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Honors Capstone

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Complexity Science and World Politics

This paper is an exploration of the topic of complexity science and a demonstration of its applicability to the social sciences. As part of my research for the paper, I browsed the American University Bender Library for books on the topic. The results of my search were more than disappointing: there were less than 50 books directly or remotely related to complexity science. Moreover, they were scattered around a number of different sections, as there is no section in the library dedicated to complexity science or its applications. When I picked up David Byrne's book called "Complexity Theory and the Social Sciences" published in 1998, I noticed that American University copy of it had never been opened. I suspect this is the case with many other copies of this same book in libraries throughout the country (…or just those of them that bothered to acquire one).

Those first steps in writing my Honors Capstone were both discouraging and enlightening: I realized that my research was not going to be easy, but that my paper would be worthwile.

As my experience in the American University Library revealed to me, complexity science is not a popular topic in the academia. Although there has been some research on its applications beyond the natural sciences, social scientists have generally failed to embrace it as

a possible theory and a potentially useful mode of thinking. The academia has not introduced complexity as a topic in social science classrooms and there are no guidelines developed for teaching it to students of the social sciences.[1]

Having become deeply intrigued with complexity and having identified its virtual absence from the academia, I realized the need for it to be properly introduced to the academic circles. Therefore, the first goal of my paper to demonstrate that complexity theory is applicable to our study of the social sciences. What is more, by providing a new way of approaching the social sciences, complexity can expand our understanding of them.

I. Conceptual Framework

Due to the relative unpopularity of complexity theory in the social sciences, any discussion of this topic needs to be preceded by a profound and systematic discussion of complexity and the concepts that make up this science.

1. Chaos Theory:

Chaos theory is often viewed as the scientific precursor to complexity science. (Some authors have used the terms interchangeably. However, for the purpose of this paper a distinction between the two will be made.) Encyclopedia Britannica defines chaos theory as "the study of apparently random and unpredictable behavior in systems governed by deterministic laws." It is commonly accepted that the unpredictability of those systems is due to their complicated nature, but some seemingly simple systems have also exhibited high degrees of unpredictability and expanded the scope of chaos theory. One common feature

[1] With the exceptions of Professor Bob Sicina's class Global Enterprise Failure at the Kogod School of Business, American University, Washington D.C. The paper was written under the supervision of Professor Sicina, whose class discussion provided the inspiration for the paper.

among those systems is believed to be their sensitivity to initial conditions (related to the "butterfly effect" concept, which is explained a later section of this paper).

2. Complexity Science:

Stemming from chaos theory is complexity science. It is defined by Encyclopedia Britannica as "a scientific theory which asserts that some systems display behavioral phenomena that are completely inexplicable by any conventional analysis of the systems' constituent parts." While this definition sounds similar to the one of chaos theory, complexity science is used to refer to a broader set of complex systems. Unlike chaos theory, which is intended to be limited to mathematics, mechanics and thermodynamics, complexity science is used to refer to social or other systems involving living organisms. Therefore, complexity science is very much inspired by the living world and can be thought of as a broad-based inquiry into the common properties of all living things and systems: "beehives and bond traders, ant colonies and enterprises, ecologies and economies" (Pascale, p. 5).

3. Complex Adaptive Systems:

The behavior of complex systems is the main subject of study by complexity scientists. As author Neil Harrison puts it, complexity science is the study of complexity systems (Harrison, p. 2). Encyclopedia Britannica defines a system as complex when it is composed by "many interacting components whose behavior or structure is difficult to understand." Some structurally complex systems might have simple behavior patterns, while other systems might be structurally simple, but exhibit complicated and unpredictable behavior. An example of the former could be any machine, and an example of the latter can be the Internet ("Complexity"). A third type of systems is those, such as the human brain, that are both structurally and

behaviorally complex. In simple systems the units and the relations between them are fixed. Therefore, they permit the future stages of development of the system to be more or less accurately predicted (Harrison, p. 2). A common feature of complex systems, on the other hand, is that they tend to generate counterintuitive, seemingly non-causal behavior ("Complexity"). It is also important to note that complex systems are open systems. An open system is one in which "the boundaries permit interaction with their environment" (Kelly, p. 12). And although the degree of openness of a system is not a measure of its complexity, most complex systems are usually open (Harrison, p. 28).

