simple steps, each linked one to the next. Moreover, while complicated problems may call for the expert knowledge of professionals, it fits well with the mindset of the progressive thinkers of the Reform Era, who saw themselves as specialized technicians who would be solely responsible for the administration of public safety.³⁴¹ Law enforcement is very comfortable with the simple and complicated models of crime, and the standard model of policing seems to provide solutions in these realms; it is merely a question of efficiently allocating resources to produce enough investigations, arrests, and prosecutions to "solve" the problem of crime.

³³⁹ Kelling and Moore, *The Evolving Strategy of Policing*, 6; *Britannica*, "Taylorism."

³⁴⁰ Kelling and Moore, 6.

³⁴¹ Kelling and Moore, 6.

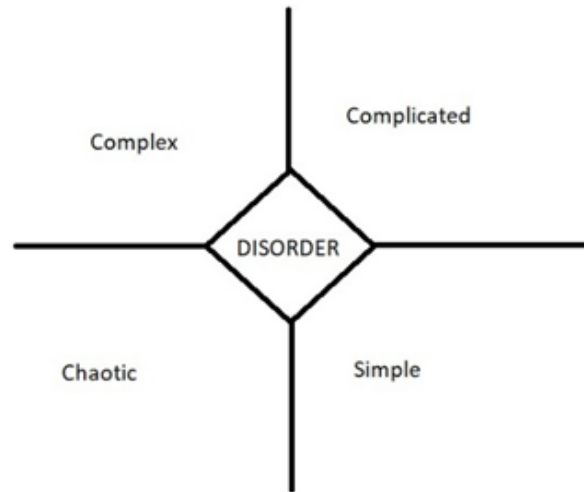


Figure 5. The Cynefin Framework.³⁴²

Both the simple and the complicated domains are the province of linearity, and the standard model of policing falls squarely within Jayanti's framework for linear epistemology. Nothing better demonstrates the standard model's assumption that closed models are sufficient for open systems than its reliance on maps. Maps are ubiquitous within the standard model; police officers are assigned beats (slivers of the map) and managers are held responsible for their own sub-sectors of the map. Activity, both police and criminal, is tracked and represented on the map. Maps are inherently a closed model, drawing hard borders, and limiting perspectives. Maps also both process and structure information; processing information by serving as a reference to someone's physical location but also structuring it by embedding information about the division of the world and the limits of someone's responsibility.³⁴³

The standard model is itself a template, so it fulfills Jayanti's second characteristic of universal applicability. The standard model's embrace of formalized reductionism via scientific management is likewise an affirmation that both police work and crime are merely the sums of their parts. Likewise, the focus on the proportionate geographic

³⁴² Adapted from Snowden and Boone, "A Leader's Framework for Decision Making."

³⁴³ Arquilla and Ronfeldt, "Looking Ahead," 445. Perhaps, it would be a good idea to begin placing "Here be dragons" at the borders of police maps to remind the viewer that they are actually working with an open-ended system.

allocation of police resources affirms the standard model's belief that reverse engineering is possible, a linear model of cause and effect is in place, and that the future can be forecast. Finally, the standard model's emphasis on stability of strategy and resource allocation assumes a system that is in overall equilibrium. In sum, the standard model of policing is designed for a linear, production-dominated environment, instead of a complex, networked, and information-dominated environment.

C. ALTERNATIVE MODELS OF POLICING

Beginning in the 1970s, a number of scholars began studying various aspects of the standard model of policing to attempt to measure their actual effectiveness. A notable segment of academics and professionals began to doubt the effectiveness of the standard model, and since the middle of the 1990s, a number of alternative models have been proposed and experimented with.³⁴⁴ Many of these approaches have been adopted, whole or in part, by various police departments. Many departments incorporate more than one of these alternatives, even when their tenets clash with each other. Departments have adopted these multiple approaches for a variety of reasons: desire to innovate, adherents within the management structure, and political necessity or expediency. To date, none of these approaches has displaced the standard model as the dominant approach or strategy to policing in America.

A growing body of literature about these various alternatives is becoming available, with supporters and critics of each method to be found. However, this literature approaches the problem from a linear epistemological frame, which embeds the assumption that crime is either a simple or complicated phenomenon. As both society and crime come to be dominated by complex network forms, linear epistemologies and methods will prove insufficient to devise solutions to problems. Arquilla and Ronfeldt state that when "designing a strategy for netwar may mean grouping together from a new perspective a number of measures that have been used before but were viewed separately."³⁴⁵ Thus, this section examines some of the most prominent alternative models of policing from the

³⁴⁴ Weisburd and Eck, "What Can Police Do to Reduce Crime, Disorder, and Fear?," 43.

³⁴⁵ Arquilla and Ronfeldt, "Cyberwar Is Coming!," 28.

perspective of complex adaptive networks and network to identify the extent they are congruent with these theoretical frameworks.

1. Compstat

Due to the immersion of traditional thinking about policy and law enforcement in linear epistemology, statistics have come to be a major driver of strategy because statistical analysis can provide useful information about linear problems. This use of statistics in law enforcement strategy often takes the form of a Compstat-like (compare statistics) program. Compstat was a program instituted in the New York City Police Department (NYPD) where police managers meet with the leadership of the department. These managers are engaged in a dialogue with leadership about a variety of statistics tallied to examine weekly, monthly, and yearly timeframes. The managers are expected to demonstrate to the upper ranks that they have knowledge of the trends in their commands and to plan future activity.³⁴⁶ Although not necessarily using the Compstat “brand name,” similar programs quickly spread throughout police departments in the United States, with one third of major city departments having implemented such a program only five years after its introduction by New York.³⁴⁷

Compstat has often been advertised as a method to prevent crime by the cities and departments implementing the program, and organizational flexibility and innovative problem solving have been identified as key components of the program, at least in theory.³⁴⁸ Yet, scholar David Weisburd and his colleagues have found that Compstat has the effect of centralizing control over middle managers and reinforcing the traditional hierarchy of control within a police department.³⁴⁹ As Weisburd and his colleagues argue, “Compstat is appealing precisely because it holds out the promise of innovation in police

³⁴⁶ David Weisburd et al., “Reforming to Preserve: Compstat and Strategic Problem Solving in American Policing,” *Criminology & Public Policy* 2, no. 3 (July 2003): 426–27.

³⁴⁷ Ratcliffe, *Intelligence-Led Policing*, 31–32. Compstat will be used as a shorthand for statistics driven strategy, where plans are devised in response to statistics and assessed on their statistical impact.

³⁴⁸ Weisburd et al., “Reforming to Preserve,” 445, 427. The other elements of Compstat programs identified by Weisburd and his colleagues are mission clarification, internal accountability, geographic organization of command, and data-driven problem identification and assessment.

³⁴⁹ Weisburd et al., 448.

organization, strategies, and tactics but does not demand a revolution in the organizational structure of American policing. Rather, it preserves—indeed, claims to reinvigorate—the traditional structure of the military model of policing.”³⁵⁰ Even some advocates note that Compstat has become a tool of centralization within the NYPD, as the focus has been on the “technocratic” aspects of the program instead of the philosophical foundation behind Bratton’s original innovation.³⁵¹

Overall, Compstat has little to offer as a strategy for policing in the Information Age. Its fatal flaw is a fundamental reliance on statistics to drive strategy. In non-linear environments, statistics do not provide meaningful information. Economist Friedrich Hayek explained that statistics were “impotent” to deal with complex phenomena because:

The statistical method is therefore of use only where we either deliberately ignore, or are ignorant of, the relations between the individual elements with different attributes, i.e., where we ignore or are ignorant of any structure into which they are organized...It is however, for this reason irrelevant to the solution of problems in which it is the relations between individual elements with different attributes which matters.³⁵²

In non-linear domains, and particularly when dealing with complex systems expressed as networks, the relationships between the elements are the key aspects to understand.

Additionally, the features of the Compstat program still structurally embed a linear understanding of the world. Critics acknowledge that Compstat’s combination of statistics and mapping led to some innovation in problem identification but note that the solution offered is generally the application of the standard model of policing.³⁵³ Compstat retains a geographic focus, which, as discussed previously, is indicative of a foundational assumption that a closed system exists. The operational focus is placed on commands

³⁵⁰ Weisburd et al., 446.

³⁵¹ Eli B. Silverman and John A. Eterno, “CompStat’s Innovation,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 412.

³⁵² Hayek, “The Theory of Complex Phenomena,” 152–153.

³⁵³ David Weisburd et al., “Changing Everything so That Everything Can Remain the Same: CompStat and American Policing,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 425.

defined by territory, with specialized units made subject to the needs of territorial commanders.³⁵⁴ Compstat reinforces hierarchical command structure, which falls squarely within practices Snowden has identified as best suited for the complicated domain, where determining best practices and seeking efficiencies in process will yield success.³⁵⁵ Even advocates for Compstat like Silverman and Eterno concede that it “cannot be a fully viable entity” without widespread organizational changes that emphasize information sharing, problem solving, accountability, and decentralization.³⁵⁶

2. Problem-Oriented Policing

Problem-oriented policing is a model of policing that posits that police should focus on solving “problems,” which are clusters of related types of incidents that bedevil a particular community.³⁵⁷ It is the evolution of a concept first proposed by Herman Goldstein in 1979, which suggested that the police needed to begin proactively identifying and addressing persistent issues in the communities they patrolled to prevent crime from occurring.³⁵⁸ Proponents of problem-oriented policing believed that the standard model’s focus on reported incidents as the unit of work created a system that would inherently reinforce tendencies to perform reactive tasks only; the hope was that reframing the focus to persistent problems would drive proactive strategies.³⁵⁹

Although the exact method for implementing problem-oriented policing varies from agency to agency, the SARA model has emerged as a fairly standard template. SARA stands for scanning, analysis, response, and assessment.³⁶⁰ The key to differentiating

³⁵⁴ Weisburd et al., 421.

³⁵⁵ Snowden and Boone, “A Leader’s Framework for Decision Making,” 70.

³⁵⁶ Silverman and Eterno, “CompStat’s Innovation,” 402.

³⁵⁷ Herman Goldstein, “What Is Problem-Oriented Policing?,” ASU Center for Problem-Oriented Policing, 2001, <https://popcenter.asu.edu/content/what-pop>.

³⁵⁸ “What Is Problem-Oriented Policing?,” George Mason University Center for Evidence-Based Crime Policy, accessed December 7, 2020, <https://cebcp.org/evidence-based-policing/what-works-in-policing/research-evidence-review/problem-oriented-policing/>.

³⁵⁹ Wesley Skogan et al., *On the Beat: Police and Community Problem Solving* (Boulder, CO: Westview Press, 1999), 4.

³⁶⁰ “The SARA Model,” ASU Center for Problem-Oriented Policing, accessed December 7, 2020, <https://popcenter.asu.edu/content/sara-model-1>.

problem-oriented policing from the standard model lie in the analysis and response phases. Analysis of problems must go beyond merely identifying suspects into many other types of data that may shed light on underlying causes; the response phase should include many actions beyond making arrests, to include prompting community groups and other government agencies to carry out specific, pre-identified tasks.³⁶¹ Ideally, the process concludes with a rigorous, often quantitative, assessment of the solutions implemented to identify successes, failures, and areas for future improvement.³⁶² A further goal of many practitioners of problem-oriented policing is to begin associating specific types of solutions with types of problems to create various pre-assembled toolkits that can be used in the future for others facing the same problem.³⁶³

Much about problem-oriented policing would seem to lend itself to a complexity-based approach to policing. As was previously discussed, Eck, one of the main proponents for problem-oriented policing, has used some concepts from complexity in his work, but has not fully embraced complexity as the theoretical paradigm governing crime and police work.³⁶⁴

The strategic aspects of problem-oriented policing started as a headquarters function, but has become more decentralized in recent years. Eck believes that it should remain in the upper echelons of an organization because problem analysis performed by street officers as a collateral duty is generally of a reduced quality.³⁶⁵ Critics of problem-oriented policing agree that as it is currently structured in most agencies, individual street officers lack a true ability to engage in problems solving, support from analytical units, the ability to make or leverage connections, and generally rely on enforcement as their solution

³⁶¹ Skogan et al., *On the Beat*, 5–6.

³⁶² ASU Center for Problem-Oriented Policing, “The SARA Model.”

³⁶³ Eck, “Police Problems,” 85.

³⁶⁴ See Chapter IV of this thesis.

³⁶⁵ John Eck, “Why Problem-Oriented Policing,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 170–71.

to problems.³⁶⁶ A sensible middle point between these two positions is adopting small teams or squads as the location for the problem-solving function. An agency utilizing an approach organized around multiple teams could fulfill the recommendation by Arquilla and Ronfeldt that governments adopt hybrids of hierarchies and networks to confront networked adversaries.

Many of Eck's observations about the actual practice of problem-oriented policing are also congruent with complexity. He notes that while SARA is presented as a linear model, it is often applied iteratively in the real world.³⁶⁷ An iterative application of this model would be beneficial, as it would capture the adaptations of complex adaptive networks to changing conditions, as well as apply the benefits of iterative adaption for police agencies seeking to harness complexity for the community's benefit. Eck lays out five premises behind problem-oriented policing, which include "that the causes of these troubles [brought to the police] are often complex," "that the police should make systemic enquiries into these complexities," and "learning from successful and unsuccessful innovations makes police more effective."³⁶⁸ Eck appears to be using complex in the colloquial sense in these assertions, but by using the technical sense of the word, those premises become literally true. The final premise again speaks to adaptive, iterative learning.

