Anarchy and complexity

Philosophy

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This paper draws a philosophical parallel between the characteristics of anarchism with the sciences of complexity. The absence—αν, an—of a ruling principle—arche, άρχή—is the conditio sine qua non, it is claimed, for a further search for ground and fundament. The most basic features common to both anarchism and complexity are the absence or critique to control as well as the importance of self-organization. Embracing the theory of complexity inevitably leads towards the acceptance of anarchy. A spirit of anarchy pervades complexity science even if: a) it has not been explicitly thematized, or b) it has not been the explicit concern of researchers and scholars working in the field.

Introduction

The future is undetermined, and as Bohr once pointed out, predicting is difficult especially when it is about future. Contemporary world is characterized by a constant fluctuation of events, and increasing uncertainty—in many levels and domains, systems and layers of reality. As it has been said, societies witness an increase in the degrees of freedom—which, by and large, is a positive feature—whilst *experiencing transitions away from hierarchical control*[1]. This means that, increasingly, the world is becoming more and more unpredictable—at least by the means of the traditional models of classical science.

Nowadays, cutting-edge science is providing new mechanisms of explication for many types of social phenomena. The sciences of complexity are located within these sciences, and they are responsible for introducing more accurate and sophisticated models for understanding non-linearity and shed new lights on the understating and explanation of phenomena characterized by irreversibility, sudden changes, surprise, turbulence and fluctuations, for instance. To be sure, social interactions in human social systems are characterized by such features, particularly in the current non-zero sum world.

This paper argues that there is a strong conceptual and theoretical relationship between complexity and anarchism that has not been sufficiently seen and worked out in the literature about complexity. The claim is supported by four arguments, thus: firstly, complexity entails a scientific revolution, hence a radical shift in science. Such a scientific revolution can help manage complex human social systems. We do not dig into the rationale of the epistemology and history and philosophy of science but we focus on the implications of such a radical turn the complexity sciences entail. On this basis, the paper concentrates on the proper understanding of anarchism; this is the second section of the paper. Various explanations and levels are provided. Thirdly, the reasons supporting why complexity is, or leads to, anarchy are offered, that make clear the problematic stance of control when dealing with increasingly complex systems. Finally, the match is made the other way round as the paper shows why and how anarchy is seeded in complexity science, or also how the various features that characterize complexity can be taken up as features of anarchism. At end, several (open) conclusions are drawn.

Complexity as a scientific revolution: The language of complexity

By now, Kuhn's interpretation of the history of science in terms of scientific revolutions[2] is a common place. Kuhn was, as it has been pointed out, the right man in the right place. For, the understanding of science's march in terms of revolutions can be found in a number of authors more or less contemporary to Kuhn. Thus, [3,4,5], and a bit later also [6] conceive of the history of science is terms of disruption, lack of continuity, breakdowns, and radical critique, rather than in linear terms and as linear progress. Further on, Serres goes up to interpreting the history of science as the story of bifurcations—exactly in the sense as the concept is understood in the framework of complexity theory. Here, for the sake of brevity, we shall take for granted the entire discussion and justification of scientific revolutions. We just take them up in terms of their consequences and entailments for complexity science.

The sciences of complexity, openly or tacitly, are a scientific revolution[7,8,9]—a new science[10]. The very concept *the sciences of complexity* was donned early on at the Santa Fe Institute by the scientists, researchers and theoreticians devoted on the field meaning a radical shift *vis-à-vis* classical reductionist linear science.

The language of complexity encompasses concepts, behaviors and phenomena whose properties are, among others, nonlinearity, bifurcations, fractality, far-from-equilibrium behaviors, chaos and strange attractors, percolation and failure cascades, scale-free networks, degrees of freedom. Table 1 summarizes the language of complexity:

Indeed, a scientific revolution entails new forms of (social and knowledge) organization, new approaches, new rods, the use of metaphors, neologisms, and re-definitions[7]. It has been repeatedly pointed out that complex systems imply a sort of cultural and counter-intuitive character[77] throughout which new concepts are coined out whilst others that prevailed so far become useless and unnecessary.