Complex systems are also often referred to as complex adaptive systems, which alludes to their capacity to adapt and change in response to changes in their environment. This change usually happens through some kind rearrangement or reorganization of the agents within the system. In short, complex adaptive systems can be defined as systems of independent agents "that can act in parallel, develop "models" as to how things work in their environment, and most importantly, refine those models through learning and adaptation" (Pascale, p. 5).

4. Agents and self-organization:

Complexity theory takes an agent-centric approach to the study of complex systems. The units in a complex adaptive system are commonly referred to as agents because of their relative autonomy and discretion over their actions that they exercise within the system. In any living system, for example, each unit of life has a range of freedom of choice. That freedom is absent in simple closed systems, such as machines for example (Harrison, p. 3).

The freedom of action is what gives complex adaptive systems the ability to self-organize. Self-organization is defined as the tendency of complex adaptive systems "to shift to a new state when their constituent elements generate unlikely combinations" (p.113).

5. Decentralization:

The notion of agents' self-organization is inherently linked to another main feature of complex adaptive systems—their decentralization. In simple systems control can generally be found in one or few locations. Moreover, there is little interaction, if any, between the lines of command and the effects of the central authority's decisions are clear and traceable. In a car for example, the central authority is what the driver does, and hitting the breaks usually does not control the car's sound system or windows ("Complexity").

In contrast, complex systems are thought to exhibit a diffusion of authority and power is spread over a decentralized structure. A number of units or even all units may combine to generate the behavior of the entire system ("Complexity"). This gives the system much more flexibility and therefore unpredictability. Here again, the Internet is the most obvious contemporary illustration of this notion, because it is highly dependent on the ways in which its users decide to use and shape it.

Many of the concepts related with complex adaptive systems are related to the notion of this decentralized self-organization of agents taking place in those systems.

6. Equilibrium and chaos:

While simple systems are more static and prone to equilibrium, complex systems are defined as dynamic and dissipative- they use energy (Harrison, p. 4). Living systems, as the most common example of complex systems, demonstrate this notion with the continuous state of

change and flux that they are in. Moreover, any living system draws its energy from the resources it extracts from its environment (Harrison, p. 4).

Since complex systems exist in a perpetual out-of-equilibrium state, they are thought to be chaotic. Contrary to popular belief, the term chaos here does not suggest that they are disorderly. Author David Byrne argues that the contrast between chaos and order is a dichotomy socially constructed in the Western mind-set. The origin of the word chaos (Greek for void) alludes to the same conclusion. Byrne explains that the binary logic of the chaos-order dichotomy can be replaced by the four-valued logic of Taoism, in which "not-order is not equivalent to anti-order" (Byrne, p.16). This take on chaos is much truer to the scientific usage of the word, which treats chaos as equivalent to not-order, and sees it as containing or preceding order (Byrne, p.16). In mathematical terms, for example, chaotic behavior is just another mathematical regime. In it, chaotic behavior does not repeat itself and is therefore labeled aperiodic. However, it is important to note, that even so, chaotic behavior is definable in mathematical parameters and while it might appears random or irrational, mathematically it is not (Kiel, p.23-24).

Thus, instead of disorderly and disorganized, complex adaptive systems should be thought of as having different and changing forms of organization that are subject to the self-organization forces at work within those systems and to the environmental factors surrounding those systems. This is a notion, which logically leads one to realize that complex adaptive systems are more flexible to their internal and external conditions and environments, which is why they are called adaptive. Thus, as Encyclopedia Britannica explains, they tend to adapt

quickly to unexpected events because their components have more latitude for independent action ("Complexity").

7. Emergence:

The notion of emergence is a result of the connectedness between agents in complex adaptive system and their constantly changing relationships and states. The term emergence in this context is used to denote a new state or condition in a system (Pascale, p. 113). In other words, emergence is the unexpected appearance of new properties in a system. Those properties are not present in the building blocks of the system: its agents, its subsystems, etc. Instead, they emerge from the interaction of those components. This alludes to the fact that the behavioral patterns and properties of complex systems cannot be predicted based on the knowledge of their parts in isolation. Thus, emergence is one of the most distinguishing features of complex systems ("Complexity"). The sound produced by an orchestra is an example of the emergent product of the interaction of the sounds of the numerous different instruments (Pascale, p. 114).

