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Anticipatory Intelligence and Adaptive Influence: A New Paradigm for Foreign Policy Development

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Complexity theory reveals a nation is not just a people with a government; it arises from competition and the compromises continually being made by the many groups at many levels within it. Anticipatory intelligence that combines this complex system perspective with today's powerful computational tools can provide the deeper insights needed to advance U.S. foreign policies, particularly promoting democracy, to adaptively influence the behavior of foreign populations.

U.S. policymakers are continually pressing the IC to pursue more effective means of understanding complex challenges to better manage foreign affairs. What are the best measures to mitigate a global pandemic while maintaining a functional society? How do brutal dictators in Iran and North Korea retain power despite crushing isolation and sanctions? How can the Taliban continue to undermine the overwhelming military strength of the United States and its allies? Looking back, how did Mohammed Bouazizi, a seemingly irrelevant Tunisian fruit stand vendor, ignite the Arab Spring and how could the Islamic State, an al-Qa'ida splinter group, grow to control 34,000 square miles of territory across the Middle East?

NIU's Center for Anticipatory Intelligence and Adaptive Influence ($C(AI)^2$) applies complexity theory and advanced computational methods to better understand intelligence problems and improve policymaking to bridge an enduring gap in the academic-government nexus, bringing research and innovation to practical government application.

Although social and behavioral scientists, as well as military strategists, have applied a variety of widely respected and useful methods aimed at better understanding populations for the purpose of policy formulation,[1, 2, 3] complex adaptive systems theory, also known as complexity theory, argues that the inherent reductionism of these approaches results in information loss that undermines their overall efficacy.

This *Research Short* argues that fusing complex adaptive systems theory with innovations in advanced computational methods can help transcend this problem. Complexity theory argues that the ability to address the above foreign policy challenges lies in understanding the interdependencies of a foreign state's or region's subcomponents (e.g., ethnic groups, businesses, political parties)—interactions that get filtered out with traditional, reductionist, or formulaic ways of understanding human behavior.[4, 5, 6] By applying advanced computational methods and techniques to simulate the interdependent relationships of the systems' subcomponents, researchers can generate virtual laboratories to test their understanding, which often uncovers counterintuitive insights. To understand the profound implications of these ideas, it is necessary to develop an understanding of and intuition for complex systems.

Complex Adaptive Systems

The study of complex systems and its applicability to anticipating human behavior dates back to the ancient Greeks, but traditional scientific approaches have failed to capture complex systems' interdependent nature. Governments, public health systems, societies, and other complex systems are multilevel and multidimensional adaptive networks.[7] Societies, for example, exist at multiple levels: individuals compose families that compose neighborhoods that compose cities, and so on. Furthermore, multidimensional networks operate inside each level: individuals exist in family networks, friend networks, business networks, information networks, and political networks. These networks constantly transform as individuals, businesses, political parties, and other cohesive entities alter their behavior, which shifts their interdependencies with their environment, allies, competitors, and suppliers.[8, 9, 10, 11, 12] These interdependencies mean a society's behaviors cannot be understood by examining

sub-elements in isolation—as is done in the reductionist approach that has dominated science. Splitting the whole to examine its individual parts breaks the interrelationships that produce the behaviors of interest.

Studying such a rich and dynamic tapestry of relationships has been crushingly difficult, but the advent of advanced computational power offers a path forward. Before the digital computer, mathematical attempts to understand even simple versions of these types of interactions were so cumbersome they were ignored.[13, 14] The computer's ability to brute force its way through large numbers of calculations has greatly advanced the study of complex systems[15, 16] in ways that have allowed us to fundamentally rethink some of the most basic processes of policy development. (See Appendix.)

Democracy, for example, epitomizes the complexity concept known as the *edge of chaos*—the transition space between order and chaos.