Now, nonlinear behaviors as well as many of the concepts mentioned in table 1 are naturally endowed in political phenomena. Thus, the behavior of political agents, the evolution of political phenomena, and the cascading of political revolutions, for instance, are highly unpredictable. Public corruption travels and pervades a political organization thanks to informal complex networks of ties among public servants. Likewise, political decisions once applied over social systems usually produce irreversible outcomes. But so are economic dynamics too, as well as environmental processes and changes, for example. Such behavior can be grasped in terms of complexity theory as percolation. Like this, many other examples [78,79,80] that evidence the complexity of political phenomena can be mentioned. However, as our world became increasingly interconnected, only very recently such endowment begun to be evident[1].

A key concept in complexity theory is degrees of freedom. Originated within physics and mathematics [81] it refers to a system or behavior that loses rigidity, gains articulations and movement, and acquires flexibility either spatially or temporally. When the concept is transposed into politics and the social sciences it becomes highly suggestive. Thus, the complexity of a system corresponds to the degrees of freedom it has or exhibits. Social human systems have a large number of degrees of freedom that, however, are constrained or restricted by institutions that operate with centralized control. The structure and dynamics of those institutions have been identified as a tree topology[82,83]. Yet, a tree topology is quite different from complex networks — the structure of human social systems—precisely in the rigidity and low degrees of freedom it has. Such a structure encompasses links, clusters and hubs. Synchrony and bursting[64].

Concepts	Relevant references
Complex adaptive system	11,12
Far-from-equilibrium	13,14
Chaos	15,16,17,18
Edge of Chaos	19
Fractality	20,21
Scale-free networks	22,26,27
Small Worlds	28,29,22
Sudden changes and surprise	30,31,32
Catastrophes	33,34,35
Modeling and simulation	11,36,37,38,39,40,41,42,43
Percolation	44,45
Failure cascades	44
Non-Classical Logics	46,47,48
P vs NP problems	49
Nonlinearity	50,51
Bifurcations	52
Self-organization	13,53,54,55,56,57
Crisis	58,59,33,60
Randomness	61,62,63
Bursting	64,65
Adaptation	66,67
Emergence	68
Dissipative structures	13
Phase transition	52
Swarm intelligence	69
Complex systems engineering	70,71,72
Cooperation	73,74,75,76
Turbulence	10

Table 1 *The language of complexity*

Politically, the history of mankind can be seen as the imposition of order in a top-down fashion upon human social systems. Thus, order and norms, control and verticality, centralization and discipline have traditionally been considered as compulsory for the existence of human systems. The use of laws, normativity, and symbolic group tags—most notably anthems, flags and national dates, etc.—do fulfill a restrictive role, or if one wishes, a unitary and coherent one. Institutions in general artificially restrict the natural tendency towards self-organization and self-control that human social systems would present in the absence of these coercive institutions[82].

From a philosophical point of view, complexity can be seen as a sort of naturalization of the world and society. In general, over against physics that was the model or metaphor of modern science[84,85], biology and ecology have been taken as metaphors or models for highly complex systems. In this sense, according to Kauffman[86] the biosphere evolves as fast as it can, not faster or slower. This is very different from the way in which centralized institutions try to organize human social systems, by embracing the impossible task of regulating every possible human interaction, for instance via planning, strategies, goals, governmental or state policies, law, and the like. If so, the juridical laws and political normativity in their current form actually tend to block the harmonic evolution and adaptation of communities in the sociopolitical domain.

In contrast, complexity theory is teaching contemporary scientists that the best way to generate order in a complex system is by letting it self-organize in interaction with its environment. As a matter of fact, self-organization is a spontaneous behavior in complex systems, and the environment cannot be controlled. Self-organization, it appears, has been traditionally avoided in the history of social human systems, and diverse mechanisms have been developed to impede it. Thus, the idea of having leaders (in a strictly vertical sense) and governors dwindles in this scenario; top-down leaders become rulers, governors and commanders act as attractors that amplify negative feedbacks, as they inhibit the capacity of human social systems to generate their own adaptive order. Traditionally they have been called as "decision-makers", along with CEOs at the corporate level. In many cases, the idea of the need of governors is the direct responsible for conflicts at mezzo and micro-levels (in-between cities and the globe). Indeed, micro social systems, provided with a defined political view, see formalized positions of power as the only way to reach their power objectives. As a consequence, the configuration of political systems reinforces the traditional idea of power. In the end, nation-states and corporations stand out against the own existence and well-being of humans and nature because inflate the maneuverability of a few groups upon the latter, which while aiming at increasing this capacity, limit the self-organization of human and natural social systems by imposing top-down control.

