States and the System as complex adaptive systems

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Version: 210317

ABSTRACT

Social systems - including states and the System - can be considered 'complex adaptive systems' (CAS), which process data with 'schemata', that inform these CAS about courses of action that support their survival changes. Regularities provide guidance to CAS. Regularities in the System arise from a combination of simple fundamental laws and the operation of change, which can produce 'frozen accidents'. Path dependence and lock-in (further) contribute to the magnification of regularities. Complex adaptive systems seem to function best in a régime intermediate between order and disorder.

complex adaptive systems | complexity | system | war | war dynamics | regularities | patterns | war cycles | finite-time singularity dynamic | froze accidents | evolution

SIGNIFICANCE STATEMENT

The discussion in this paper provides clues to better control and eventually prevent wars, thus averting suffering and destruction.

1. INTRODUCTION

Murray Gell-Mann (1) defines complex adaptive systems (CAS) as "systems that take in information - in the form of a data stream - and find perceived regularities in that stream, treating the rest of the material as random. Those regularities are compressed into a schema, which is employed to describe the world, predict its future to some extent, and to prescribe behavior for the complex adaptive system itself. The schema can undergo changes that produces variants, which compete with one another. How they fare in that competition depends on selection pressures, representing the feedback from the real world. Those pressures may reflect the accuracy of the descriptions and predictions or the extent to which the prescriptions lead to survival of the system."

In this paper, I discuss - based on Gell-Mann's observations - how the concept of 'complex adaptive systems' applies to the (International) System, and its typical dynamics.

2. DEFINITIONS AND METHODS

Humans, social systems - including states, and the System itself - can be considered complex adaptive systems, as well (2), I argue.

States continuously take in and process data from their environment, and interactions with other social systems. The data is 'processed' - made sense of - with the help of 'schemata', which are closely related to the state's interests and basic requirements; and are helpful in 'describing the world', as Gell-Mann argues.

The processing of data by a state, and the identification of regularities, result in 'situational awareness'. The schemata a state adopts, are not only helpful in describing the world, but also in prescribing behavior, - (possible) courses of action for the state, - to promote its interests and to ensure its fulfillment of basic requirements and its survival.
How states fare in their competition with other states can be considered the feedback Gell-Mann refers to, and is dependent on the selection pressures that 'apply to' the anarchistic international System.

Gell-Mann and others (3) (4) argue that "complex adaptive systems function best in a régime intermediate between order and disorder", a subject I also discuss in my research. On the one hand, complex adaptive systems can in such a régime "exploit the regularities provided by the approximate determinism" of (what Gell-Mann names) the quasi-classical domain, and on the other hand, "at the same time they profit from the indeterminacies" (so-called "noise', fluctuations, and random events (in case of the System), etc.), "which can be helpful in the search for 'better' schemata".

What actually are 'better' schemata for states, depends on the selection pressures that are operating in (and on) states and the System (a state's environment). The notion of 'better schemata' is related to the concept of 'fitness', but is a concept that is difficult to define in case of the states operating - surviving - in the System. Fitness in case of states is 'endogenous', and as Gell-Mann argues: "emerging from the vagaries of an evolutionary process that lacks any external criterion for success".

3. REGULARITIES AND 'FROZEN ACCIDENTS'

Gell-Mann explains that "a complex adaptive system discovers regularities in its incoming data stream by noticing that parts of the stream have features in common. The similarities are measured by what is called mutual information between the parts."

The four accelerating war cycles that can be identified in the war data (the dataset provided by Levy (4), and make up a 'finite-time singularity dynamic', are based on the mutual information contained in these four cycles.