Democracy Viewed Through Complexity

Exploring the dynamics of democracy formation through a complex systems lens illustrates the challenges of understanding those complex systems and developing effective foreign policies that influence their behavior. Political systems embody the elegant nature of complex systems and the delicate balance that can exist within them. Democracy, for example, epitomizes the complexity concept known as the *edge of chaos*—the transition space between order and chaos. An easily understandable metaphor is to think of water in liquid form as the transition space between ice—a frozen, ordered regime where every molecule is locked in place (e.g., autocracy)—and vapor, where molecules are chaotically careening in all directions (e.g., anarchy). Ubiquitous in the universe, the edge of chaos is where life thrives and complex systems exist. Maintaining the edge is critical to life's origins and its maintenance. If the universe's matter had been too densely packed, no complex activities would have emerged, and if it had been too dispersed, no matter would have come together to create the complex elements that produced life. Similarly, if genomic networks were either too ordered or too chaotic, they would not be able to coordinate the essential biological activities needed for life.[17]

This concept should also resonate with anyone who has worked in an organization. Too many rules, too much bureaucracy—and the organization grinds to a halt because no new approaches can pass through the overly rigid structure. Conversely, a chaotic organization cannot identify who does what, so nothing happens. In the political realm, a democratic governance system best maintains society at the edge of chaos, because it enables the population to solve the hard problems[18, 19] that promote broader prosperity.[20] Democracy offers problem solvers the flexibility to innovate (chaos) and sufficient structure to capitalize on their innovation (order). Understanding governance as a society's attempt to find an optimal dynamic between order and chaos has profound implications.

The universe's tendency to thrive between order and chaos transmutes the rational and moral justifications for democratic forms of government into inherent laws and natural dynamics.[21] The edge of chaos idea is profound in its revelation that a multitude of individuals and organizations

at multiple levels—all competing and compromising for their self-interest—is able to find solutions and solve complex problems more effectively than seemingly more efficient problem-solving regimes, such as a benevolent dictatorship.[22] The challenge with the edge of chaos concept, much like complexity in general, is that its principles are not well understood at the level of detail needed to develop policy. The edge of chaos provides a frustrating heuristic for foreign policy because no known laws exist akin to Newton's in physics that define the mix of structure and flexibility to optimize governance. Even simple computational experiments to explore the concept have proven controversial.[23, 24, 25]

Nevertheless, the edge of chaos can provide insight into the development of U.S. efforts to promote democracy abroad that would challenge conventional approaches because the theory redefines the concepts of state and government. Understanding democracy as a balance between order and chaos forces policymakers to look at a nation-state not as a homogenous entity being governed but as competing interests held by layers of groups and individuals influenced by their associated governance, both formal and informal. This layered complexity also gives validity to the ongoing battle in international relations theory, where different camps argue for the primacy of their particular approach (e.g., foreign policy realists versus domestic politics and elite decisionmakers). Complexity would contend they are each correct, but the details within the foreign system will determine the main driver(s) for specific situations. The abstraction of complex systems as adaptive networks is an effective perspective to make sense of those alliances and competitions among individuals, groups, cities—and on up to nations.

Governance and Networks

The power of a population's network structure and the governance of the flow of resources across it shape our world. One stark example is China's and Europe's differing rates of historical development. Although the Chinese invented the printing press and gunpowder centuries before Europeans, these inventions had far less impact in China, in large part because of different network structures. Information and inventive energy easily flowed across Europe's network of interconnected kingdoms, while the Emperor maintained tight control of information and imperial technologies under China's tightly controlled hub and spoke network.[26] Understanding these network dynamics provides deeper insight into societal behavior and changes over time.

A similar network analysis can reshape how one understands the impact of U.S. aid, moral suasion, or military action and can reveal how Washington's policies can, counterintuitively, work against U.S. interests. The traditional approach would conclude that the best way to support a foreign "government" would be to provide resources to support it. From a complex systems perspective, however, it becomes clear that the resources the United States provides go to a subgroup or set of groups in conflict with other groups pushing competing interests. The United States becomes a wealthy new node in the network that alters the foreign groups' internal competition because the group the United States supports has less incentive to compromise with other groups to form a more broadly supported and stable long-term government.[27] The supported

group can compel others to adopt measures that would solidify its hold on power, encouraging autocracy—as was seen during the Karzai governance of Afghanistan.[28] By altering the flow of resources within a country, U.S. Government policy changes how those foreign networks evolve. The complex systems perspective suggests the United States will better achieve its democracy promotion objectives if it pursues policies that maintain balance among competing groups, a vastly more difficult challenge than picking potential winners.