The process of emergence is inherently related to the unpredictability of complex systems. Since emergence is a sudden arising of new patterns and structures with new properties (Goldstein), their shape and form cannot be known before they actually emerge. This is another reason for the inherent unpredictability of complex systems.

8. Non-linearity:

Non-linearity is another term in the complexity theory taxonomy that denotes a feature responsible for the systems' unpredictability. Complex adaptive systems exhibit non-linear behavior as there is no discernible causal relationship between the continuity of their actions

and states. In complex systems many factors, both internal and external to the system, symbiotically interact to cause an effect (Harrison, p.13). The interaction of those factors in itself can often become a venue for emergence and the forces produces by those interactions might not be virtually contingent with the forces behind the interactions. This shows that the causation link in complex adaptive systems can easily be obscured by the complexity of the circumstances.

9. Butterfly Effect:

The non-linear nature of complex adaptive systems can be viewed as a prerequisite to what has become known as the theory of the "butterfly effect." This theory postulates that two identical systems, starting from nearly the same condition, can rapidly evolve in entirely different ways. In their book *Chaos Theory in the Social Sciences* authors Douglas Kiel and Euel Elliot explain the theoretical background to chaos theory and its concepts. They explain that in nonlinear dynamic systems, "operating in a chaotic regime, small disturbances can have explosive and disproportionate," therefore non-linear, effects (Kiel, p. 24). Chaotic regimes tend to amplify such disturbances, unlike systems in a steady state of equilibrium tend to "damp" them. This is the phenomenon that complexity scientists refer to as sensitivity to initial conditions. In other words, systems that are in a state of chaos, or operate in chaotic regimes, are sensitive to small changes. Those small changes and occurrences have the potential to massively impact the system as its behavior initially slightly alters, then changes, and finally explodes over time. What is more, systems with very similar starting conditions can in diverge greatly in their evolutions because they are chaotic. They can evolve into very different systems and structures over time (Kiel, p. 24).

The theory was exemplified by a discovery by Edward Lorenz, a mathematical meteorologists working with computer simulations of the weather. Lorenz discovered that the weather was so sensitive to initial conditions that numerical forecasting was not applicable for more than a few days ahead. (The phenomenon received the name "butterfly effect" after a paper called "Does the Flap of a Butterfly's Wings in Brazil Set off a Tornado in Texas?" that Lorenz presented in 1972) ("Complexity Theory").

The "butterfly effect" stems from the interaction of the different properties of complex systems. The ability of the different parts of a complex system to interact, as well as the dynamic and non-linear nature of the systems, enable small changes in initial conditions to have disproportionate outcomes. Another feature of complex systems, namely their openness to outside forces, is another important precondition to the "butterfly effect." (A butterfly flapping its wings in a steady balloon would be an illustration of a closed system in which the wings' motion would not have any effect outside of the balloon.) The system's existence far from equilibrium is also a prerequisite for the actualization of those properties of the system that lead to unpredictable outcomes.

10. Black Swan Theory

Directly related to the idea of the "butterfly effect" is the Black Swan theory. (The term stems from the notion that no amount of observations of white swans can allow the inference that all swans are white, but one single observation of a black swan is needed to refute that conclusion (Earp, p. 1). In his book *The Black Swan: the Impact of the Highly Improbable*, author Nassim Nicholas Taleb advances the idea that rare, unpredictable and extreme events are the high-impact drivers of change and evolution in history. Among many historical and anecdotal

examples are the Great Depression, the events of 9/11 and the current financial crisis. As Taleb puts it, the Black Swan idea is based on the structure of randomness in empirical reality. Taleb argues not only that the emergence of Black Swans is possible, but also that the extreme, the unknown and the very improbable dominates the world that we live in (p. xxvii).