Finally, he notes several hallmarks of a good problem-oriented policing strategy, all of which also hold true for a complexity-based approach. Namely, he holds that a good strategy should encourage partnerships between the police and a range of others, is focused on data collection and analysis, draws on officer expertise, and values ends over means.³⁶⁹ The emphasis on partnerships is about the police forming new network ties with other organizations and leveraging those ties to expand their capabilities. Data collection and

³⁶⁶ David Weisburd and Anthony Braga, "Problem-Oriented Policing: The Disconnect between Principles and Practice," in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 198–99.

³⁶⁷ Eck, "Why Problem-Oriented Policing," 169–70.

³⁶⁸ Eck, 166.

³⁶⁹ Eck, 174.

analysis is needed not just for the mapping and analysis of complex systems and networks, but will become increasingly important, as information dominance becomes the primary mode of conflict in the Information Age. Utilizing the expertise of officers leverages adaptive learning. Finally, the valuing of ends over means emphasizes a break with the linear epistemology of the standard model and the associated fascination with statistics. Statistics will likely still have a place, probably to identify and quantify problems, but an emphasis on ends devalues relatively meaningless statistics like the number of arrests made, stops conducted, and average response time, which can obscure if true progress is being made.

3. Community Policing

A closely related model of policing is the community-policing model, which was also born out of a dissatisfaction with the standard model of policing. Whereas Goldstein was critical of the reactive nature of the standard model, community policing's advocates were unhappy with the widening gulf between police officers and the communities they served. They believed that the technological advances (particularly the automobile) and professionalization movement that recast police departments as the sole providers of public safety led to an isolation of officers that eroded the bonds between police officers and community members.³⁷⁰ Developed in response to these observations, community policing is about building civic engagement and developing “new channels for learning about neighborhood problems.”³⁷¹

Generally, community policing can be described as having three “densely interrelated” dimensions: citizen involvement, problem solving, and decentralization.³⁷² It is difficult to draw a bright line between community policing and problem-oriented policing. For example, one DOJ publication uses both the SARA model and Eck's crime

³⁷⁰ Bureau of Justice Assistance, *Understanding Community Policing: A Framework for Action* (Washington, DC: Bureau of Justice Assistance, 1994), 6.

³⁷¹ Wesley Skogan, “Community Policing,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 29.

³⁷² Skogan, 27–28.

triangle in explaining the problem-solving dimension of community policing.³⁷³ Critics of community policing often point to the “ambiguity and flexibility [that] give [s] community policing its all-things-to-all people character.”³⁷⁴ Perhaps the best way to understand the difference between the two is where the emphasis lies; problem-oriented policing emphasizes the study of and compilation of solutions to problems, while community policing emphasizes forming relationships and partnerships with the community.

Advocates of community policing call for devolving decision-making power to individual police officers to give them the ability to learn and respond to the particular circumstances and problems in the communities in which they work.³⁷⁵ Importantly, community policing advocates criticized deployment strategies that “treat patrol officers as interchangeable parts.”³⁷⁶ What community policing envisions is having police officers act independently, learn from and adapt to their particular environments, optimize efforts through trial and error, and to reorganize policing to recognize the importance of the very particular relationships of unique officers to very particular circumstances; in short, to act like agents within a complex adaptive system. Although they are not using the language of complexity theory, these are calls for policing to begin acting in the complex domain.

Studies of the effectiveness of community policing have been somewhat mixed. Some of the best analysis comes from a decade long project in Chicago, which applied letter grades to various outcomes. Chicago’s community policing efforts scored high in public involvement (B), partnerships with other agencies (A), and internal organization (A); problem solving, on the other hand, only earned a score of C.³⁷⁷ Even advocates of community policing concur that it does not appear to reduce crime rates much, but note

³⁷³ Community Oriented Policing Services, *Community Policing Defined* (Washington, DC: Community Oriented Policing Services, 2014), 10–12, <https://cops.usdoj.gov/RIC/Publications/cops-p157-pub.pdf>.

³⁷⁴ Stephen Mastrofski, “Community Policing: A Skeptical View,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 46. Interestingly, this criticism mirrors one of the main criticisms of complexity.

³⁷⁵ Skogan, “Community Policing,” 35.

³⁷⁶ Weisburd et al., “Reforming to Preserve,” 446–47.

³⁷⁷ Mastrofski, “Community Policing,” 50.

that it does reduce non-crime disorder problems and appears to increase perceptions of police legitimacy.³⁷⁸ This result suggests that informing community-policing efforts with an explicit grounding in complexity and network theories may improve problem solving efforts. Alternatively, community policing might be an effective way to apply the narrative level of netwar, deliberately seeking to connect and influence with as many networks as possible in the community.

One issue with community policing is that it tends to be geographically oriented, much like the standard model and Compstat. Officers assigned to community policing initiatives are often assigned to and kept within specific geographic boundaries.³⁷⁹ Defining these geographic areas can be an issue, particularly in dynamic neighborhoods. Boundaries and compositions of neighborhoods can change faster than the police can keep up with, and when the organization of these initiatives are focused around police subdivisions, community representatives often only have a portion of their constituents within any given police beat.³⁸⁰

Additionally, many community-policing advocates have an infatuation with foot patrols. This infatuation appears to be an outgrowth of the 1981 Newark Foot Patrol experiment, which was a foundational study in what would become community policing.³⁸¹ The general theory is that removing officers from patrol vehicles will lead to increasing interactions with members of the public and rebuild connections between the police and the community. However, at least one study found that community-policing officers actually engaged in less interaction with the community than patrol officers did because they spent more of their on-duty time in meetings.³⁸² Additionally, that same

³⁷⁸ Skogan, "Community Policing," 39. Skogan found a consistent 10–15% increase in the favorable view of the police by both white and minority residents of Chicago during the same study.

³⁷⁹ Skogan, 36.

³⁸⁰ Ralph B. Taylor, "Incivilities Reduction Policing, Zero Tolerance, and the Retreat from Coproduction: Even Weaker Foundations and Stronger Pressures," in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 156–57.

³⁸¹ "Community Policing," National Police Foundation, December 6, 2020, <https://www.policefoundation.org/projects-old/community-policing/>.

³⁸² Mastroski, "Community Policing," 54.

study found that community officers spent more time with “respectable” citizens than marginalized ones.³⁸³

The belief that foot patrol will automatically lead to more community engagement seems to be based on a somewhat romanticized view of the past, when society was less extensively networked and neighborhoods were perceived as more central to community life. It appears that calls for increased foot patrol are falling victim to means over ends thinking and indirectly calling for what is desired; perhaps because what is desired is not truly recognized. What a desire for community engagement is actually calling for is for police departments and individual officers to form ties to the many different networks that form communities. Grounding policing in complexity and network theory would instead provide the tools to demand directly and explicitly and model these sorts of interactions to provide a structure to community policing initiatives, as well as the tools to identify social networks that an agency has not formed even a weak tie to. An emphasis on foot patrol without being fully cognizant of the emerging network society is confusing a tactic with a strategy. In a time when both citizens and criminals are both more interconnected and mobile than ever, police agencies that want to increase engagement, enhance legitimacy, and fight crime can ill afford to make this mistake.

4. Focused Deterrence

Focused deterrence (also known as “pulling levers”) is a model of policing that traces its origins back to the Boston Gun Project, which was an application of problem-oriented policing to the city’s youth homicide problem in the mid-1990s.³⁸⁴ This project, implemented as Operation Ceasefire, specifically targeted identified gang members and pulled them into meetings known as call-ins. During a call-in, gang members would meet with law enforcement, clergy, social workers, victims, and family members affected by violence, and other identified members of the community; a united message of moral

³⁸³ Mastroski, 54. Presumably, a large overlap occurs between the pool of “respectable” citizens and those inclined to attend police-community meetings.

³⁸⁴ David M. Kennedy, “Policing and the Lessons of Focused Deterrence,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 205.

condemnation of violence would be presented along with offers of services for those members who wanted to take up the offer.³⁸⁵ Law enforcement officials present informed the gang members that they were known to law enforcement, specific enforcement would be targeted based upon violence, and that enhanced measures (such as filing of cases in federal court instead of city court) would be employed in this enforcement.³⁸⁶ Operation Ceasefire resulted in reductions of 63% in youth homicides and large reductions in associated shootings and sounds of gunshots calls.³⁸⁷

This approach has been replicated in other cities and is becoming considered a distinct model of policing in its own right. Focused deterrence as a model consists of five components: identification and focus on a very specific problem, research to identify groups of offenders, assembling partners to work with law enforcement, using both law enforcement and social services, and direct communication with offenders about what will trigger enforcement.³⁸⁸ Focused deterrence has generally been employed to target gang violence, drug market interventions, and those deemed to be “high-risk offenders.”³⁸⁹ Available empirical indicates that focused deterrence is one of the new approaches to policing that has the greatest measurable impact on crime.³⁹⁰

Focused deterrence is also highly compatible with the concept of complexity-based policing. Most significantly, the concept of networks is already fundamental to the focused deterrence model. Applications of focused deterrence have begun to make extensive use of

³⁸⁵ Michael Sierra-Arevalo and Andrew V. Papachristos, “Social Networks and Gang Violence Reduction,” *Annual Review of Law and Social Science* 13 (2017): 381–382.

³⁸⁶ “Gun Violence Programs: Operation Ceasefire,” National Institute of Justice, June 24, 2008, <https://nij.ojp.gov/topics/articles/gun-violence-programs-operation-ceasefire>.

³⁸⁷ Anthony Braga, David Weisburd, and Brandon Turchan, “Focused Deterrence Strategies and Crime Control: An Updated Systematic Review and Meta-Analysis of the Empirical Evidence,” *Criminology & Public Policy* 17, no. 1 (2018): 220.

³⁸⁸ Kennedy, “Policing and the Lessons of Focused Deterrence,” 207.

³⁸⁹ Braga, Weisburd, and Turchan, “Focused Deterrence Strategies and Crime Control,” 209.

³⁹⁰ Anthony Braga and David Weisburd, “Police Innovation and the Future of Policing,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 550.

social network analysis, to both identify problematic individuals and direct their efforts.³⁹¹ One landmark study in Chicago, which built a social network out of individuals who had been arrested together, discovered “that 70 percent of all non-fatal shootings occur in networks comprising less than 6 percent of Chicago’s total population.”³⁹² Several evaluations of concluded focused deterrence programs noted significant decreases of violence in gangs socially connected to targeted gangs.³⁹³ On the other side of the project, the success of the original Ceasefire was credited to the Boston police building a “network of capacity consisting of dense and productive relationships” with its partners.³⁹⁴

Successful implementation of focused deterrence recognizes the importance of relationships between the various elements; ramped up enforcement is pointless without the relationships in place to communicate directly to offenders.³⁹⁵ This focus on relationships is a key break from the statistics dominated, linear mindset that often currently prevails in law enforcement. Mechanically, if criminals who are behaving as adaptive agents in complex adaptive systems cause gang violence and other crime problems, then direct communication is an excellent way to affect not only their individual adaption but also the emergent behavior of the system as a whole.

Part of the analysis step of focused deterrence is the development of “group audits” where those who are knowledgeable about the gang, drug market, or offender pool in question compile and collect their information.³⁹⁶ This strategy recognizes that police officers have a large amount of knowledge that goes unused because it is not needed for any particular legal proceeding; often, this knowledge makes clear that what may appear

³⁹¹ Kennedy, “Policing and the Lessons of Focused Deterrence,” 212–14; Sierra-Arevalo and Papachristos, “Social Networks and Gang Violence Reduction,” 382.

³⁹² Andrew V. Papachristos, Christopher Wildeman, and Elizabeth Roberto, “Tragic, but Not Random: The Social Contagion of Nonfatal Gunshot Injuries,” *Social Science & Medicine* 125 (2015): 143.

³⁹³ Braga, Weisburd, and Turchan, “Focused Deterrence Strategies and Crime Control,” 237–38.

³⁹⁴ Anthony Braga, Brandon Turchan, and Christopher Winship, “Partnership, Accountability, and Innovation: Clarifying Boston’s Experience with Focused Deterrence,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 228.

³⁹⁵ Kennedy, “Policing and the Lessons of Focused Deterrence,” 214–16.

³⁹⁶ Sierra-Arevalo and Papachristos, “Social Networks and Gang Violence Reduction,” 381.

to others as random is anything but random.³⁹⁷ This strategy is a first step in moving away from a production-dominated organization towards an Information Age organization. With information disassociated from the need to produce a specific arrest or prosecution, more information is actually processed by the organization than if it employed the standard model of policing. When knowledge is only sought out to support a specific arrest, it sends the message that the standard model, dominated by producing cases and arrests, is what the agency values. Instead, these types of audit sessions are a step towards moving an agency's structuring of information towards an Information Age paradigm.

As mentioned previously, partnerships with the community are a key component of focused deterrence. The inclusion of the ministers of the Ten Point Coalition in Operation Ceasefire served as a signal of transparency and accountability that prevented a view of the program as just another abusive dragnet.³⁹⁸ It is more than just an example of building networks by law enforcement; it is about waging the struggle on the narrative level of netwar, both defensively and offensively. In building a network of capacity with the local community, law enforcement reinforces a pro-civil society narrative about its operations. Directly confronting networked offenders with a unified moral message about the impacts and unacceptability of their actions disrupts their shared narrative, and if effective, spreads the pro-society narrative throughout the network.

The original Operation Ceasefire stopped in the year 2000, due to the difficulty in keeping the network assembled by the Boston police focused on the same problem over an extended time period.³⁹⁹ A complexity-based understanding of policing could help in addressing this difficulty. It would recognize that complex adaptive networks are defined by the fact that they change over time, and programs to address them must be designed for change as well. Moreover, problems are often the manifestations of these networks, so focusing on the network instead of the problem prepares the participants for change and

³⁹⁷ Kennedy, "Policing and the Lessons of Focused Deterrence," 209.