Anticipate and Adapt

The new perspectives for understanding population dynamics that complexity theory offers will require a new intelligence analysis and policy formation paradigm.

- The term **anticipatory intelligence** must reclaim its original link to foreseeing the behavior of complex challenges. In this context, it means to assess the competition dynamics within foreign populations to anticipate possible outcomes, including those driven by U.S. policy.[29] Critically, these systems are "deterministically unpredictable," much like the weather. Because there is always a point after which the dynamics cannot be predicted,[30] the IC must strive to anticipate what is possible—but recognize that the future is unknowable and that policy will always have unintended consequences.
- This unpredictability and the unintended consequences inherent in complex systems mean policy must have **adaptive influence,** meaning foreign policy's purpose is to influence the adaptive path of a foreign population by altering its interdependencies, its flow, and its resources across its network to create a balance of competing interests that promote a healthy democracy. Policymakers will need to constantly adapt their policies as the unexpected occurs.

What specifically this anticipatory intelligence and adaptive influence look like, how long policies may last, or how often they need to adapt is unknown and will vary in each situation.

Anticipation and Adaptation Require Computation

Accepting this new complex systems paradigm presents the practical question of how can those tasked with developing foreign policy understand the competing interests and internal governance mechanisms necessary to create effective policy? It is here that computation becomes critical. Computation is merely the process of following a pre-defined set of instructions—mathematical or not—and is now synonymous with computers, which can brute force their way through billions of instructions per second. Computation is a tool for complex systems exploration, much like an astronomer needs a telescope to see distant stars or a doctor needs a stethoscope to listen to the heart and lungs. Understanding and influencing the competitive dynamics of a foreign population requires computational support for three reasons.

First, the sheer size of the problem demands computational tools be part of analysis and policy development to exploit their processing capability. Humans can process in their heads or on

paper only a small portion of the complex web of competing interests that form a nation, and this task becomes exponentially harder when those competing interests are adapting. Computational tools are the only way to process not only the interactions of a foreign system's main groups and their adaptations but also the interactions and adaptations of the families, villages, cities, regions, and other entities that make up that country. Just as computers are required to process the massive amounts of data now produced, computers are needed to simulate the layers of individuals and groups of concern and their adaptation.

Second, computational power is needed to simulate the interactive mechanisms of the various groups to see if these interactions can be influenced to form a democracy. Foreign populations must be understood as a set of interactive mechanisms[31] that defy simple analytic equations (e.g., $E= MC^2$ or $A^2+B^2=C^2$). If behavior emerges from the interactions of the groups within a foreign system, then the challenge is to determine what essential mechanisms must exist within that system to produce behavior consistent with U.S. foreign policy goals. Finding, describing, and understanding these mechanisms requires IC professionals to synthesize the local behaviors and understand those behaviors' relationships with the emergent properties of the system. This is a subtle but crucial difference compared to the analytic approach which assumes the pieces are directly related to the system behavior. This analytic approach can be seen in frameworks like PMESII (Political, Military, Economic, Social, Infrastructure, Information) that assume to understand a population an analyst must describe each part (e.g., P+M+E+S+I+I = foreign nation). Policy formation is equally linear in its approach; for example, enact laws to encourage a population to adapt from a controlled to an open economy.[32] Both are inappropriate for understanding and influencing complex, nonlinear systems that require synthesizing the interactions of competing elements and then trying to understand the relationships of this synthesis to the emergent behavior, which may be counterintuitive. As the saying goes "if you didn't grow it [simulate the micro interaction of the agents and produce the same macro phenomenon] then you didn't understand it..."[33]