The unpredictability of Black Swans alludes to the fact that if they were to appear, this would happen in the context of a complex system. With its non-linearity, inherent unpredictability, property of sudden unexpected emergence and reliance on single agent contributions, the nature of complex adaptive systems seems conducive to the occurrence of Black Swans. Taleb seems to recognize this fact, as well. His description of the Black Swan-prone framework uses the metaphor of two diametrically opposed "states:" the state of Mediocristan and the state of Extremistan. Mediocristan is composed of what Taleb calls mediocre members. In other words the agents in the system are homogenous and the system and its environment offer them little opportunity to change that state. In contrast, Extremistan boasts a high level of randomness in the make-up of its population. There is no typical inhabitant of the state, and the inhabitant are largely unlimited by their environment in how they might act (Taleb, p. 36). Although Taleb does not denote it explicitly, it looks as though Mediocristan is governed by a centralized authority mandating some set of rules and guidelines which suppress diversity. Extremistan on the other hand, seems to be subject to no central government. Instead, its inhabitants and their individual evolutions govern the system. Taleb, then notes that Extremistan is where most of the Black Swans occur (Taleb, p. 37).

Although his Black Swan theory can be applicable to all complex adaptive systems, it has be designed to be applied to people's lives and humanity as a whole.By its nature, a Black Swan,

as described by Taleb, is unpredictable. Therefore, he argues that instead of trying to forecast such events and map out their development, people need to adjust to their existence. And while it might sounds rather dictatorial Taleb's part to mandate that people get used to what is unexpected and has not yet happened, he does offer some logical solutions to the problem of adapting to Black Swans. First, Taleb argues that people have failed to reach the abstract notion of Black Swans despite its numerous manifestations in history. This, according to Taleb, shows people's general unpreparedness and inability to internalize abstract notions as a rule. Therefore, instead of accepting the possibility of those high-impact low-probability events and the Black Swan theory as their explanation, people usually try to reason out some logic of causation that they had "failed" to figure out before the event. They would rather ascribe some logic to it in hind-sight, than accept the abstract notion of the randomness and the Black Swan as explanations to startling unexpected events.

II. The Gap in Scholarly Work:

What the above overview of complexity concept is supposed to do is direct the attention to and shed some more light on the entirety of the complexity framework. What my research of the topic has concluded, is that complexity has been both loosely defined and understudied.

The scholarly work focused on providing a clear definition of complexity has been insufficient. No definitive and comprehensive taxonomy has been developed, which naturally impedes the further study and application of the concept. The terms used to describe complexity have not been provided with operant definitions. As Earnest and Rosenau argue, "the epistemology and ontology of complex systems theory are poorly defined" (p. 145).

Moreover, scholars have described and focused on different aspects of the theory, instead of on its central concepts. Thus, the scholarly work on complexity has not come up with a definitive set of features describing the complexity framework.

Even more importantly, little scholarly attention has been devoted to the application of complexity principles in the social sciences. The social sciences have been used to provide examples of the different features of complexity, but have not greatly benefited from complexity theory in return. Since this paper is intended to initiate fuller use of the complexity principles in the social sciences, I provide a demonstration of the applicability of complexity thinking in the field of world politics. The following sections re-address most of the concepts of complexity already discussed and show how they can be applied to the study of world politics. Moreover, they detail how the study of international relations can benefit from being discussed from a complexity standpoint.

III. Complexity in World Politics

World affairs can almost intuitively be called a complex field. Even, after decades of theorizing about world events, scholars are often left in the dark about the reasons and the causes behind certain world events. The unexpected but sweeping fall of the Soviet Union and the terrorist attacks on the U.S. are some of the most memorable examples of events that were entirely unexpected and yet managed to completely alter the dynamics of the world, and 'change the course of history' as some might put it. Years of theorizing and debating have not solved the mystery behind those events, and more specifically the mystery of how nobody saw them coming. This failure has made it clear that the current scholarly approaches to international relations have numerous practical limitations and are unable to explain some

important phenomena in the field. This reveals the need for a new, more insightful approach to the study of world affairs (Harrison, p. 1).

Looking at world affairs through a complexity theory lens provides some illuminating insights. This new approach stresses the complex nature of world politics, and opposes it to the current attempts by scholars to simplify world affairs in order to "understand them better." Thus, what follows is a demonstration of the applicability of the major concepts of complexity to the reality of world affairs.