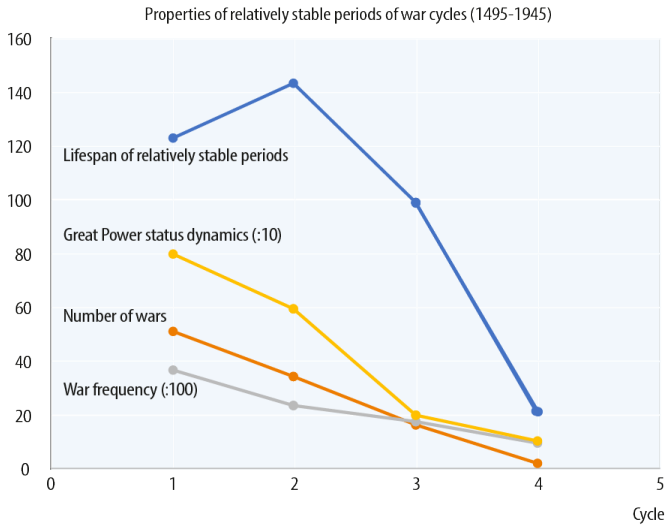

***Figure 1**: 'Mutual information' contained in four war cycles during the period 1495-1945 (6).*

"Regularities in the world arise from a combination of simple fundamental laws and the operation of change, which can produce frozen accidents". This is also the case for the regularities that arise in the war dynamics of the System: The war dynamics of the System and the regularities that can be identified are also produced by a combination of fundamental laws - which belong to what I name the 'deterministic domain' of the System - and the operation of change; the 'random' dynamics in the contingent domain of the System (more precise: contingent dynamics are the product of a 'combination' of deterministic laws and change) (2).

With '*frozen accidents'* Gell-Mann refers to "change events that turned out in a particular way, although they could have turned out differently, and produced a multiplicity of consequences. The common origin of all those consequences in an antecedent change event can give rise to a great deal of mutual information in a data stream."

Hitler's appointment as Chancellor of Germany in 1933, can be considered such a 'frozen accident' as defined by Gell-Mann, that produced a multiplicity of consequences, and 'regularities' in the *contingent* domain of the System.

Gell-Mann observes: "As time goes on, more and more frozen accidents, operating in conjunction with the fundamental laws, have produced regularities. Hence, complex systems

of higher and higher complexity tend to emerge with the passage of time through self-organization (1).” And “Not everything keeps increasing in complexity, however. Rather, the highest complexity to be found has a tendency to increase. In the case of complex adaptive systems, that tendency may be significantly strengthened by selection pressures that favor complexity.”

Our history - the process of (cultural) evolution - I argue, can be considered a more or less coherent collection of frozen incidents, that in conjunction fundamental laws, have produced a number of regularities, including the four accelerating war cycles that can be identified during the period 1495-1945.
The System has become increasingly complex over time: In case of the System, selection pressures have strengthened (social) structures that favor complexity, because of their ability to ensure the fulfillment of basic requirements and survival in the environment these structures (including states) must cope with (and are themselves integral parts of).

In the System, as I explain in my research (2)(6), there is - what is named - ‘path dependency’, a tendency of the System to reinforce certain ‘choices’ and developments, which resulted in a ‘lock-in’. The finite-time singularity dynamic, that was accompanied by four accelerating war cycles, was a highly - and increasingly - path dependent dynamic, that locked in (‘forced’ by physical laws) on the production of increasing amounts of tensions, and a need to implement upgraded orders, with an accelerating frequency, which eventually led to the European’s collapse in 1939; at that point the (European) System produced infinite amounts of tensions, and consequently experienced a phase transition (towards non-anarchistic structures in Europe, and the implementation of a first order at a global scale of the System).