Being as it might be, the sciences of complexity provide sound models and explanations for understanding, deal and harness the nonlinearity of complex systems. Hereafter, we argue, politics could turn to the sciences of complexity as guidelines in times of increasing unpredictability of society.

Within the framework of complexity science the need for centralized control seems to be unfruitful, needless or highly limited[87]. The same applies, a fortiori, for politics. Trying to achieve order in human social systems by turning to a centralized authority brings, as it happens, more disruption. Imposed or external mechanisms of organization usually perturb the harmonic self-organization of socio-political dynamics[82]. In this context the current and mainstreamed justification of governments, modern states and leadership faces big challenges.

An important question arises then, namely how can political organization solve the problem of organizing increasingly complex social systems? We believe the substantial relationship that exists between anarchism and complexity can provide a solution to this problem. Embracing complexity as a scientific problem rather than as a theoretical framework inevitably leads to the plausibility of anarchic political organization. However, the relationship goes both ways: the sciences of complexity are *stricto sensu*, sciences of the anarchic, in the sense that they deal with non-governable systems. In the following, arguments will be provided.

Anarchy re-visited

The standard traditional understanding of anarchy links the concept with anomy, disorder, lack of organization, and violence[88]. Moreover, anarchism has been generally biased as or in a political context. The truth is that such an understanding falls short and does a little favor to the concept. Philosophically, anarchy does not imply disorder, but order[89]—a specific type of order: a self-organized one that rises bottom-up[90]. Following this, anarchism points to the idea of self-government[91,92] and self-regulated systems without imposed or elected rulers[93]. Consequently, anarchy could even lead to peaceful sociopolitical interactions; being an undetermined space for politics, it goes against the idea of imposition via centralized and top-down, i.e., usually coercive, mechanisms to achieve order.

There is a long history as to the concept and practice of anarchy and it encompasses a worldview wherein freedom, autonomy and independence are brought out openly to the fore. More specifically, over struggle and competition, the spirit of anarchy has always entailed cooperation, solidarity and the absence of self-interest, the rejection of authority whatsoever. Without going into a historical panorama, without any doubt, in the history of anarchy stand out the *akrasía* in the ancient Greece, the poetry of W. Blake, the noble spirit vis-à-vis the poorer by Kropotkin, the educational philosophy of H. Read, or the spiritual writings of the late Tolstoy, to mention but only some inspiring sources. Indeed, along history, anarchy has been expressed or also adopted by a number of authors. Thus, for instance, [94], Bakunin[95], Proudhon[96], Kropotkin[97,98], among many others have made of anarchist ideas their own way of thinking and living. From a methodological point of view, Feyerabend [99] has argued in favor of a methodological anarchism. All in all, anarchy is not the opposite to organization, but only to hierarchy and power.

Anarchism has prevailed to some extent not only—and even not mainly, in politics, but also regarding the understanding of ecosystems, scientific method, economics, and art, among many fields. From a theoretical point of view, anarchy can be safely said as claiming for multiplicity, diversity, a criticism to monism in all its faces, and the absence of external constraints and restrictions. Now, such pluralism is one of the salient features of complexity, according to [100]. On the social scale, anarchy has always been matched with mutual-aid, cooperation, solidarity over against prevailing powers at every place and moment. Most notably, [101] have considered how cooperation is possible under anarchy. Furthermore, the complexity of cooperation—particularly in solving the Prisoner's Dilemma—has been worked out and to a large extent solved by [74] on a simulated (agent-based) model.

Table 2 shows a general panorama of the fields and domains where anarchy has effectively existed so far.

Anarchy emerges as a concept and practice particularly in times and contexts of crisis, namely when steady order breaks down and turbulence and instability emerge; in other words, it appears when institutions and the establishment cannot cope with complexity. Nonetheless, it should be clearly pointed out that anarchy has nothing to do with messing up things—noise, arbitrariness. From a technical point of view, anarchy is about a radical critique to algorithmic systems and behaviors.

Economy	[102,97,103,104]
Art	[105]
Ecosystems and Nature	[106,107]
Politics	[108,109,95,97,110,111,112,113,114]
Philosophy	[115]
Poetry	[116]
Archaeology	[117]
Social Movements	[118]
Sexual Liberation	[119]
Religion	[120]
Anthropology	[91]
Education	[121]

Table 2 *Anarchist theories and fields*

There are three main ways of organization for structuring and organizing a society, namely hierarchies, heterarchies and anarchies. Hierarchies entail tree topologies, pyramidal, rigid, vertical, political regimes, centralized control and Turing-like decision-making processes. Hierarchies can easily be explained as linear, i.e., sequential structures and as law-like dynamics. By and large they are the predominant standard view of human history, particularly when seen from the standpoint of the western civilization. A critique to the topology and architecture of these pyramidal control systems has been considered by [82].