1. Complex Adaptive Systems in World Politics:

As discussed earlier, complexity science focuses on the study of complex adaptive systems. In the field of international relations complex adaptive systems can be found on many levels. Most current International Relations textbooks recognize those levels as: systems, states, societies, governments and individuals. While this identification is a step in the right direction, in their erroneous striving for simplicity, authors have often attempted to choose one of those options in the end, and defend their choice against other alternatives (Harrison, p. 26). By focusing on single levels of analysis, scholars have failed to look at the broader picture of the forces at play on the international arena.

Unlike conventional international relations theories, complexity science models its approach around the study of the layers in world politics as interrelated systems (Harrison, p. 26). For example, instead of focusing on just the state, as any class on the realist view in world politics teaches, complexity models its world system as a hierarchy of nested subsystems. Thus, any system or set of systems within this analysis constitutes the environment of all the other systems and subsystems (Harrison, p.26). It is important to note that the state is not discarded

as an object of analysis. In fact the state itself is conceptualized as a complex adaptive system. However, instead of viewing it as a solid body as realism does, complexity discusses the state as a combination of all the flexible sub-bodies within the state (Harrion, p. 184).

This interpretation reveals that, just as typical complex systems do, the complex system of world affairs acts in a counterintuitive manner and generates unforeseen results. This is due to both the complicated structure and the complex behavior of the actors on the international arena. The units within the international system are not fixed, and nor are their relationships. As with any complex system, this makes any prediction of the future development of the system rather inaccurate.

2. International Relations and Actors as Agents

Since complexity theory takes an agent-centric approach to the study of complex system, the applicability of this approach to the study of world affairs needs to be revealed, as well.

Conventional discussions of world politics take into account the importance of the state as a central actor, while only marginally recognizing the potential influence of sub-state and non-state actors. Constructivism, for example, treats states as the main subjects, but states are still assumed to be unitary actors with set identities and interests (Harrison, p. 8). Historical materialism, on the other hand, focuses solely on the structural forces that dictate state behavior and disregards the characteristics of the states (Harrison, p. 27).

However, as discussed earlier, such theories oversimplify the picture by making assumptions about the state, and by excluding other important actors from their narratives. There are progressive thinkers in the field of international relations, who have pioneered by

presenting the notion that states can no longer be viewed as the most significant and influential actors on the world arena. Mark Stout, Thomas Lynch III, and T.X. Hammes, are three such pioneers. In their article, "Transnational Movements and Terrorism" they present the notion that national and international security now involves non-state actors to "an extent unprecedented in history" (Stout, p. 28). "Transnational movements and sub-state groups" they argue, now "have tremendous power both to contribute to the greater good and to bring about violence, death and repression" (Stout, p. 28). The international environment today is conducive to the development and flourishing of such non-state actors, more so than it is to the development of states' ability to match this development. It is argued that technology, and most notably bio-technology, has the potential to empower the not-so-well-meaning of those groups. There are in today's international environment, some political, social and technical trends that set the conditions for future conflict. Even though such conflict may involve smaller non-state entities, they might be more powerful than the ones traditionally viewed as such. This is so, because "emerging political, business, and social structures have consistently been more successful at using nascent technology than older, established organizations." Thus, it is important to prepare for significant shocks even before today's nascent technologies mature and the fragility of globalization manifests itself in another destructive Black Swan (Stout, p. 32).

This is a notion that, if realized and internalized by states, can have vast practical implications. If state leaders shake off the limitations of conventional international relations theories of the world, the danger will become much more obvious to them. What is more important, they will be able to respond with adequate and timely policies and deter some of

the threats posed by non-state actors (Stout, p. 29). After all, recognition is thought to be one of the main requirements of some of those groups, which states have continuously overlooked and denied to negotiate with.

States are usually modeled as entities with objective and rational interests. They are viewed as having the same goals and aspirations, all revolving around the acquisition of power and competitive advantage over other states. This approach reduces the range of "possible causal explanations for any perceived social event, simplifying causal analysis and hypothesis generation and testing" (Harrison, p.8).