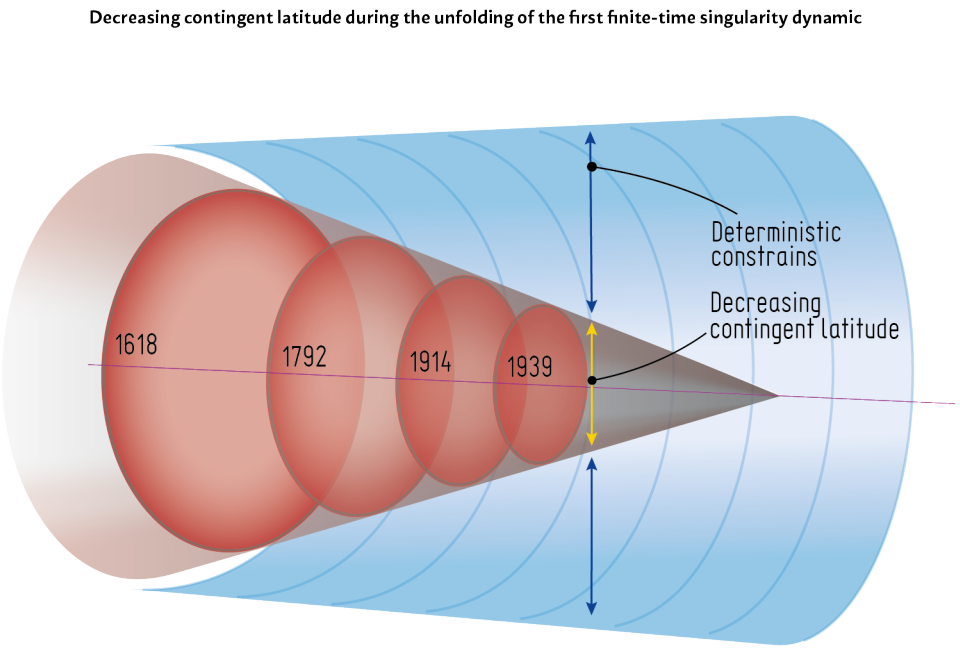

Figure 2: *This figure shows how the contingent latitude of the System - its ‘sensitivity’ for change events and accidents - decreased during the unfolding of the finite-time singularity dynamic (1495-1945). This ‘narrowing of options’ can be attributed to physical laws that apply to the System’s dynamics, and the increasing path dependent nature of the (war) dynamics of the System, and the resulting lock-in (2).*

4. THE SECOND LAW OF THERMODYNAMICS AND EVOLUTION

Gell-Mann also explains that the fact that "more and more complex forms of life" do not violate the second law of thermodynamics: Evolution can be considered what Gell-Mann explains, "informational entropy increase", as "living things" come into better adjustment with their surroundings, by reducing informational discrepancies (with their surroundings). These adjustments result in an overall increase in entropy.

Gell-Mann also explains that "When a complex adaptive system gives rise to a new kind of complex adaptive system, whether by aggregation or otherwise, that can be considered a gateway event." Gateway event Gell-Mann defines as breakthroughs "that open up whole new realms of possibility, sometimes involving higher levels of organization or higher types of function." Gateway events occurred in biological evolution, but also in the evolution of social systems, and opened up new levels of organization.

During the period 1495-1945, through an interactive - co-evolutionary - process in four stages (four cycles), the System 'simultaneously' produced states and successive 'intrusive' international orders, that merged during the fourth systemic war (the second World War, 1939-1945), when in 1939 the European System reached the critical connectivity threshold, produced infinite amounts of tensions, and consequently produced a phase transition. (Systemic wars can be considered 'forceful' adjustment of schemata of states, and the resulting international orders, the 'overlap' that could (at that stage) be accomplished.)

During this co-evolutionary process - which was driven by population growth and (increasing) rivalries between states - Europe (the System) evolved from a collection of circa 300 diverse and loosely connected social structures, with a total population of circa 83 million, into a highly connected anarchistic system, consisting of 25-30 standardized states with a population of circa 544 million. The standardization of social structures (in similar state structures) can (also) be attributed to the same selection pressures social systems and their populations had to cope with.

The 'merging' of states structures and the international order by means of the fourth systemic war (the Second World War, 1939-1945), is an example of an event - a gateway event, according to Gell-Mann - when complex adaptive systems (social systems, states) by means of aggregation give rise to a new complex adaptive system (an upgraded order).
This event - the phase transition 'as such' - is a direct consequence of the physical laws that apply to the System and its dynamics.
The resulting configuration (appearance of the international order) - the outcome, and the rule sets that apply to states - is shaped by the frozen accidents the System experienced during its (preceding) evolution, and how these frozen accidents were 'magnified' the path dependent nature of its dynamics and the resulting lock-in.

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