³⁹⁸ Braga, Turchan, and Winship, "Partnership, Accountability, and Innovation," 236–37.

³⁹⁹ Braga, Turchan, and Winship, 238.

may even allow for a metric by which to assess and declare victory, should the network be sufficiently altered or disrupted.

An explicit complexity-based model of policing could guide and improve focused deterrence efforts. Problems with the implementation of focused deterrence have often included a lack of relationships between law enforcement and other partners, as well as insufficient analysis of the targeted problem.⁴⁰⁰ A complexity-based approach would have police officers thinking in terms of networks and relationships automatically, and the transition to understanding the primacy of information dominance would emphasize the need for robust analysis. While focused deterrence is beginning to make use of social network analysis, the focus is still generally on groups that have a conscious association, like street gangs. An understanding of complex, dynamic networks would broaden the conceptual scope to include self-organizing systems whose individual members do not necessarily consciously associate with each other.

Finally, in a recent evidence-based review of focused deterrence efforts Braga, Weisburd, and Turchan noted the need to “shed some much needed light on the theoretical mechanisms underlying focused deterrence policing.”⁴⁰¹ They observed that the current research could not determine which elements of the focused deterrence programs were most effective, but held out hope that advanced statistical analysis methods would help quantify the impact of each element and provide guidance for future efforts.⁴⁰² Of course, just as with Compstat, statistical analysis is the wrong method for meaningful analysis of complex systems. Indeed, the very strength of focused deterrence is identifying, building, and leveraging relationships to impact networks of actors. Focused deterrence is the model perhaps the most congruent with law enforcement for the Information Age; attempting to apply a linear epistemology to it will not adequately explain how and why it works.

In conclusion, recognition is growing that the standard model of policing no longer appears to be effective, but as yet, little appreciation exists for why that is so. No shortage

⁴⁰⁰ Braga, Turchan, and Winship, 239–41.

⁴⁰¹ Braga, Weisburd, and Turchan, “Focused Deterrence Strategies and Crime Control,” 239.

⁴⁰² Braga, Weisburd, and Turchan, 239–40.

of alternative models of policing has been proposed to replace it, but none has been conceived with the changes to the underlying structure and fundamentals of the network society or the Information Age. However, at least some of these models offer some practices that may serve as building blocks or stepping stones to the day-to-day operations of a complexity-based policing model.

Compstat is the least useful alternative, as it is statistically driven, which places it squarely in a linear view of the world. Problem-oriented policing as it currently exists only shallowly engages with complexity, but it emphasizes iterative learning. It is not a large conceptual leap to realize that a problem is the manifestation of a complex system's operation and move from the problem to the system as the unit of work. Community-oriented policing calls for officers to act like adaptive agents in a complex adaptive system, but lacks the theoretical foundation to design, measure, and implement effective community engagement in the modern world. Focused deterrence is the most aligned with a complex, network driven view of the world, but has not explicitly broken free from a linear, reductive viewpoint. To the extent that existing alternative models recommend practices well-suited to a complex environment, it appears to be either accident or narrowly tailored responses to recognized shortcomings of the standard model. Adopting complexity as the theoretical underpinning of a model of policing would provide an internally consistent means to integrate elements of these various models and address the shortcomings of the standard model of policing.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. SENSE MAKING FOR LEADERS

The conception of American society as the network society is fundamentally different from the more familiar industrial model. A well-developed linear epistemology exists for the industrial model, but has not yet been developed for a complex, non-linear world. Law enforcement leaders will be called upon to break with their internalized assumptions about a profoundly linear world and begin conceptualizing the world as a complex environment even as they attempt to adopt a complexity-based model. This chapter examines how a structural view of information can help illuminate an embedded worldview that may not be immediately obvious. It then examines the tacit importance of the concept of order to law enforcement, and how this concept causes discomfort when confronting complexity. It offers the Cynefin framework as a method for law enforcement leaders to make sense of complex environments in the absence of a true complex epistemology. Finally, it concludes with a discussion of an application of movement between the various Cynefin domains to complexity-based policing.

A. INFORMATION STRUCTURING

The ability to work with information will come to be the measure of effectiveness of an organization (or network) in the Information Age. However, as already discussed, advanced information processing technology is a necessary, but not sufficient component for a truly informational, network society.⁴⁰³ Arquilla and Ronfeldt criticize the tendency for theorizing about information to focus solely on information as a message and on technological capacity to transmit, store, and otherwise process raw data.⁴⁰⁴ They propose the structural view as a complementary mode of thinking about information. The structural view of information holds that in any system with a structure, latently embedded information is not being actively “processed,” but is processed via its often-unnoticed

⁴⁰³ See Chapter III of this thesis for a more in-depth discussion of this topic.

⁴⁰⁴ Arquilla and Ronfeldt, “Looking Ahead,” 442–43. They note that Warren Weaver, the father of complexity theory, was also a seminal figure in information theory.

presence, influences, and defines the system.⁴⁰⁵ Structured information acts on “incoming information [which] may get restructured before it is absorbed, processed, and/or sent on its way...” and so serves as a filter by which the system perceives the world around it.⁴⁰⁶

Arquilla and Ronfeldt have identified four elements that form a schematic for a structural view of information (Table 1). An ideational superstructure “is the level of ideas and ideologies, myths and maxims, values and norms, rites and rituals, laws and rules, etc., that define, often abstractly, the nature of a culture and the structures within it.”⁴⁰⁷ The organizational structure element concerns itself with the extent any given organization is devoted to information or communications.⁴⁰⁸ The technological infrastructure element is about specific information technologies and their employment or integration.⁴⁰⁹ The interaction between language and conceptual thought, and the importance of vocabulary in both conceiving and expressing thought, occurs at the linguistic substructure.⁴¹⁰

Table 1. The Structural View of Information.⁴¹¹

Ideational Superstructure
Organizational Structure
Technological Infrastructure
Linguistic Substructure

All four of these elements must align for policing to evolve into a complexity-based model. Other chapters in this thesis have engaged with the technological, linguistic, and

⁴⁰⁵ Arquilla and Ronfeldt, 443–44.

⁴⁰⁶ Arquilla and Ronfeldt, 445.

⁴⁰⁷ Arquilla and Ronfeldt, 449.

⁴⁰⁸ Arquilla and Ronfeldt, 449.

⁴⁰⁹ Arquilla and Ronfeldt, 450.

⁴¹⁰ Arquilla and Ronfeldt, 450.

⁴¹¹ Arquilla and Ronfeldt, 452.

organizational elements in the structural view. However, if the ideational superstructure of policing is not aligned with a non-linear, complex, and networked view of the world, any attempt to incorporate a complexity-based model will either prove superficial or fail. The tacit presence of embedded information can be expected to exert a strong pressure towards linear models of thought until a complete complex epistemology is devised and becomes culturally prevalent.

One powerful example of this concept is the prevalence of chess as a strategic metaphor for leaders in many fields. Arquilla and Ronfeldt observe that in chess, “territory is very important, units are functionally specialized, and operations proceed sequentially until checkmate.”⁴¹² They contrast chess with the game of Go, “which is more about creating networks of pieces than about protecting hierarchies of pieces.”⁴¹³ Each game has fundamental assumptions about the nature of the world, and what is effective in interacting with it silently present and influencing the player’s world view. To adopt a complexity-based model of policing successfully, leaders in the profession must begin to examine what tacit assumptions of linearity are presently embedded in the ideational superstructure and begin developing new narratives and metaphors that capture the nature of the network society.

B. ORDER AND UN-ORDER

A recurring theme in the literature surrounding complexity and netwar is the contrast between order and chaos. Kurtz and Snowden observe that this theme is deeply embedded in the human psyche and is found in many different mythologies; typically, the mythological forces of order establish their domain over the human world, although some agents of chaos (often embodied as trickster gods) still remain active in the world.⁴¹⁴ They trace the prominence of linear, “ordered science” since the Enlightenment back to this

⁴¹² Arquilla and Ronfeldt, *The Advent of Netwar*, vii–viii.

⁴¹³ John Arquilla and David Ronfeldt, “A New Epoch—and Spectrum—of Conflict,” in *In Athena’s Camp: Preparing for Conflict in the Information Age* (Santa Monica, CA: RAND, 1997), 11.

⁴¹⁴ Kurtz and Snowden, “The New Dynamics of Strategy,” 463.

presumption of existence as a fundamentally ordered domain.⁴¹⁵ However, the study of complexity theory has illustrated that the world is not simply divided into linear, structured order and pure, unknowable randomness. Instead, a non-linear realm exists with its own set of knowable dynamics where emergent organization can arise. Kurtz and Snowden call this domain un-order to differentiate it from linearity, but signal that dynamics still govern the domain.⁴¹⁶

This underlying presumption of linear order is especially appealing to law enforcement officers and their leadership, and it is almost certainly part of the profession's ideational superstructure. Law enforcement popularly conceives of itself as "the thin blue line" separating order from chaos. The most successful law enforcement officers tend to be those who are temperamentally inclined to calm down excited situations and restore adherence to norms and rules in disorderly situations. Law enforcement's view of the world is currently greatly centered in the linear epistemology. Kurtz and Snowden explicitly identify Taylorism as belonging to the ordered view of the world, and Taylorism was essential to developing the now-dominant "standard model" of policing.⁴¹⁷ The result is that psychologically and philosophically, most law enforcement leaders are uncomfortable operating in the domain of un-order and view it as a "bad" domain in contrast with the "good" domain of order.

This mindset will not serve in the Information Age and the network society. Institutions and leaders that cannot adapt to operating in the domain of un-order will lose both legitimacy and effectiveness, and they will be supplanted by those that can. Development of a non-linear epistemology is necessary but is beyond the scope of this work. However, Snowden's Cynefin framework (Figure 6) offers a useful guide for thinking strategically about operating in non-linear environments. Kurtz and Snowden stress that Cynefin is a sense-making framework and not one for categorization; therefore,

⁴¹⁵ Kurtz and Snowden, 463–64.

⁴¹⁶ Kurtz and Snowden, 465. They trace this term to an uncommon meaning of "un" to indicate the simultaneous existence of similarity and difference, pointing out "undead" as the most familiar use of this sense of the word.

⁴¹⁷ Kurtz and Snowden, 463–64. See Chapter V of this thesis for a discussion of the relation of Taylor's scientific management to the standard model of policing.

no domain is “better” than another.⁴¹⁸ This point needs to be kept in mind, as they note that individuals instinctively try to “pull” problems into the domains within which they are comfortable operating.⁴¹⁹ The utility of Cynefin for law enforcement leaders is as a guide to develop a deep comfort operating in complex environments, and not as a mere survival mechanism until they are able to return to highly ordered environments.

Broadly speaking, the framework is divided between the ordered domains on the right, and the domains of un-order on the left (Figure 6). Kurtz and Snowden further subdivide it into three “ontological states:” order (where comprehensive knowledge is paramount), complexity (where patterns can be conceived), and chaos (too unstable for patterns to exist).⁴²⁰ The decision-making model in the ordered domain begins with receiving data, determining the right answer, and then taking the mandated action. Determining the right answer is a matter of either applying a pre-determined rule or consulting with experts, as appropriate to either simple or complicated problems.⁴²¹ Decision making works differently for complexity. Due to the non-linear and dynamic nature of this domain, gathering information does not lead to fruitful reductive analysis. Instead, the key is to probe the system to search for emergent patterns, and then seek to amplify desirable patterns and dampen undesirable ones.⁴²² Chaos is so unstable and dangerous that immediate action is called for, followed by observing the reactions, and then taking further action to continue moving the problem in the desired direction.⁴²³

⁴¹⁸ Kurtz and Snowden, 468.

⁴¹⁹ Kurtz and Snowden, 470.

⁴²⁰ Kurtz and Snowden, “The New Dynamics of Strategy,” 470. Refer back to Chapter II for definitions of simple and complicated.

⁴²¹ Kurtz and Snowden, 468–69.

⁴²² Kurtz and Snowden, 469.

⁴²³ Kurtz and Snowden, 469.

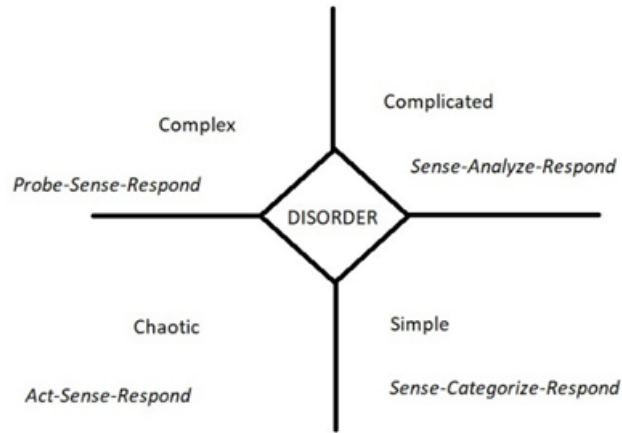


Figure 6. The Cynefin Framework with Decision Making Models.⁴²⁴

Perhaps the easiest way to illustrate the Cynefin framework is to apply these domains and decision-making processes to existing uses within law enforcement (Table 2). Consider throwing an annual parade for the Fourth of July as an example of the simple domain. As the law enforcement requirements will generally be the same year after year, it is only necessary to recognize the approach of the holiday and refer to the previous year’s plan. The solution already exists. As long as someone discerns the correct category for the problem (and does not utilize the Thanksgiving Day parade plan), the correct answer is obvious. More complicated would be the planning of a new marathon to be run throughout a city, which requires identifying a 26.2-mile course, staging areas, medical facility, and support equipment. Here, leadership perceives the need to create a plan but will generally be best served by going to those members of the agency who have built up an expertise in planning for intricate, large-scale events. While it requires more specialized knowledge, the problem yields to reductionism and a detailed plan can be created to successfully run the event.