Complexity theory, on the other hand, views the characteristics of social entities as the factors that generate actions and participate in the construction of the systems' structure. In this framework, there are forces internal to states that affect the actions of agents. Moreover, complexity would hold that agent behavior patterns are the reflection of the interactions between the agents' internal features and dynamics and their environment (Harrison, p. 27). The state is viewed as both a complex system and a unit within the international system of states (Harrison, p. 8). This approach allows for changes in state behavior to be expected. Moreover, complexity theory does not assume uniformity among states' goals or objective rationality. To the contrary, it assumes diversity among agents: each state can have unique goals and views on how to achieve them. This major implication of complexity thinking views rationality as a subjective concept based on each state's position in the world, relationships with other actors in the environment, historical background, cultural priorities, etc (Harrison, p.27).

The relationships between the actors in international systems and their environment illustrate the openness of systems and subsystems on the international arena. As noted earlier, this openness is a vital quality of complex adaptive system, as it is integral to the emergence of Black Swans. That the main actors on the international arena exist in an open system, however, has not been widely recognized by international relations scholars.

3. Decentralization and Self-organization in World Politics:

Although, the applications of the notions of decentralization and self-organization in world politics are quite intuitive, they have not been widely embraced by scholars. The logic behind them stems from the agent-based model proposed by complexity. In other words, on an international arena where all actors (state actors, as well as non-state actors) are the agents and drivers of events, and there is no centralized authority or uniform goal above them to mandate their behavior, it is the interaction or self-organization between agents that has the potential to predetermine the dynamics in the system.

4. Equilibrium and Chaos in World Politics:

The interaction and self-organization processes among the agents in world politics are continuous processes. Classical international relations paradigms tend to disagree with this notion as well. They see world affairs as a homeostatic system, or in other words, one that exists in a state of equilibrium. Realism, for example, presumes that the international system always aims for and returns to a state of balance between forces. This, however, is a misguided notion that mistakes the international system with a simple system. Indeed, it is true that simple dynamic systems tend towards equilibrium. But unlike simple systems, complex ones are

never homeostatic, and according to the complexity paradigm, world politics unquestionably falls under the complex systems category (Harrison, p. 11).

For complex systems, moments of equilibrium are fleeting. Even when they are frequent, they are temporary and distinct phenomena. Notable examples of this rule are periods in history where the global international system has found itself in a balance-of-power situation. Power was balanced in Europe before the First World War, as well as during the Cold War, but both of those instances clearly happened under unique conditions and were not the prosperous and peaceful times that one might think of as the state of equilibrium (Harrison, p. 11).

Chaos, as it applies to world politics, is generally just as misunderstood as the state of equilibrium. Conventional thinking suggests that if the international system is described as chaotic, it is random, disorganized, and even somehow wrong. If we look back at the scientific definition of chaos, we start to realize that this is not the case. All that the term "chaotic" suggests is that the system does not repeat itself: no future set of circumstances is identical to a past one.

According to author Thad Brown, for example, any political system is chaotic. Chaos exists when "the long-term prediction of a system is impossible because uncertainty in a system's initial state grows exponentially fast over time" and this is the state that all political systems are found in. This notion implies that forecasting the future behavior of political systems on the international arena based on the past is problematic. According to Brown, the problem arises because current memory of the past is usually erroneous (Brown, p. 119 in Kiel). In other words, when based on past experiences and knowledge of the past, projections for the

future do not have a better chance to be successful than those projections that are based on the present. Lessons from the past are projected on the future through the prism of the present. Thinking of the past in hindsight and in light of the current situation gives us a biased take on the past events. When looking back we would tend to omit actions and forces that do not fit the made up causality chain that we identify; we disregard how events might have turned out differently with only a small change of the conditions. And if they had turned out in that other alternative way, we would be identifying in hindsight other sets of forces and events that would "explain" the current outcome (Sicina). As Nassim Taleb puts it, "our minds are wonderful explanation machines, capable of mounting explanations of all manner of phenomena, and generally incapable of accepting the idea of unpredictability." Even when events are unexplainable, people try to provide convincing explanations for them after the fact (Taleb, p.10). This phenomenon is also the reason why world affairs are not universally recognized as chaotic: scholars and practitioners mislead themselves by thinking that their knowledge of the past and the present is sufficient for creating a viable projection for the future. In reality, the international system is irregular. And the source of this irregularity is its property as a nonlinear system to separate initially close trajectories exponentially fast over the course of their development (Brown, p. 119).