In contrast, in heterarchies power is distributed horizontally[122]. A conspicuous historical example of a heterarchical systems is the Incaic history in ancient Peru[123] or also the Tayronas, Muiscas, and Sinú cultures in pre-Columbian history[124]. Whereas hierarchies can be said to be uniform in history, heterarchies can differ greatly from one another, since they obey particular characteristics of the community where they exist. Paradoxically, heterarchies were present during most of the history of human societies, although they were not properly seen by the official history in the west. Ubiquitous throughout the world in indigenous societies, some even survive to-date[125,126]. The western world has been possible at the cost of stealing other peoples and cultures history and tradition, as Goody[127] has argued.

As to anarchies, they have only existed at the level of local communities and as alternatives to the current *Zeitgeist* in a given period. From a theoretical point of view, anarchy, we claim, shares the spirit of complexity science, since the bottom-line is about gaining degrees of freedom. Indeed, a complex system has been defined as a system that: a) either has (a large) degrees of freedom, or b) gains degrees of freedom—so much so that the more degrees of freedom a system exhibits the more complex it is. From a social, economic, and political standpoint, the contrary becomes more than evident, namely if and when any given system loses degrees of freedom its complexity decreases. The crux here is that complexity science is about *increasingly* complex systems. To be sure, among all the possible political systems anarchy could be seen, or is, as the most complex.

The idea of control has been systematically and deeply grounded along the history of the western civilization. From this point of view, the claim for anarchy may sound counter-intuitive. Axelrod and Cohen have argued about the need and feasibility of *harnessing complexity*[128] which can be taken as understanding, working with, and living in and with complex phenomena, instead of just rejecting or manipulating them. On a different track, Taleb[60] argues in favor of anti-fragile systems and thinking, meaning the capacity to evolve and adapt, in other words change.

To be sure, there is no one only form of anarchism. Etymologically, its origins bases upon the assumption of the absence—*an (άν)*, which means *no*- of a ruling principle—arche (*άρχή)*. As such the concept was coined in the archaic Greece, i.e., before the transition to democracy and the outset of the western civilization in the classical Greece. In its vulgar or popular sense, anarchy has been traditionally taken as disorder, chaos, anomy, and lack of any kind of organization. Such an understanding is, however, mistaken.

Indeed, *an-archy* is the condition for a further search for principles and rules and it reveals, moreover, as the *conditio sine qua non* to any possible life and organization to be. In other words, it is the autonomy, the freedom, the independence that allows for higher or better horizons, dynamics and structures. Anarchy, it appears, is the very seed and proper name for freedom, autonomy and cooperation.

Mainstream political theories work as lenses through which every sociopolitical interaction is measured and standardized. These lenses advocate for a single, and moreover, a unique way for doing politics. Liberalism, most notably, implies that representative democracy is the best way to validate sociopolitical interactions, and that the latter should be subdued to a higher level structure called the rule of law. From a philosophical take, democracy seems to be the only reasonable way in the story of western civilization.

On the other side, in his critique to capitalism Marxism Bakunin proposed the dictatorship of the proletariat while holding the same tree topology of its counterpart because he was aware of how the ideal of the supremacy of the proletariat would still hold the existence of a closed group of people—sort of aristocracy[110]. The communist system as claimed by Marxists would seek and maintain more power and means, essentially preserving thus the traditional structure of a vertical and hierarchic society and history. The despotism of the closed unique party of the Bolsheviks on top of the Soviet Union and other countries for decades helped enhance this idea. Originally and paradoxically, the Bolsheviks emerged from self-organized assemblies of workers called the *soviets*. Despite the desire of the soviets of pursuing equality in society, it was Lenin and his party who centralized the authority and managed thus to manipulate and deviate a spirit that was essentially anarchic, i.e., self-organized [129].

Since Bakunin's time, the situation has not changed dramatically—for most countries are still ruled by closed aristocracies—with a variety of names: corporatism, aristocracy, institutionalism and neo-institutionalism, etc. Nevertheless, such artificial way of trying to achieve order in human society contrasts with the complexity that characterizes its interactions and the organicity that is present in its dynamics.