An excellent example of the complex domain would be a demonstration or protest march, particularly of the kind seen throughout the United States in the second half of 2020. These marches were executed by groups with sometimes tenuous relationships with law

⁴²⁴ Adapted from Snowden and Boone, “A Leader’s Framework for Decision Making.” As explained in Chapter II, they author is retaining an older naming convention for the domains to fit with a broader discussion of complexity.

enforcement, often were carried out with minimal collaborative planning with law enforcement, and due to a tense environment, often carried the possibility for violence to occur. Unlike in the ordered domain, rigid adherence to step-by-step plans is almost guaranteed to lead to failure in this situation. Instead, law enforcement leaders needed to probe the problem by trying various measures, sensing how the crowd reacted, and then amplifying tactics that led to desirable responses and dampening situations or abandoning tactics that led to undesirable ones.⁴²⁵

Finally, chaotic situations are those that are so dangerous that immediate action must be taken. The September 11 attacks, or the riot at the U.S. Capitol, are examples of these types of situations, which are fortunately rare for law enforcement. In a chaotic situation, there is no time to consult a manual or experts, or to study the changes in patterns in response to a stimulus. Decisive action is called for, followed by an assessment of how circumstances have changed and then continued action with the intention of moving the situation out of the chaotic domain and into one of the others.

Table 2. Application of Cynefin Framework to Police Functions.

Domain/Decision Making Process	Sample Police Activity
Simple (sense-categorize-respond)	4th of July Parade
Complicated (sense-analyze-respond)	New Marathon
Complex (probe-sense-respond)	Protest/Demonstration March
Chaotic (act-sense-respond)	September 11, U.S. Capitol Riot

C. MOVING WITHIN THE CYNEFIN FRAMEWORK

Complex systems and networks are dynamic, and they are altered by interacting with them. Therefore, it is possible to move between domains by way of taking action, and Kurtz and Snowden have defined several distinctive movements on the Cynefin framework (Table 3). *Asymmetric collapse* occurs when an organization has settled into a stable environmental niche and does not recognize that the governing dynamics have changed,

⁴²⁵ Again, see Leverone, “Crowds as Complex Adaptive Systems.”

which leads into a collapse into chaos.⁴²⁶ *Imposition* is the application of force to stabilize chaos into easily perceived and reducible problems.⁴²⁷ *Exploration* is the easing of hierarchical control to allow the formation of new connections and facilitate emergent properties.⁴²⁸ *Just-in-time transfer* “involves the selective choice of stable patterns in complex space for ordered representation.”⁴²⁹ Finally, *swarming* is an alternative means of moving out of chaos to order by creating multiple opportunities for complex patterns to manifest, amplifying desirable ones, and then stabilizing those patterns by moving them into a complicated space.⁴³⁰

Table 3. Cynefin Dynamics.⁴³¹

Movement	Starting Domain	Ending Domain
Asymmetric Collapse	Simple	Chaos
Imposition	Chaos	Simple
Incremental Improvement	Cycles between simple and complicated	
Exploration	Complicated	Complex
Just-in-time Transfer	Complex	Complicated
Swarming	(Chaos to) Complex	Complicated

Imposition is currently the most favored of the Cynefin dynamics by law enforcement leaders, owing to their current sense of the world. When crime problems become a sufficient priority, the response is often an attempt to “flood the zone” by throwing disproportionately large numbers of resources at the problem (often defined as much by geographical boundaries in lieu of particular manifestations of the problem) to smother it. This response can be maintained for relatively short periods of time, but is relatively costly, as other areas and issues must make do with diminished resources. It is not that imposition is always the wrong response, but in truly chaotic contexts, it is the

⁴²⁶ Kurtz and Snowden, “The New Dynamics of Strategy,” 475–76.

⁴²⁷ Kurtz and Snowden, 476.

⁴²⁸ Kurtz and Snowden, 476–77.

⁴²⁹ Kurtz and Snowden, 477.

⁴³⁰ Kurtz and Snowden, 477.

⁴³¹ Adapted from Kurtz and Snowden, “The New Dynamics of Strategy,” 476.

appropriate and most efficient response. However, too often, complex contexts are viewed as chaotic. Applying the Cynefin framework as a sense-making device allows for the recognition of complexity as a legitimate domain and prevents a sort of “panic response” of automatically resorting to imposition upon realizing that one has left the realm of linear order.

The movements between the complex and complicated domains are useful for understanding the elements of a complexity-based approach to policing. Kurtz and Snowden have chosen “exploration” as their term for moving from the ordered domain to the complex; similarly, “probe” is the first step of the decision-making process for complexity. Both of these terms try to convey to leaders that complexity is not a problem to be definitively solved, but instead is a problem to be approached iteratively and through trial and error. Exploration connotes a sally into complexity to observe the result and determine whether to amplify or dampen the outcome. Law enforcement leaders can use exploration as a sense-making device when they try to craft interventions in complex systems. Instead of committing to a formalized right answer, it is instead to be expected that multiple probes will be attempted to monitor responses from the system. Without the attachment to a “right” answer, it is easier to abandon efforts that do not lead to desirable patterns emerging, as well as prepare multiple alternatives in addition. In adapting law enforcement agencies to a complexity-based approach, exploration allows a way to envision loosening traditional hierarchy and bureaucracy while still maintaining an organizational structure. This mindset will be especially useful if attempting to implement the types of blended hierarchies and networks envisioned by Arquilla and Ronfeldt.

The just-in-time transfer is named for the production model, wherein needed resources appear precisely when needed but are not kept on hand before or after.⁴³² Similarly, when information is pulled out of a complex system for study, it is a reflection of the system at that moment. The system is not static; the future will be different from the present observation and people must be very careful about attempting to determine necessary interactions and outcomes that occurred in the past. In a complexity-based

⁴³² Kurtz and Snowden, 477.

policing model, it will at times be necessary to pull knowledge from the complex domain into the complicated to take action on it. One example could be using a network model to choose and make an intervention by removing a key node by an arrest or other means. The just in time mindset affirms that this information is generated at the moment it is needed for a specific purpose and cautions against a broader use. It is tempting to fall back into a reductionist mindset and believe that this image of the system represents a necessary outcome of prior conditions or will hold for the future. Leaders must remember that while they can interact with and manipulate complex systems, those systems will still defy accurate predictions despite detailed study.

Finally, Kurtz and Snowden identify swarming as an alternative path out of chaos from imposition; where imposition moves directly from chaos to the simple domain by the application of force, swarming moves into the complex, and then into the complicated. Swarming functions by employing multiple gambits or probes and seeing if emergent patterns form in response to them. Once these patterns have been recognized, they can be amplified if desirable, and then an intervention can be crafted to move from the complex domain into the complicated. The conception of swarming for Kurtz and Snowden as a sense-making technique is similar to the tactical conception devised by Arquilla and Ronfeldt.⁴³³ Both senses of swarming involve multiple points of contact with the system, designed both to act and gather or distribute data, and to determine what is effective and discard what is not.

The earlier illustration of applying the Cynefin framework to policing drew upon the crowd control function of a police department because it is an area where successful leaders are already operating across the four domains, even if not conceived of or recognized as such. When it comes to the law enforcement aspect of policing, the standard model and thinking squarely in the ordered domains still reign supreme. However, the network society has arrived, and complex dynamics are driving more and more aspects of society, to include crime. Although individual days or cases may exist in the other domains,

⁴³³ Their conception does not involve starting from a chaotic space, but is otherwise very similar in function.

the daily leadership and strategy of policing must operate in the complex domain. A failure to adapt to this new complex reality, to continue to treat crime and policing as a simple or complicated problem, will lead to asymmetric collapse. The widespread unrest and police legitimacy crisis in 2020 may be a warning sign that policing is headed towards this collapse.

Applying the Cynefin framework may help law enforcement leaders recognize and make sense of complex environments. The perception of the police as the border between order and chaos is fundamental to their self-conception and influences their decision making. Narratives are important; Arquilla and Ronfeldt identify the narratives that an organization tells about itself, to itself, as one of the five levels of netwar. For policing, this narrative currently leads the profession astray. Policing is so grounded in the ordered domains and linear epistemology, and unfamiliar with complexity, that any perception of un-order is immediately assumed to be chaos. This misidentification of chaos often leads to the selection of imposition as the tactic of choice, even though it is mismatched to the complex domain and will be ineffective or counterproductive. Cynefin provides a narrative understanding of complexity (as opposed to a strictly technical one) and differentiates it from chaos; even though complexity also exists in the domain of un-order, it has a structure and is not chaotic. This justifies complexity as a legitimate domain for law enforcement to operate within and preserves the current narrative understanding as defending against the encroachment of chaos. In this way, law enforcement leadership can begin building epistemological comfort in the complex domain while also building the technical skills and knowledge needed to operate in a complex environment.

THIS PAGE INTENTIONALLY LEFT BLANK

VII. FINDINGS, CONCLUSION, AND RECOMMENDATIONS

In their edited volume on police reform, scholars David Weisburd and Anthony Braga write, “often in social systems, the recognition that something must change is brought about by a period of crisis or challenge to existing programs or practices.”⁴³⁴ The beginning of the 21st century has certainly seen a recognition that the standard model of policing is insufficient and that “something must change” in policing. From the law enforcement perspective, great emphasis has been placed since the turn of the century on studying, developing, and spreading alternatives to the standard model, yet none has been able to displace it as the dominant method of dealing with crime. The second half of 2020 saw enduring, widespread protests across the country directed against law enforcement and the criminal justice system. These protests, sparked by the controversial use of force incidents, expressed the profound dissatisfaction still felt by many communities within the country about the current state of policing. The sense that the police are “like lifeguards frantically swimming against the tide from one incident to another, employing different tactics in a disjointed and unfocussed manner with little or nothing to show for it at the end of the day” persists.⁴³⁵

The dissatisfaction with the state of policing occurs because it is an institution that is no longer aligned with the dynamics that drive and organize society. Failure to recognize this misalignment makes attempting solutions ineffective or inefficient. As non-linear processes are increasingly governing society, the harm from failing to adapt to the new reality will only accelerate. Law enforcement must reform itself to a model aligned with the Information Age to prevent an asymmetric collapse for the profession.

This thesis started with the question “what would a model of policing based on complexity theory look like?” This chapter answers that question by presenting the findings, conclusion, and recommendations derived from the preceding chapters. First, this

⁴³⁴ David Weisburd and Anthony Braga, “Understanding Police Innovation,” in *Police Innovation: Contrasting Perspectives*, ed. David Weisburd and Anthony Braga, 2nd ed. (New York: Cambridge University Press, 2019), 4.

⁴³⁵ Ratcliffe, *Intelligence-Led Policing*, 165.

chapter presents a number of findings, which illustrate a number of the frameworks and intellectual tools that could be incorporated into a complexity-based model of policing. Next, the chapter presents the main conclusion derived from these findings, that a complexity-based model of policing must inherently be designed for the Information Age. A series of recommendations provide a view of what the operational structure of such a model may look like. Finally, the chapter examines several areas of interest for additional research and study.

A. FINDINGS

This thesis examined what academic literature exists on applying complexity to policing and found that the majority of uses envisioned so far are for short-term decision making or limited retooling of functions, such as intelligence analysis. However, exploration and extension of existing literature revealed a variety of applications of complexity and related theories throughout policing. These applications of complexity range from immediate and tactical to long-term and strategic employments.

First, the framework of complex adaptive systems was found to be a useful model to understand the behavior of a street robbery problem in Washington, DC. The case study revealed that far from being merely an aggregation of separate incidents, the robberies are best understood to behave as an interlinked system that responds to changes in the environment. The implication of this finding is that crime problems should be attacked as complex systems or networks and seek to remove key nodes, inhibit interconnection and communication, and change the feedback agents are receiving that is amplifying crime.

Second, the TIMN framework was found to be a useful model to understand the present state of American society. Rapid and profound changes in information and communications technology have created dense webs of interconnection between people that have unlocked the power of networks to become the primary organizational form in modern society. Complexity theory provides the technical explanation for the “power” of these networks, as once they become sufficiently dense, they exhibit complex, nonlinear behavior. The TIMN framework provides an easy to understand way to relate networks to previous social forms and understand how society has transitioned from a production-

oriented society to an informational society, where the ability to process information determines power.

Third, netwar was found to have mixed applicability at the present moment. It provides a useful framework to understand networked conflict in an Information Age environment. The most theoretically developed element of netwar is the tactic of swarming. Clear evidence for swarming was found in the case study, where the robbery CAS effectively utilized swarming against Washington, DC's hierarchically organized police department. However, law enforcement's current reductionist view of crime means that it only collects comprehensive data applicable to the doctrinal level of netwar and very little, if any data, connected to the other levels. This lack of data makes it difficult to apply netwar to crime conclusively; however, as policing adopts a more systemic or network-oriented view of crime, this data deficiency should be resolved and allow for a more definitive determination. Alternatively, the five levels of netwar could provide a useful framework for evaluating changes made in a law enforcement agency to adapt to a complexity-based model.