As explained earlier, chaos does not equal disorder or randomness. The assertion of the chaotic property of world affairs does not suggest that events happen randomly in it, or that they are unrelated to each other. Instead, it suggests that as every complex system, the international system is highly sensitive to the interactions and changing forms of organization of its subsystems and agents.

As applicable as chaos as a concept is to the world affairs, scholars have found it difficult to find place for it in their studies of the field. As Thad Brown puts it, “what is reasonable for chemistry, physics, or neurobiology is more difficult to accept in the social sciences”. This could be because it is difficult to find “crisp illustrations of chaos” in international politics. However, the science of international politics, might eventually reconcile itself to the fact that the traditional methods of study, data collection and statistical analysis cannot access all important aspects of politics (Brown, p. 135).

5. Emergence and World Politics:

The concept of emergence is somehow more evident in the international system. In complex systems, the whole is thought to be more than the sum of its parts. This is the case with the international system as well: social and political institutions emerge from the interactions of individuals. Those resulting institutions then form their own identities as a result of the interactions among their members, and the society’s interaction with the environment and other societies. When such different groups interact, new institutions and formations emerge on a new level. This is how, as a result of continuous interactions on various levels, societies, states, and unions of states are formed (Harrison, p. 32).

As in complexity science, emergence in the international system is often sudden and unexpected, although scholars often try to justify and explain it in detail in hindsight. Before the emergence of the European Coal and Steel Community (ECSC), the precursor to the European Union, few scholars of international or European studies would have predicted the magnitude of the union that was going to develop.

6. The Butterfly Effect in World Politics:

As already established, the world politics system falls under the category of complex adaptive systems. A major quality of complex adaptive systems is that they are chaotic, which logically makes the international system chaotic, as well. A major implication of chaos as a property of any system is that that system becomes susceptible to the butterfly effect. In other words, in world affairs, virtually unimportant and small occurrences can trigger disproportionately significant events. This sensitivity of the system, according to Kiel and Euel, has important implications for social scientist, as virtually identical systems can undergo unique histories (Kiel, p. 25). Numerous examples of this phenomenon can be found in history. The differing developments of the former Soviet republics and satellite states after the dissolution of the Soviet Union are such one example. Many scholars have tried to theorize and explain the unique post-Soviet experiences of those nations, but it has been noticed that no specific model of development could be established, despite the large number of variables and factors that researchers have examined. Thus, it seems that each nation took on a different path of development, not based on the specificity of the state it found itself in in 1991, but based on some decisive moment in its development that predetermined its course.

7. Black Swans in World Politics:

Accepting the butterfly effect as a concept strongly applicable to the field of international relations simply opens a door for Black Swans. In short and as explained earlier, Black Swans are high-impact, low-probability events.

The presence of Black Swans in international systems is an argument that can be made just based on the analysis of world politics as a complex adaptive system, so far. The international relations system is an open one, which according to Taleb, is where more Black

Swans occur. Moreover, the set of variables and factors in it is enormous and cannot be clearly defined, which makes prediction exercises harder.

A brief look at the historical development of the international systems demonstrates Taleb's argument that it is dominated by Black Swans. A convincing example that he provides is the development of religions. The rise of Christianity in the Mediterranean basin and later in the Western world, for example, can be considered a Black Swan: historians at the time did not see it coming, and yet it turned out high-impact occurrence. Contemporary historians of Christianity might be surprised at the absence of any mention of the new religion in the Roman chronicles, because they would tend to believe that such a major and influential force would have attracted the attention of their colleagues in the early ages. However, as many other sweepingly important events in history, the emergence of Christianity remained unnoticed before the new religion spread.

An important implication from the Black Swan notion and the presence of Black Swans in world affairs is that history and societies do not crawl. Instead, they jump (Taleb, p. 11). When a Black Swan occurs, when one pole of the bipolar world collapses, when airplanes intentionally crash in the middle of a metropolis, the status quo changes overnight. Such occasions represent the kind of discontinuities in the chronology of events that illustrate the importance of Black Swans. Months before the collapse of the Soviet Union, its citizens would not dare raise their voices against the government, would not even dream of it dissolving in a heartbeat. Days after the dissolution, citizens of the newly emerged states were rejoicing and audibly praising the change. On the day before the 9/11 attacks, international terrorism was nowhere near the top security and foreign policy priorities on the agenda of the United States.