Third, details matter. A team of analysts and policy developers could hand-process a few groups and interactive mechanisms to see how a system could function, but understanding the diversity within the population matters. In one of the first attempts to apply computational tools to real life dynamics, analysts replicated the archaeological record of Long House Valley in Arizona. Long House Valley was home to the Kayenta Anasazi, the ancestors of the southwest indigenous tribes now known as the Pueblo. The model sought to replicate the archaeological record from 800 to 1350 Common Era, which included abandonment of the area by the Anasazi around 1300. The modelers programmed their agents to replicate aggregate population statistics such as life span, birth rates, etc., to recreate the Long House Valley population. However, the model could not replicate the archaeological record until the modelers diversified their population. It mattered whether one person's life was longer or shorter than another's, or that a person gave birth earlier or later. Once this diversity was added, the simulation matched the record.[34] Eloquently, this model showed the unique experiences of an individual life matter.

Moving from a manually produced sparse understanding to computationally supported detailed understanding will provide greater insights into the dynamics that are producing the emergent

behavior within the complex system of interest. Ideally, intelligence professionals across government could rapidly simulate a particular complex system to use as a virtual laboratory—enabling them to better understand system behavior and allowing policymakers to test new policies *in silico* before implementing them. This approach will ensure more rigor and conserve U.S. resources, as policies that expend the minimum resources for maximum benefit can be more easily identified. The challenge is "democratizing" these simulations, so they become more pervasive than PowerPoint. They also must be supported by a vibrant ecosystem that constantly allows the users to bring in new knowledge. Although it goes beyond the scope of this paper, there are nascent efforts to build the necessary supporting ecosystem to make this vision a reality.

Even if this vision becomes a reality, however, there will always be more details than analysts and U.S. foreign policy entities can capture. Computational tools are understanding aids, not answer machines. They will provide more rigor and insight than had been possible but will not give the users the perfect policy or replicate the situation exactly. Although the routine and widespread use of simulations will not be perfect, they have the potential to reveal insights as significant as the discovery of bacteria or the structure of the human genome.

New Paradigms for Foreign Policy

Complexity theory reveals nations are not just a people with a government; nations arise from competition and the compromises continually made by the many groups at many levels within them. Basing assessments and implementing policy on this new perspective will provide better understanding and more effective policy. Anticipatory intelligence and adaptive influence capture this approach. Examining the fundamentals of complex systems reveals ways to improve the foundational concepts that guide intelligence and foreign policy. Within this understanding is a tremendous number of unanswered questions about the dynamics and features of complex adaptive systems, but by exploring them, we can understand them. Adopting and integrating these new paradigms challenges an IC that must continue to produce analysis and assessments and cannot afford to fundamentally rethink every aspect if its embedded processes. Complex systems theory would argue the only way to proceed is to nurture new species (i.e., start-ups) of intelligence entities attempting different variations of these ideas and allowing them to mature. This approach is consistent with both ecological systems and capitalist economies. These IC "start-ups" must be groups of passionate individuals trying the seemingly impossible—or at least the very difficult. Although many will fail, those that succeed will bring about new paradigms that will allow the United States to maintain its global competitive advantage.

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If you have comments, questions, or a suggestion for a *Research Short* topic or article, please contact the NIU Office of Research at **NIU_OOR@dodiis.mil**.

Appendix: A First Step Forward

With complexity theory penetrating deeper into the social sciences and the barriers of entry to computational tools dropping,[35, 36, 37] the ability to provide U.S. policymakers with greater understanding of the environment facilitating more effective foreign policy initiatives is greatly enhanced. But, one of the great paradoxes of complex systems science is that at the same time that computers make it possible to effectively grapple with complexity, those same computers and their associated networks also increase the very complexity in question. Nonetheless, the competitive nature of international relations requires the IC, think tanks, and academic researchers to aggressively apply complex system concepts to their analysis to broaden understanding and enable policymakers to take more effective action. This may well be only a first step as the dynamics of complex systems are poorly understood and further investigation may result in fundamentally new scientific conceptualizations.

Endnotes

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