Fourth, complexity was found to provide a solid theoretical grounding for understanding and interpreting various models of policing. The standard model of policing enshrines a linear and production-oriented worldview, which is at odds with the non-linear and informational forces coming to dominate society. Four major alternative models of policing were examined: Compstat, problem-oriented policing, community policing, and focused deterrence. Compstat was found to be the least useful alternative, as it reinforces a linear view of the world. The remaining three alternatives all have elements that are consistent with complexity but also have gaps in their models that limit their effectiveness. Complexity was found to provide tools to fill those gaps and offers the possibility of designing a theoretically informed, cohesive model that can combine the best features of all three.

Finally, this thesis found that the Cynefin framework is a useful tool for the leadership of police agencies to develop comfort with operating in complex environments. Perhaps the key embedded narrative for law enforcement is that of being the line separating the social order from chaos and barbarism. This separation hampers an adoption of a

complexity-based model, because complexity exists outside of order, but apart from chaos. However, the Cynefin framework not only provides a visual diagram of that distinction, but also introduces the intellectual concept of un-order to legitimize complexity as a space within which law enforcement can work.

Taken as a whole, these findings show that it is not only possible, but also imperative, to reorient policing around a complexity-based model.

B. CONCLUSION: EVOLVING INTO THE INFORMATION AGE

Ronfeldt's TIMN framework has already been presented as a guide to thinking about how society has evolved into the network society. Arquilla and Ronfeldt have also developed a complimentary four-stage model of conflict, which can be extended into an equivalent model of policing for each stage.⁴³⁶ Societal evolution (Table 4) along the TIMN framework occurs as technological advancements allow for advancements in information gathering, processing, analysis, and exchange. The forms found along each successive level of the framework require more sophisticated information processing and structuring to function effectively. As each new form is incorporated into society, outmoded institutions are either discarded or diminished and their functions assumed by newly dynamic and dominant institutions.

Table 4. Societal Evolution.

Society	Information	Model of Conflict	Model of Law Enforcement
Tribes	Simple/Limited	Melee	Primitive L.E./Thief Takers
Institutions		Massing	Peel Model
Markets		Maneuver	Standard Model
Networks	Complex/Emergent	Swarming	Complexity Based

⁴³⁶ Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 7–8. See footnote 4 for an explicit connection of this conflict model to the TIMN framework.

Society's means of maintaining public order and enforcing the law has evolved along with its process through the TIMN framework. The first level of the framework, the tribe, has the least capacity and need for information processing. Its associated mode of conflict is the individual melee, which at its most advanced requires only sufficient coordination to gather a number of like-minded individuals together, but with conflict devolving into a number of individual struggles once joined. Similarly, early law enforcement systems were often a matter of individual efforts, with little communication or information processing required or occurring. For example, England's "thief-takers" received a bounty for arresting criminals, but they were private individuals who operated as independent contractors.⁴³⁷ In colonial America, the sparsely manned watches, sheriffs, and constables were few in number and generally operated as independent agents rather than a true institutional force.⁴³⁸

The second level of the framework is the institution. Institutions required organized systems of storing, processing, and communicating information to become more effective than tribal arrangements. While these advancements were great, the institutional information processing ability functions most robustly when dealing with simple and complicated problems. The associated mode of conflict is massing, which in many ways reached its height in 19th century warfare; hierarchical units functioning in strict formations bringing organized force to bear on the opponent and communicating by means of written orders and early signaling technologies, such as semaphore and telegraph.⁴³⁹ Fighting in this fashion required a great deal of discipline, which was installed by relentless drill.⁴⁴⁰ Importantly, this drill not only installed technical competencies in the soldiers, but also began structuring information for the institution by embedding information, values, and ideas in the worldview of the individuals who made up the organization.⁴⁴¹ The

⁴³⁷ Dempsey and Forst, *An Introduction to Policing*, 6.

⁴³⁸ Samuel Walker and Charles Katz, *The Police in America: An Introduction*, 5th ed. (New York: McGraw Hill, 2005), 28.

⁴³⁹ Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 13–14.

⁴⁴⁰ Arquilla and Ronfeldt, 13–14.

⁴⁴¹ Arquilla and Ronfeldt, "Looking Ahead," 454, 461.

equivalent model of law enforcement for this level of the framework is the early modern police departments, modeled on the Metropolitan Police Department established by Sir Robert Peel in London in 1829 with the adoption of a paramilitary hierarchy, uniforms, and discipline.⁴⁴² By establishing a relatively well-staffed organization and employing a system of assigning officers to territorial beats, these institutions were able to bring an organized and regulated effort to bear on crime, leveraging an institutional advantage over the largely disorganized and individual efforts of previous systems of law enforcement. Additionally, these agencies adopted similar communication technologies with the installation of telegraph stations and police call boxes.⁴⁴³ Finally, the institutionalization of law enforcement began to structure information in the profession by dividing territory into beats (and the consequent reliance on maps), the production of reports, and the tracking and measuring of various statistics. It is little surprise that with the modern foundation of the profession in the Industrial Revolution, a reductionist and linear view of the world was deeply embedded within it.

The third stage of the framework is the market, which requires even more capacity for information processing and distribution. It is at the market stage, with its connections and interplay between a wide array of agents and a system for introducing and reacting to feedback, that complexity begins to emerge.⁴⁴⁴ Maneuver is the associated form of conflict with this stage of the framework. Maneuver warfare came into its own with the spread of electronic communication, which allowed for the concentration of forces (often combining multiple branches, such as airpower and ground units) at the “decisive point.”⁴⁴⁵ Importantly, electronic communication had the effect of “turning armed forces into “sensory organizations,” as well as fighting units.”⁴⁴⁶ The equivalence with the standard model of policing is clear. Police officers responding to 911 calls and calling in specialized

⁴⁴² Walker and Katz, *The Police in America*, 26.

⁴⁴³ Doyle, “The Memoirs of Sherlock Holmes, by Arthur Conan Doyle,” 14.

⁴⁴⁴ Ronfeldt, *Tribes, Institutions, Markets, Networks*, 8–11. No pun is intended, both words are meant in their technical sense.

⁴⁴⁵ Arquilla and Ronfeldt, *Swarming and the Future of Conflict*, 17–18.

⁴⁴⁶ Arquilla and Ronfeldt, 17.

support (such as detectives, canine, crime scene, helicopters, etc.) is an attempt to concentrate the power and resources of the department at the decisive point, in this case, individual instances of crime. Patrol units, linked via two-way radio and computer aided dispatch also attempt to serve a sensory function by communicating information about what they observe to a shift commander.

The final stage of the framework is the network. Networks require the technological advances of the Information Age to create the ubiquitous and dense connections that allow complex systems to flourish. Arquilla and Ronfeldt associate their concept of swarming as the model of conflict for the network stage of the framework. They note that the primary objective of swarming is the disruption of an opponent's cohesion.⁴⁴⁷ Complex systems and networks rely on the connections between nodes and agents to achieve self-organized criticality and function effectively. Disrupting those connections, either by severing them or overloading them, destroys the coherence of the system and causes it to dissolve entirely or shatter into smaller, less capable and more manageable fragments.

The preceding chapters of this thesis have argued that society has proceeded into the transformation into this last stage of the framework. In particular, crime (along with many other aspects of society) is increasingly becoming driven by complex network dynamics. An equivalent model of law enforcement needs to be developed that is matched to the present environment, which is highly interconnected and non-linear.

C. RECOMMENDATIONS

It seems somewhat incongruous to offer an explicit design or plan for a complexity-based model of policing. The idea that a product can be built to a schematic and then repeated at scale is firmly entrenched in the linear epistemology and industrial mindset that no longer serves as an effective mental model for interpreting the world. The way forward likely lies in harnessing the power of complex systems by law enforcement, employing useful ideas, and emergent behavior as agencies begin to experiment with complexity-based and informed models of law enforcement. In this spirit, the following

⁴⁴⁷ Arquilla and Ronfeldt, 23.

recommendations should not be read as a road map but as a set of attractors that could potentially lead to beneficial patterns cohering. These recommendations are grouped into three categories: intellectual, workforce, and organizational.

1. Intellectual

The first recommendation is to begin explicitly educating law enforcement officers in complexity theory, network theory, and related topics. Leadership will need to become adept in these areas because they will be overseeing the evolution of law enforcement into a new, complexity-based model. Rank and file members also need this knowledge, because they will be responsible for actually performing the work in this new model and will need to understand how and why their job will be changing. Education for both leaders and members will need to occur on both the broad, conceptual level, as well as the detailed technical level.

A second recommendation, following on the first, is to begin developing an alternative mindset and corresponding narratives to fit a complex environment. The law enforcement mindset is currently a production oriented one, centered on the output of reports, investigations, arrests, and prosecutions. This mindset is common across all levels of the profession; leadership looks at output levels and what they hope to be correlated measures of public safety while the rank and file hopes to advance their career by closing cases and bringing in arrests for prosecution. This mindset must be replaced by one that thinks in terms of measuring, mapping, and intervening in complex systems.

Related to developing this new mindset is the need to begin developing new, high-level narratives about law enforcement. This new narrative is the “ideational superstructure” identified by Arquilla and Ronfeldt, which sits atop their structural view of information. These narratives are needed first to ensure the proper realignment of the law enforcement organization to a complexity-based one. As discussed in the previous chapter, the current predominant narrative that law enforcement officers are agents of order does cause discomfort and an instinctual aversion to any departure from the ordered domains. If the narratives embraced by an organization have an inherently linear, industrial character,

any attempts truly to evolve the organization are likely to either fail or become yet another passing fad that does not truly displace the standard model of policing.

2. Workforce

Frontline law enforcement officers are going to have to become much more like data scientists than they currently are to perform effectively in a complexity driven environment. However, police officers are already required to wear a large number of hats: diplomat, tactician, coach, parent, counselor, paramedic, and law enforcement officer. Adding an additional skillset to that mix is not an optimal path to ensuring expert competency or ensuring sufficient time is available to perform the data analysis needed. Therefore, while police officers will need a working knowledge of this subject matter, and should be encouraged to become practitioners, agencies should hire analysts to focus on the information management and analysis aspect of working with complex systems and networks.

These analysts should have or receive both education and training in applications of complexity theory and network analysis. They will need to utilize specialized computer software to perform various analyses of complex networks and organize the vast amounts of information that will increasingly become the lifeblood of information-age agencies. These analysts should be considered an operational position, equivalent to sworn officers, and deploying out of the office into the field when appropriate and as much as possible.

The successful integration of these analyst positions requires the intellectual recommendations outlined earlier so that previous missteps from attempts to integrate intelligence analysts can be avoided. Management often frequently utilizes analysts because they possess technological skills to produce maps and other documents focused on quantifying the present state of crime and not strategic in nature.⁴⁴⁸ In an Information Age environment, analysts need to be viewed as operational personnel to free them from tasking as support staff by agency management. With all levels of the agency possessing an underlying theoretical framework and orientation, products demanded of analysts are more

⁴⁴⁸ Nina Cope, "Intelligence Led Policing or Policing Led Intelligence?," *British Journal of Criminology* 44, no. 2 (2004): 195; Ratcliffe, *Intelligence-Led Policing*, 155–56.

likely to be aligned with strategic and operational goals and less about simple counting. One study of intelligence analysts in the United Kingdom found that poor data quality (gathered mainly from reports completed by police officers) not only hampered their ability to conduct meaningful analysis but also resulted in their products being devalued by the field officers, because they knew bad data was being input.⁴⁴⁹ The orientation of all levels of the agency in an informational, complex network view of crime should avoid this problem because the focus and incentives align with the recording of high quality, pertinent data and move away from mere production of reports, regardless of their quality.

A final recommendation is to leverage the interdisciplinary nature of complexity. In his 1948 paper that sparked the inquiry into complexity, Weaver spoke of the approach used by the English, and later the Americans, in winning the Battle of the Atlantic against German U-boats in the Second World War. Weaver noted that operational analysis teams were formed to plan and adjust strategy; these teams contained not only the expected professionals like mathematicians and engineers but also included professionals from a wide variety of other fields seemingly unrelated to naval strategy.⁴⁵⁰ Some of these other experts, such as an endocrinologist and an X-Ray crystallographer, were recognized as key members of English teams.⁴⁵¹ To that end, it is recommended that law enforcement agencies develop limited-term fellowships for academics and professionals in unrelated fields to work on systems analysis for the agency. Hopefully, these fellowships would result in the agency reaping unexpected insight, as well as helping to form the crucial weak ties to other networks that are essential in the Information Age.

3. Organizational

Day-to-day operations of police agencies will have to change significantly to implement a complexity-based model of policing successfully. Basic procedures and organization communicate information about an agency to its members and law enforcement leaders will need to examine what aspects of their current operations tacitly

⁴⁴⁹ Cope, "Intelligence Led Policing or Policing Led Intelligence?," 193.

⁴⁵⁰ Weaver, "Science and Complexity," 541.

⁴⁵¹ Weaver, 541.

communicate a grounding in a linear, production-oriented view of the world to their members. The following recommendations are not sufficient to serve as a ground up reimagining of a police agency, but serve as potential starting points to adopt a complexity-based model.

First, agencies should divorce themselves from patrolling based upon beats. Police beats are inherently linear and reductionist and are based upon the flawed concept of controlling territory. In the modern world, where individuals are both more mobile and interconnected than ever before, complex networks of criminals are not limited to discrete geographical areas. Geographic divisions will likely remain necessary for some administrative purposes, and some features of the physical world will determine a location-based deployment of officers, but these deployments should be greatly limited.⁴⁵² Systems and networks, not maps, should be the main drivers of the deployment of officers.