Day after them, Congress was passing what seemed to be a blank check for the president to react to the attacks. His reaction was war (Murray). Those two notable examples demonstrate how not even slightly predictable events can suddenly change the "course of history"; how they can quickly change the status quo and make history jump.

IV. Discussion of Conclusions:

My effort to demonstrate the applicability of complexity science concepts to the study of world politics convinced me that complexity has a lot to offer to the academic world. In order to present this conclusion, this paper had to address a gap existing in the existing scholarly works. I found complexity science to be vaguely defined and crudely understudied by scholars in the social sciences. What is more, of the books and articles about the issue that have been published, many offer one-sided presentations of the topic or conceal its concepts and messages in impenetrable language. Thus, one of the central conclusions of my work has been the pressing need for further and more profound systematic scholarly explorations of the applicability of complexity theory to the social sciences.

As a part of my study, I wondered about the reasons why complexity has been understudied and not applied to the social sciences. This was one of the questions that I asked during my interview with Dr. Mary Ann Allison, a principal of the Allison Group and co-author of the book "The Complexity Advantage: How the Science of Complexity Can Help Your Business Achieve Peak Performance." According to her, there were a couple of main reasons why complexity has not had a greater impact among practitioners of social sciences. First, she shared her belief that people, including social scientists, do not generally think in abstract terms. However, in order for anyone to see the applicability of complexity to any social science,

they need to step back from the in-depth and detailed studies that they would normally be devoted to, and look at the broader picture of the science in question and the applicability of complexity to this picture. This alludes to a common notion circulating the scholarly world, and namely that scholars often get trapped in their respective fields of study, which narrows their horizons and views of the world. In order for one to be able to apply a new framework to any social science, they probably need to not be too entrenched into their particular field and have the open mind to adopt new perspectives.

Another reason for the rarity of complexity discussions in the social sciences that Dr. Allison discussed was the conservative peer review process. According to her, publishing works on accepted ideas is easier than publishing new theories and criticisms of old ones.

Despite the existing gap in scholarly literature on the topic, Dr. Allison shared her belief that not only can complexity provide and insightful mode of thinking for the study of world affairs, but it can also offer some broader wisdom about the times we live in today. It is her belief that the world is now developing faster than ever, innovations are appearing more often, and some people are lagging in their ability to adapt to those rapid changes. Thus, people in their respective societies are now, more than ever before, actual agents in complex adaptive systems. Their ability to self-organize and adapt to their environments is crucial to the survival of their systems/societies. They need to continuously adapt in order to avoid lagging behind and becoming obsolete. Thus, an understanding of this reality and the properties and qualities of complex adaptive systems can make it easier for people to accept and assume their new roles in this changing new world that surrounds them. The work of the Allison Group is an example of the successes of such a holistic approach. The Group conducts “research into the

nature of community and social change and works with businesses, governments, and NGOs to improve their capacity to generate positive results in rapidly-changing environments" (The Allison Group). Thus, they spread understanding about the applications of complex adaptive systems, and especially about the role of single agents in them. Dr. Allison shared her belief that once people internalize this idea, they become agents for change and spread the notion further.

In an attempt to do my part for spreading knowledge about complexity and initiate some scholarly work that will fix the existing gap in the literature, my paper has provided an initial overview of the main concepts of complexity and presented them in an organized manner. This is intended to facilitate the understanding of those concepts and makes their applications to the social sciences follow more logically from the theoretical backbone of complexity. My discussion of these applications has flown quite naturally. I did not have to stretch my thinking and understanding of complexity in order to explain world phenomena through its perspective. In other words, complexity science as a mode of thinking is a good fit for the study of international relations.

By providing a detailed demonstration of the applicability of complexity science to world politics, this paper has revealed the need for further exploration of the topic of complexity. As a new and somehow revolutionary mode of thinking, complexity science carries the potential to expand our knowledge and understanding of numerous social science fields. Therefore, the complexity framework should be introduced into the academia. When used as an approach to world politics and other social sciences, it can provide students of those subjects with an insightful alternative point of view and way of looking at the material.

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