Abandoning police beats as a fundamental concept will have significant effects on how police agencies are organized. Many patrol sections are organized around staffing beats and various aggregations of beats form administrative subdivisions, commanded and controlled through a paramilitary hierarchy. The netwar doctrine holds that hierarchies struggle to confront networked adversaries, and that governments will need to combine both hierarchical and network forms of organization to cope with this new dynamic.⁴⁵³ Police departments should reorganize away from territorial patrol into squads headed by a sergeant (or equivalent first line supervisor).

Each of these squads should be a mixed unit of both sworn officers and analysts. Again, previous lessons learned from intelligence-led policing's attempts to integrate analysts into police departments inform the logic of this recommendation. Analysts can collect and search out higher quality information and produce a better product when they

⁴⁵² For example, an event like a parade or marathon would require a map-based deployment of officers. Similarly, the U Street corridor of Washington, DC, (referenced in the Appendix) is a very dense collection of bars and nightclubs, and attracted thousands of people on weekend nights. It is prudent to deploy some officers with such a concentration of people in a relatively small geographic area, as issues requiring police service are almost certain to arise.

⁴⁵³ Arquilla and Ronfeldt, "The Advent of Netwar (Revisited)," 15–16.

interact with their clients who is tasking or requesting their services.⁴⁵⁴ One study of intelligence-led policing found that first line supervisors mimic both officers and management in their use of analysis, which suggests that they may actually be more important customers for analytic products than line officers may.⁴⁵⁵ Complexity-based policing's analysts are envisioned as operational personnel, working side-by-side with police officers in the field as much as possible and integrated fully into the base operational units. In addition to providing plenty of interaction with the sworn personnel, it provides opportunities for each role to inform the other about priorities; sworn personnel can ask for additional information about observations they have made in the field, while analysts can inform sworn officers to look for particular things. First line supervisors, who are already well positioned to make use of analytic products, can fuse the efforts of each half of the squad and direct them towards a common purpose. Above all, these analysts need to be regarded as line personnel, on par with the sworn officers and devoted full time to these operations. Management needs for support staff and supplementary analysis should be the domain of separate, dedicated personnel.

To enable these teams to focus on complex networks of bad actors, the primacy of responding to 911 calls should be reevaluated. The development of the modern 911-call system led to a feedback loop of increasing demand for police service leading to increased capacity and repeating again.⁴⁵⁶ With 911 response increasingly driving day-to-day police operations, and the Taylorism prevalent in the professionalization movement, it is no surprise that the measurement and improvement of various statistical measures (such as average response time, units available, calls resolved per hour, etc.) came to define attempts to improve police performance. However, complex systems do not yield to such measures, and cannot be defeated by continued attempts to shave seconds off a response to a 911 call. Moreover, the primacy of 911 response inherently entrenches a production-oriented

⁴⁵⁴ Ratcliffe, *Intelligence-Led Policing*, 127–28.

⁴⁵⁵ Rachel Boba Santos and Bruce Taylor, “The Integration of Crime Analysis into Police Patrol Work: Results from a National Survey of Law Enforcement Agencies,” *Policing: An International Journal of Police Strategies and Management* 37, no. 3 (2014): 516.

⁴⁵⁶ Walker and Katz, *The Police in America*, 39–40.

mindset, as it sets the individual crime or incident as the unit of work; each leads to the production of various “products,” such as reports, investigations, and arrests, and cements the mirage that efficient production can decompose a complex network.

Currently, if a patrol shift has 40 officers at work, the vast majority, if not all, of the officers will be assigned to various beats and tasked with responding to 911 calls. Under the recommended team-based approach, the shift would be broken into anywhere from four to six teams, composed of both officers and analysts, and each headed by a first line supervisor. One or two teams would be tasked with the primary duty of responding to 911 calls for the shift, and the rest would be tasked with working on various problems (understood as manifestations of complex systems). All teams would still be linked by radio communication, and could be diverted to emergency assignments, crimes occurring close to their present location, or as otherwise necessary when deemed so by management. Even in a complexity-based model of policing, 911 calls will need to be answered, but should not be the primary focus of activity for the shift.⁴⁵⁷

Finally, departments will need to begin consciously building networks of resources they can bring to bear on the complex networks they begin mapping. As networks are identified as being responsible for various crimes and other problems, the department can begin crafting interventions. Critical nodes in the networks can be targeted for removal or attempts to impede or degrade their ability to communicate with the other nodes in the network. Many of these interventions are likely to be the familiar tools of arrest and prosecution. The experience with focused deterrence shows that when police agencies build networks of capacity with other governmental agencies and community resources, additional interventions can be staged beyond simply arresting lawbreakers. Additionally, once networks have been mapped and critical nodes identified, non-traditional interventions could be attempted, such as high quality and individually targeted educational or employment opportunities.⁴⁵⁸ Whatever interventions are selected, the impact on the

⁴⁵⁷ The present political movement to reevaluate what types of 911 calls should result in a police response could provide an opportunity for departments to reduce their call volumes.

⁴⁵⁸ These non-traditional interventions may also be useful in situations where critical nodes in a network are not engaged in criminal activity themselves, but do serve to tie many others together.

complex network must be evaluated and then stabilized if desirable. If desirable patterns are not forming in the system, alternative methods should be selected and tried.

D. AVENUES FOR FURTHER RESEARCH

Little literature is available on complexity and policing, and most discussions of the Information Revolution and policing focus merely on integrating new IT into existing paradigms. Therefore, the field is largely open for further research about the topics contained in this thesis.

One area that will be greatly important for further research is on the actual implementations of complex network analysis in a law enforcement setting and attempts to implement the suggestions offered previously. This thesis is concerned with laying out a theoretical grounding for a complexity-based model of policing; practical efforts in the field are likely to yield new insights and refinements to the theory. Additionally, practical work will help develop the tools, techniques, and knowledge base to implement a complexity-based model fully.

A second area for further research is into the distinction between a complex adaptive system and a complex adaptive network. This thesis builds off previous research about crowds as complex adaptive systems.⁴⁵⁹ In a crowd control context, CAS theory appears to be the most useful framework to understand the dynamics governing crowd behavior, as the behavior of the system and not individual agents, is important. However, it seems that while CAS theory provides a critical insight into the dynamics of crime problems, such as street robberies, the behavior and attributes of individual nodes become much more important. Therefore, the author would propose addressing these as complex adaptive networks. This term denotes that the network will behave like a complex adaptive system, but the use of network emphasizes the importance and focus on individual nodes. Further research should indicate if it is a meaningful or useful distinction.

A third area of research is on the ethics and philosophy of a complexity-based worldview. What is the role and value of an individual embedded in these systems? To

⁴⁵⁹ Leverone, "Crowds as Complex Adaptive Systems."

what extent, if any, do complexity and network dynamics outweigh free will? What level of monitoring and intervention in such systems and networks is ethical? What are the ethics of purposely trying to fragment a complex network, particularly if some key nodes of the network are not involved in criminal activity? All these questions (and more) have important implications about what *ought* to be done, and what society will accept, versus what *can* be done. At a bare minimum, professional ethics for law enforcement will need to begin devising answers to some of these questions, although they have value for the broader society as well.

Related to this field will be legal thought about complex systems. As law enforcement begins thinking about and responding to crime in terms of complex systems and networks, a spillover effect is likely in the legal system. Questions about surveillance and information privacy will take on more importance than ever before in a world where information processing is the key measure of power. If law enforcement strategy becomes driven by network dynamics, on some level, so will prosecutions as prosecutors rely on law enforcement to bring defendants before the courts. Should this scenario become explicit? Criminal charges can be brought for being part of explicit criminal organizations, thus, should similar ones be brought for playing an outsized role in a self-organized system? Should the value of someone's position in a complex network play a role in sentencing? These questions are not only philosophical ones, but also technical ones. To what extent is this new understanding of the world consistent with or in conflict with established legal precedent? Are existing precedents sufficient to guide the law in these areas? What types of new laws need to be written?

E. FINAL REMARKS

This thesis has presented an argument for a fundamental reinterpretation of policing, based upon establishing a new worldview and intellectual framework for the profession. Although different groups have different grievances with the current policing model, widespread agreement states that policing and law enforcement are in need of change. This thesis has argued that it is vital to recognize that society in the United States is transitioning into an informational, network-based society increasingly governed by

nonlinear, dynamic processes. Law enforcement cannot produce its way out of the current dilemma. Indeed, the attempt to produce more arrests and more prosecutions, no matter how efficiently, is likely to make the situation worse. The friction from continuing to force an industrial worldview in an informational society will scale nonlinearly.

One way or another, the current hierarchical model of law enforcement will be affected by the network society. Arquilla and Ronfeldt point out that while the death of hierarchies has been predicted before in history, what tends to actually happen is the diminishment of existing hierarchies (and the rise of new ones).⁴⁶⁰ The current moment is a perilous one for policing, with the prominence of “defund the police” as a meme in current discourse. It does offer an opportunity for policing to shed distractions and tasks best handled by other government agencies and to focus on the core law enforcement mission. As both the public and government officials are reconsidering the mission of policing, it is possible for law enforcement to advocate for the wholesale change to the profession that evolving to a complexity-based model entails. However, the previous examples of diminished hierarchies suggest the possibility that if the profession insists on clinging to outdated worldviews and mindsets, policing will emerge greatly diminished.

Think of a London thief-taker watching the first of Peel’s uniformed Metropolitan Police officers leaving their station and patrolling the city streets. Policing today stands at the cusp of as great a change in law enforcement, as the fundamental nature of society has once again shifted. Crime and societal disorder have embraced complex dynamics and network forms of organization, while policing continues to insist on linear, hierarchical responses. The profession can choose to embrace change and evolve to match a complex society, or it can continue to cling to a familiar, if outdated, worldview.

⁴⁶⁰ Arquilla and Ronfeldt, “Looking Ahead,” 459.

APPENDIX

This report is used with permission and is included as it is not publicly available. This report has been modified to redact personally identifiable information regarding suspects arrested, and to remove information about specific methods, tactics, and responses.⁴⁶¹



1620 V Street NW, Washington, DC, 20009 (202) 673-6820 FAX (202) 555-5000

MEMORANDUM

TO: Patrol Chief
Patrol Services North

FROM: Commander
Third District

DATE: September 11, 2019

SUBJECT: Crime Plan to Robberies in the Third District

Overview:

The Third District has seen a 37% increase in the number of robberies in 2019 when compared to the same time period in 2018 (346 vs 253). Sector 1 and Sector 3 have seen increases of 69% and 37% respectively during this time period, while Sector 2 has seen an increase of 27%.

In addition, there have been 65 robberies in the past 30 days, which represent a 141% increase in the number of incidents as compared with the same time period in 2018 (27 in 2018).

⁴⁶¹ Commander, Patrol Services North, Third District, Metropolitan Police Department, Washington, DC, personal communication, September 1, 2019.

Robbery Incidents by Sector/PSA (as of 9/10/2019)						
Sector/PSA	2018 YTD	2019 YTD	% Change	30-Day 2018	30-Day 2019	% Change
Sector 1	87	93	7%	7	25	257%
302	50	57	14%	3	19	533%
304	37	36	-3%	4	6	50%
Sector 2	102	172	69%	13	23	77%
305	49	87	78%	6	15	150%
306	21	37	76%	6	4	-33%
308	32	48	50%	1	4	300%
Sector 3	64	81	27%	7	17	143%
301	21	35	67%	4	8	100%
303	18	16	-11%	2	3	50%
307	25	30	20%	1	6	500%
Total	253	346	37%	27	65	141%

Synopsis:

Over the last 30 days, the most common method of robbery has been force and violence/AWIR (32 robberies) followed by snatch (10 robberies). In addition, during the last 30 days eleven (11) gun related robberies were reported in the Third District, but eight (8) of those have occurred in the last 7 days (September 3 – September 9, 2019), including three (3) commercial gun robberies.

Robberies by Method Aug 11 - Sep 9, 2019	
Method	Count
F&V	29
AWIR	3
Snatch	10
Attempt - Snatch	1
Gun	8
Commercial - Gun	3
Knife	2
Attempt - Knife	3
Commercial - Knife	3
Fear	2
Pickpocket	1
Total	65

Sixty-six percent (66%) of robberies over the past 30 days have involved groups of two or more suspects (43 of 65). The most common group sizes are two individuals (19 robberies) and three individuals (11 robberies).

Robberies by Suspect Count Aug 11 - Sep 9, 2019	
# of Suspects	Count
One	22
Two	19
Three	11
Four	5
Five	2
Six	2
Eight	3
Ten	1
Total	65

Sixty-nine percent (69%) of robberies have occurred during the midnight shift. The most active time period overall has been midnight shift over the weekend.

Robberies by Shift and Day August 11 - September 9, 2019								
Shift/Day	MON	TUE	WED	THU	FRI	SAT	SUN	Total
Day	0	0	1	2	1	1	1	6
Evening	2	0	3	4	0	1	4	14
Midnight	3	2	4	1	5	15	15	45
Total	5	2	8	7	6	17	20	65

In the 60 day period of July 12 – September 9, 2019, there have been forty-three (43) individuals arrested for Robbery (or Receiving Stolen Property that had been taken in a robbery) in the Third District. Of the 43, 27 of them were juveniles at the time of arrest (those highlighted below):

CCN	Arresting Agency	Arrest Number#	Arrest Date	Arrest Location	Arrest PSA	Arrest Category
18140494	MPD	101924335	8/1/2019	1620 V STREET NW	301	Robbery
19119635	MPD	JU1922489	7/15/2019	3031 14TH STREET NW	302	Robbery
19119635	MPD	JU1923227	7/22/2019	1305 COLUMBIA ROAD NW	302	Robbery
19119790	MPD	JU1924839	8/6/2019	3636 16TH STREET NW	302	Robbery
19121033	MPD	031922654	7/17/2019	1620 V STREET NW	301	Robbery
19121649	MPD	JU1922102	7/12/2019	1722 6TH STREET NW	308	Robbery
19121649	MPD	JU1922103	7/12/2019	1722 6TH STREET NW	308	Robbery
19121649	MPD	JU1922104	7/12/2019	1728 6TH STREET NW	308	Robbery
19122188	Metro	511922175	7/12/2019	700 M STREET NW	308	Robbery
19122241	MPD	031922185	7/12/2019	2016 GEORGIA AVENUE NW	305	Robbery
19123966	MPD	JU1922453	7/15/2019	1317 COLUMBIA ROAD NW	302	RSP
19124864	MPD	091924014	7/29/2019	600 RHODE ISLAND AVENUE NW	308	Robbery
19127703	MPD	101924313	8/1/2019	3120 16TH STREET NW	302	Robbery
19127912	MPD	031923159	7/21/2019	125 Q STREET NW	308	Robbery
19127912	MPD	031923161	7/21/2019	125 Q STREET NW	308	RSP
19128376	Metro	JU1923233	7/22/2019	1305 COLUMBIA ROAD NW	302	Robbery
19131480	MPD	031924025	7/29/2019	637 FLORIDA AVENUE NW	306	Robbery
19131480	MPD	031924026	7/29/2019	1800 7TH STREET NW	305	Robbery
19134659	Metro	JU1924258	7/31/2019	1104 7TH STREET NW	307	Robbery
19134659	Metro	JU1924268	7/31/2019	1104 7TH STREET NW	307	Robbery
19141372	MPD	031925337	8/11/2019	3160 16TH STREET NW	302	Robbery
19141372	MPD	031925338	8/11/2019	3160 16TH STREET NW	302	Robbery
19141372	MPD	JU1925335	8/11/2019	1400 IRVING STREET NW	302	Robbery
19141372	MPD	JU1925360	8/11/2019	3020 14TH STREET NW	302	Robbery
19142593	MPD	JU1925528	8/13/2019	1306 U STREET NW	305	Robbery
19142593	MPD	JU1925530	8/13/2019	1306 U STREET NW	305	Robbery
19142593	MPD	JU1925531	8/13/2019	1810 13TH STREET NW	305	Robbery
19142622	MPD	JU1925519	8/13/2019	1306 U STREET NW	305	Robbery
19142622	MPD	JU1925520	8/13/2019	1306 U STREET NW	305	Robbery
19142622	MPD	JU1925521	8/13/2019	1810 13TH STREET NW	305	Robbery
19145200	MPD	031925960	8/16/2019	1919 14TH STREET NW	305	Robbery
19147612	MPD	091926290	8/20/2019	2041 GEORGIA AVENUE NW	306	Robbery
19147612	MPD	091926291	8/20/2019	2041 GEORGIA AVENUE NW	306	Robbery
19152667	MPD	JU1927245	8/30/2019	1620 V STREET NW	301	Robbery
19152669	MPD	JU1927256	8/30/2019	1620 V STREET NW	301	Robbery
19153320	Metro	511927156	8/29/2019	700 M STREET NW	307	Robbery
19154295	MPD	JU1927337	8/31/2019	1030 FAIRMONT STREET NW	304	Robbery
19154295	MPD	JU1927339	8/31/2019	1030 FAIRMONT STREET NW	304	Robbery
19157876	MPD	JU1927890	9/5/2019	1700 IRVING STREET NW	302	Robbery
19159007	MPD	JU1928081	9/7/2019	815 V STREET NW	305	Robbery
19159007	MPD	JU1928082	9/7/2019	815 V STREET NW	305	Robbery
19159364	MPD	031928143	9/7/2019	1220 7TH STREET NW	307	Robbery
19159364	MPD	JU1928141	9/7/2019	1220 7TH STREET NW	307	Robbery

The Criminal Research Specialists will be asked to review juvenile court records to ascertain the case and detention status of these juveniles. In the event that it is learned that juvenile offenders have been released into the community, home visits will be conducted by PSA officers to encourage compliance with their conditions of release. In addition, members will familiarize themselves with individuals currently under supervision by Department of Youth Rehabilitation Services (DYRS) or Court Social Services (CSS) so that response to crimes in progress can include visits to these residences.

Trends:

When analyzing the sixty-five (65) robberies that have taken place in the past the past 30 days (August 11-September 9), the following has been determined:

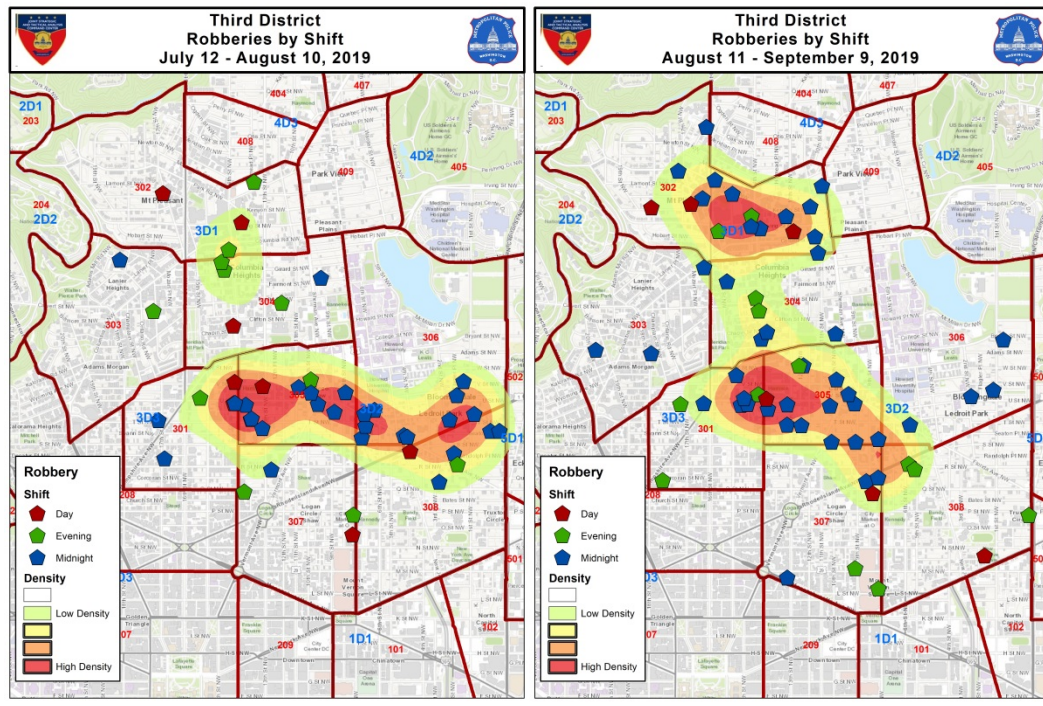
Day of Week: Sun (20); Mon (5); Tue (2); Wed (8); Thu (7); Fri (6); Sat (17)

- Time of Day: Day (6); Eve (14); Mid (45)

Density Maps:

Analysis of the robberies that have taken place in the past 30 days vs the 30 days prior shows a shift in the geographic area where the robberies are occurring. What had previously been an area bounded by 16th Street to the west, V Street/Florida Avenue to the north, North Capitol Street to the east, and S Street to the south has shifted to the west and north. The Columbia Heights area has now seen a considerable uptick in the number of reported robberies in the past 30 days. Both of these areas include commercial corridors

and Metro stations. There are many nightlife establishments in these areas that may contribute to the number of victims. Evening and Midnight shifts are the most heavily represented in these geographic areas.



Plan of Action:

Remaining portion of document has been redacted to protect methods and tactics.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

- Agar, Michael. "Complexity Theory: An Exploration and Overview Based on John Holland's Work." *Field Methods* 11, no. 2 (1999): 99–120.
- Albert, Reka, Hawoong Jeong, and Albert-Laszlo Barabasi. "Diameter of the World-Wide Web." *Nature* 401 (1999): 130–131.
- Arquilla, John, and David Ronfeldt. "A New Epoch—and Spectrum—of Conflict." In *In Athena's Camp: Preparing for Conflict in the Information Age*, 1–20. Santa Monica, CA: RAND, 1997.
- . "Cyberwar Is Coming!." In *In Athena's Camp: Preparing for Conflict in the Information Age*, 23–60. Santa Monica, CA: RAND, 1997.
- . "Looking Ahead: Preparing for Information-Age Conflict." In *In Athena's Camp: Preparing for Conflict in the Information Age*, 439–501. Santa Monica, CA: RAND, 1997.
- . *Swarming and the Future of Conflict*. Santa Monica, CA: RAND, 2000.
https://www.rand.org/pubs/documented_briefings/DB311.html.
- . *The Advent of Netwar*. Santa Monica, CA: RAND, 1996.
- . "The Advent of Netwar (Revisited)." In *Networks and Netwars: The Future of Terror, Crime, and Militancy*, edited by John Arquilla and David Ronfeldt, 1–25. Santa Monica, CA: RAND, 2001.
- ASU Center for Problem-Oriented Policing. "The Problem Analysis Triangle." Accessed October 10, 2019. <https://popcenter.asu.edu/content/problem-analysis-triangle-0>.
- . "The SARA Model." Accessed December 7, 2020.
<https://popcenter.asu.edu/content/sara-model-1>.
- Bak, Per, and Maya Paczuski. "Complexity, Contingency, and Criticality." *Proceedings of the National Academy of Sciences of the United States of America* 92 (July 1995): 6689–96.
- Bak, Per, Chao Tang, and Kurt Wiesenfeld. "Self-Organized Criticality: An Explanation of 1/f Noise." *Physical Review Letters* 59, no. 4 (July 27, 1987): 381–84.
- Barabasi, Albert-Laszlo. *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*. 2014 ed. New York: Basic Books, 2002.
- . "The Network Takeover." *Nature Physics* 8, no. 1 (January 2012): 14–16.

- Barabasi, Albert-Laszlo, and Reka Albert. "Emergence of Scaling in Random Networks." *Science* 286 (1999): 509–12.
- Bonney, Lesley Suzanne. "The Prosecution of Sophisticated Urban Street Gangs: A Proper Application of RICO." *Catholic University Law Review* 42 (Spring 1993): 579–1063.
- Bonnington, Christina. "In Less Than Two Years, a Smartphone Could Be Your Only Computer." *Wired*, February 10, 2015.
<https://www.wired.com/2015/02/smartphone-only-computer/>.
- Braga, Anthony, and David Weisburd. "Police Innovation and the Future of Policing." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 544–563. 2nd ed. New York: Cambridge University Press, 2019.
- Braga, Anthony, Brandon Turchan, and Christopher Winship. "Partnership, Accountability, and Innovation: Clarifying Boston's Experience with Focused Deterrence." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 227–248. 2nd ed. New York: Cambridge University Press, 2019.
- Braga, Anthony, David Weisburd, and Brandon Turchan. "Focused Deterrence Strategies and Crime Control: An Updated Systematic Review and Meta-Analysis of the Empirical Evidence." *Criminology & Public Policy* 17, no. 1 (2018): 205–250.
- Bureau of Justice Assistance. *Understanding Community Policing: A Framework for Action*. Washington, DC: Bureau of Justice Assistance, 1994.
- Castells, Manuel. "Materials for an Exploratory Theory of the Network Society." *The British Journal of Sociology* 51, no. 1 (January 1, 2000): 5–24.
- . *The Rise of the Network Society*. 2nd ed. vol. 1. The Information Age: Economy, Society, and Culture. Malden, MA: Blackwell Publishing, 2000.
- Community Oriented Policing Services. *Community Policing Defined*. Washington, DC: Community Oriented Policing Services, 2014.
<https://cops.usdoj.gov/RIC/Publications/cops-p157-pub.pdf>.
- Cope, Nina. "Intelligence Led Policing or Policing Led Intelligence?." *British Journal of Criminology* 44, no. 2 (2004): 188–203.
- Dempsey, John, and Linda Forst. *An Introduction to Policing*. 3rd ed. Belmont, CA: Wadsworth, 2005.
- Doyle, Arthur Conan. "The Memoirs of Sherlock Holmes, by Arthur Conan Doyle." Project Gutenberg. Accessed November 23, 2019.
<https://www.gutenberg.org/files/834/834-h/834-h.htm#chap12>.

- Eck, John. "Police Problems: The Complexity of Problem Theory, Research and Evaluation." In *Problem-oriented Policing: From Innovation to Mainstream*, edited by Johannes Knutsson, 79–113. Vol. 15, Crime Prevention Studies. Monsey, NY: Criminal Justice Press, 2003.
- . "Why Problem-Oriented Policing." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 165–181. 2nd ed. New York: Cambridge University Press, 2019.
- Eidelson, Roy. "Complex Adaptive Systems in the Behavioral and Social Sciences." *Review of General Psychology* 1, no. 1 (1997): 42–71.
- Federal Bureau of Investigation. "Mafia Org Chart." Accessed October 11, 2019. <https://www.fbi.gov/file-repository/mafia-family-tree.pdf/view>.
- Federal Communications Commission. "Chairman Genachowski Joins Senator Schumer, D.C. Mayor Gray, State Police Departments, and Wireless Carriers to Announce New Initiatives to Combat Massive Smartphone & Data Theft." April 10, 2012. <https://www.fcc.gov/document/announcement-new-initiatives-combat-smartphone-and-data-theft>.
- Folley, Vern. *American Law Enforcement*. 2nd ed. Boston: Holbrook Press, 1976.
- Friedman, Barry. "The Problem with Modern Policing, as Seen from the Right and from the Left." *New York Times*, June 27, 2016. <https://www.nytimes.com/2016/07/03/books/review/the-war-on-cops-by-heather-mac-donald-and-handcuffed-by-malcolm-sparrow.html>.
- George Mason University Center for Evidence-Based Crime Policy. "What Is Problem-Oriented Policing?." Accessed December 7, 2020. <https://cebcp.org/evidence-based-policing/what-works-in-policing/research-evidence-review/problem-oriented-policing/>.
- Goldstein, Herman. "What Is Problem-Oriented Policing?." ASU Center for Problem-Oriented Policing, 2001. <https://popcenter.asu.edu/content/what-pop>.
- Hall, Mark. "Facebook." *Britannica*. Accessed October 11, 2020. <https://www.britannica.com/topic/Facebook>.
- Hayek, Friedrich. "The Theory of Complex Phenomena." *Emergence: Complexity and Organization* 9, no. 1–2 (2007): 143–165.
- Holland, John H. *Emergence: From Chaos to Order*. Reading, MA: Perseus Books, 1998.
- . *Hidden Order: How Adaption Builds Complexity*. Reading, MA: Perseus Books, 1995.

- Horgan, John. *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age*. New York: Basic Books, 2015. ProQuest.
- Intelligence Commanders Group. *Report on the 2020 Protests & Civil Unrest*. Salt Lake City, UT: Major Cities Chiefs Association, 2020.
https://www.majorcitieschiefs.com/pdf/news/mcca_report_on_the_2020_protest_and_civil_unrest.pdf.
- Jackman, Tom. “Attorney General Launches Presidential Commission on Law Enforcement.” *Washington Post*, January 22, 2020.
<https://www.washingtonpost.com/crime-law/2020/01/22/attorney-general-barr-launches-presidential-commission-law-enforcement>.
- Jayanti, Elizabeth Bechtel. “Through a Different Lens: A Survey of Linear Epistemological Assumptions Underlying HRD Models.” *Human Resource Development Review* 10, no. 1 (2011): 101–114.
- Kelling, George L., and Mark H. Moore. *The Evolving Strategy of Policing*. Perspectives on Policing. Washington, DC: National Institute of Justice, U.S. Department of Justice, and the Program in Criminal Justice Policy and Management, John F. Kennedy School of Government, Harvard University, 1988.
<https://www.ncjrs.gov/pdffiles1/nij/114213.pdf>.
- Kelling, George L., Tony Pate, Duane Dieckman, and Charles Brown. *The Kansas City Preventative Patrol Experiment: A Summary Report*. Washington, DC: The Police Foundation, 1974. <https://www.policefoundation.org/publication/the-kansas-city-preventive-patrol-experiment/>.
- Kennedy, David M. “Policing and the Lessons of Focused Deterrence.” In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 205–226. 2nd ed. New York: Cambridge University Press, 2019.
- Kluger, Jeffrey. *Simplicity*. New York: Hyperion, 2008.
- Kurtz, Cynthia F., and David Snowden. “The New Dynamics of Strategy: Sense-Making in a Complex and Complicated World.” *IBM Systems Journal* 42, no. 3 (2003): 462–483.
- Leary, Richard, and Jenny Thomas. “How Complexity Theory Is Changing the Role of Analysis in Law Enforcement and National Security.” In *Intelligence Management*, edited by Babak Akhgar and Simeon Yates, 61–78. London: Springer, 2011.
- Leedy, Paul D., and Jeanne Ellis Ormrod. *Practical Research: Planning and Design*. 12th ed. New York: Pearson, 2019.

- Leverone, Robert. "Crowds as Complex Adaptive Systems: Strategic Implications for Law Enforcement." Master's thesis, Naval Postgraduate School, 2016. <http://hdl.handle.net/10945/48549>.
- Levy, David L. "Applications and Limitations of Complexity Theory in Organization Theory and Strategy." In *Handbook of Strategic Management*, edited by Jack Rabin, Gerald J. Miller, and W. Bartley Hildreth, 67–87. 2nd ed. New York: Marcel Dekker, 2000. http://www.faculty.umb.edu/david_levy/complex00.pdf.
- Magliocca, Nicholas R., Kendra Mcsweeney, Steven Sesnie, Elizabeth Tellman, Jennifer A. Devine, Erik A. Nielsen, Zoe Pearson, and David J. Wrathall. "Modeling Cocaine Traffickers and Counterdrug Interdiction Forces as a Complex Adaptive System." *Proceedings of the National Academy of Sciences of the United States of America* 116, no. 16 (2019): 7784–7792.
- Mallin, Alexander, Julia Jacobo, and Meredith Deliso. "Capitol Riot Latest: 2 Alleged Proud Boys Members Indicted on Conspiracy Charges." *ABC News*, January 30, 2021. <https://abcnews.go.com/Politics/capitol-riot-latest-man-accused-stealing-documents-mitch/story?id=75467908>.
- Mansoor, Iqbal. "Facebook Revenue and Usage Statistics (2020)." *Business of Apps*, July 30, 2020. <https://www.businessofapps.com/data/facebook-statistics/>.
- Mastrofski, Stephen. "Community Policing: A Skeptical View." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 45–68. 2nd ed. New York: Cambridge University Press, 2019.
- McChrystal, Stanley, Tantum Collins, David Silverman, and Chris Fussell. *Team of Teams: New Rules of Engagement for a Complex World*. New York: Portfolio/Penguin, 2015.
- Melgarejo, Miguel, and Nelson Obregon. "Multifractal Approach to the Analysis of Crime Dynamics: Results for Burglary in San Francisco." *Fractals* 25, no. 5 (2017): 1750043–1—1750043–15.
- Monk, Khadija, Justin Heinonen, and John Eck. "Street Robbery." *Problem-Oriented Guides for Police, Problem-Specific Guides Series*. Tempe, AZ: Center for Problem-Oriented Policing, 2010.
- Morcol, Goktug, and Aaron Wachhaus. "Network and Complexity Theories: A Comparison and Prospects for a Synthesis." *Administrative Theory and Praxis* 31, no. 1 (March 2009): 44–58.
- MPDC. "Statistics and Data." Accessed October 12, 2019. <https://mpdc.dc.gov/page/statistics-and-data>.

- NASA. "Goldilocks Zone." *Exoplanet Exploration—Planets beyond Our Solar System* (blog). Accessed October 29, 2020.
<https://exoplanets.nasa.gov/resources/323/goldilocks-zone/>.
- National Gang Intelligence Center. *2011 National Gang Threat Assessment*. Washington, DC: Bureau of Justice Assistance, 2011.
https://permanent.access.gpo.gov/gpo90495/2011_NationalGangThreatAssessment.pdf.
- National Institute of Justice. "Gun Violence Programs: Operation Ceasefire." June 24, 2008. <https://nij.ojp.gov/topics/articles/gun-violence-programs-operation-ceasefire>.
- National Police Foundation. "Community Policing." December 6, 2020.
<https://www.policefoundation.org/projects-old/community-policing/>.
- Papachristos, Andrew V., Christopher Wildeman, and Elizabeth Roberto. "Tragic, but Not Random: The Social Contagion of Nonfatal Gunshot Injuries." *Social Science & Medicine* 125 (2015): 139–150.
- President's Task Force on 21st Century Policing. *Final Report of the President's Task Force on 21st Century Policing*. Washington, DC: Community Oriented Policing Services, 2015.
- Pycroft, Aaron. "Complexity Theory: An Overview." In *Applying Complexity Theory*, edited by Aaron Pycroft and Clemens Bartollas, 15–38. Bristol, United Kingdom: Policy Press, 2014.
- Ramalingam, Ben. *Aid on the Edge of Chaos*. Oxford, United Kingdom: Oxford University Press, 2013.
- Ratcliffe, Jerry H. *Intelligence-Led Policing*. Cullompton, UK: Taylor & Francis, 2014. ProQuest.
- Reuter, Peter. "The Decline of the American Mafia." *Public Interest*, no. 120 (Summer 1995): 89–99.
- Robinson, Matthew. "Why Do People Commit Crime? An Integrated Systems Perspective." In *Applying Complexity Theory*, edited by Aaron Pycroft and Clemens Bartollas, 59–78. Bristol, United Kingdom: Policy Press, 2014.
- Ronfeldt, David. *Tribes, Institutions, Markets, Networks: A Framework about Societal Evolution*. Santa Monica, CA: RAND, 1996.
- Ronfeldt, David, and John Arquilla. "What Next for Networks and Netwars?." In *Networks and Netwars: The Future of Terror, Crime, and Militancy*, edited by John Arquilla and David Ronfeldt, 321–322. Santa Monica, CA: RAND, 2001.

- Rosser Jr., J. Barkley. "On the Complexities of Complex Economic Dynamics." *Journal of Economic Perspectives* 13, no. 4 (Fall 1999): 169–92.
- Sagarin, Rafe. *Learning from the Octopus: How Secrets FROM Nature Can Help Us Fight Terrorist Attacks, Natural Disasters, and Disease*. New York: Basic Books, 2012.
- Santos, Rachel Boba, and Bruce Taylor. "The Integration of Crime Analysis into Police Patrol Work: Results from a National Survey of Law Enforcement Agencies." *Policing: An International Journal of Police Strategies and Management* 37, no. 3 (2014): 501–20.
- Science Museum. "A Computer in Your Pocket: The Rise of Smartphones." Accessed October 11, 2020. <https://www.sciencemuseum.org.uk/objects-and-stories/computer-your-pocket-rise-smartphones>.
- Scott, John. *Social Network Analysis*. 4th ed. London: SAGE Publications Inc., 2017.
- Sierra-Arevalo, Michael, and Andrew V. Papachristos. "Social Networks and Gang Violence Reduction." *Annual Review of Law and Social Science* 13 (2017): 373–393.
- Silverman, Eli B., and John A. Eterno. "CompStat's Innovation." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 399–416. 2nd ed. New York: Cambridge University Press, 2019.
- Simon, Herbert. "The Architecture of Complexity." *Emergence: Complexity and Organization* 7, no. 3–4 (2005): 138–54.
- Skogan, Wesley. "Community Policing." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 27–44. 2nd ed. New York: Cambridge University Press, 2019.
- Skogan, Wesley, Susan Hartnett, Jill DuBois, Jennifer Comey, Marianne Kaiser, and Justine Lovig. *On the Beat: Police and Community Problem Solving*. Boulder, CO: Westview Press, 1999.
- Snowden, David, and Mary Boone. "A Leader's Framework for Decision Making." *Harvard Business Review*, November 2007.
- Stacey, Ralph D. *Complexity and Group Processes: A Radically Social Understanding of Individuals*. New York: Brunner-Routledge, 2003.
- Taylor, Ralph B. "Incivilities Reduction Policing, Zero Tolerance, and the Retreat from Coproduction: Even Weaker Foundations and Stronger Pressures." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 142–162. 2nd ed. New York: Cambridge University Press, 2019.

- Waldrop, M. Mitchell. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Simon & Schuster, 1992.
- Walker, Samuel, and Charles Katz. *The Police in America: An Introduction*. 5th ed. New York: McGraw Hill, 2005.
- Walters, Glenn. *Modelling the Criminal Lifestyle: Theorizing at the Edge of Chaos*. Switzerland: Palgrave Macmillan, 2017.
- Watts, Duncan J. "Networks, Dynamics, and the Small-World Phenomenon." *American Journal of Sociology* 105, no. 2 (September 1999): 493–527.
- . *Six Degrees: The Science of a Connected Age*. New York: W. W. Norton & Company, 2003.
- . *Small Worlds: The Dynamics of Networks between Order and Randomness*. Princeton, NJ: Princeton University Press, 1999.
- Watts, Duncan J., and Steven H. Strogatz. "Collective Dynamics of 'Small-World' Networks." *Nature* 393 (1998): 440–442.
- Weaver, Warren. "Science and Complexity." *American Scientist* 36, no. 4 (October 1948): 536–544.
- Weisburd, David, and Anthony Braga. "Problem-Oriented Policing: The Disconnect between Principles and Practice." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 182–202. 2nd ed. New York: Cambridge University Press, 2019.
- . "Understanding Police Innovation." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 1–24. 2nd ed. New York: Cambridge University Press, 2019.
- Weisburd, David, and John Eck. "What Can Police Do to Reduce Crime, Disorder, and Fear?." *Annals of the American Academy of Political and Social Science* 593, no. 1 (2004): 42–65.
- Weisburd, David, James Willis, Stephen Mastrofski, and Rosann Greenspan. "Changing Everything so That Everything Can Remain the Same: CompStat and American Policing." In *Police Innovation: Contrasting Perspectives*, edited by David Weisburd and Anthony Braga, 417–436. 2nd ed. New York: Cambridge University Press, 2019.
- Weisburd, David, Stephen Mastrofski, Ann Marie McNally, Rosann Greenspan, and James Willis. "Reforming to Preserve: Compstat and Strategic Problem Solving in American Policing." *Criminology & Public Policy* 2, no. 3 (July 2003): 421–56.

- Wright, Richard T., Scott H. Decker, and Neal Shover. *Armed Robbers in Action: Stickups and Street Culture*. Boston: Northeastern University Press, 2011. ProQuest.
- Yang, V. Chuqiao, Andrew V. Papachristos, and Daniel M. Abrams. "Modeling the Origin of Urban-Output Scaling Laws." *Physical Review E* 100, no. 3 (September 16, 2019): 1–7. <https://doi.org/10.1103/PhysRevE.100.032306>.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California