Being as it might be, traditional political systems focus on control—top-down control, specifically—, on the idea of hierarchies and on pyramidal, rigid, vertical, closed and static structures and norms. A worldview with centered, hierarchical and rigid organization corresponds to the anthropocentric view of the universe. In such a worldview, nature is conceived and justified as a means for the needs and wants of mankind. The anthropocentric view of nature corresponds to the junction of Athens, Jerusalem, and Rome—the outset of the western civilization.

A vertical and pyramidal interpretation and organization of the world and nature was reinforced early on with the importance of algorithm, namely rules, norms and recipes for the world to be possible. Thus, law and the legal system came to play a fundamental role, all of which artificially blocks the natural tendency to self-organize that human social systems, as every other complex system, present in the absence of top-down and centralized control. Nature was entirely explained and managed as a law-like phenomenon. As such, law parameterizes and defines, constraints and limits while pretending to liberate and free.

Over against hierarchies, power and control, the idea of cooperation and self-organization can be adequately seen as the rationale of and for anarchy. Indeed, an anarchic, i.e., self-organized system is the one where networks and interaction play an up most fundamental role. Cooperation, thus, entails horizontality, parallelism, the absence of a rigid center. Kropotkin, reading up from Darwin, argued in favor of a networked society based upon mutual aid [97]. In other words, ethics and compassion, solidarity and friendship, trust and giving are to be seen as the ground for a truly humane society—instead of interest and self-interest, authority and profit, competition and predation, for instance.

A remark here is necessary. Various anarchic movements can be seen in history, from religious (Cathars) to political (Russia, Italy or Spain), from artistic (surrealism) to economic (self-managing movements) or philosophical (such as pantheism) and always as local experiences. In fact, when looking at historical anarchic organizations the relatively triumphant experiences of anarchic social movements pertain to a zero-sum world. Now, since we have come to live in a non-zero-sum world, the possible history of anarchism toward future entails far more complex considerations that remain out of the scope of this paper. Here we restrict ourselves, for reasons of space, to a conceptual level. Complexity science can be safely said to be the kind of science in and for a non-zero sum world.

Why complexity is anarchic

The sciences of complexity are sciences of the anarchic in the sense it has been argued above. There is, as it happens, no one definition for complexity [130]; for a reply to Horgan's article, see M. Mitchell's http://tuvalu.santafe.edu/~jpc/SciAm-Public.html). Increasingly complex systems have been said to be non-linear [51], adaptive[66], open, far-from-equilibrium [13] or on the edge of chaos[131], synthetized bottom-up [68] non-algorithmic[132,133]—among many other features or properties.

The sciences of complexity are made up by a number of sciences (such as chaos [15], non-equilibrium thermodynamics[14], complex networks [28]), a number of theories (catastrophe theory[33], self-organization [57], turbulence[10]), approaches (first and second phase transition order [134], swarm intelligence [135]), methods (modeling and simulation [40,74], metaheuristics [43]), concepts (percolation [44], failure cascades[44], adaptation [66] and learning), problems (P versus NP problems [136], optimization[137], crises [59], randomization [61])—to name but a few.

There is no such a thing as a superior approach for understanding complex systems, phenomena or behaviors, very much as there is not supremacy of method, either. One of the great merits of complex theory has been showing and proving that there are only open systems—for closed or isolated systems are either abstractions or experimental or theoretical restraints.

From a negative standpoint, there is no one single method, language, approach, discipline, rod, or even science that defines the entire set of the sciences of complexity. Moreover, there is no a unique answer to questions such as: what is a complex system? Or, how does a system become complex? A correct understanding of increasingly complex systems is rather reluctant to classical approaches that are deterministic and reductionist. Notoriously, in the framework of complexity science parameterization, linearization, isolation of systems and phenomena, for example, become not only unfruitful but artificial and unnecessary. In contrast, a salient feature of complexity can be taken to be multiplicity and plurality, diversity and alterity. If complexity sciences have been said to be cross-disciplinary or interdisciplinary, they are then characterized by a manifold of theories, concepts, tools, rods, and approaches.

To be sure, complexity theory entails a philosophy of movement. However, unlike modern science in general, complexity science does not focus on regular, periodic, cyclic movement. Such is, indeed, the concern of classical mechanics, which identifies and explains regular movements in terms of law-like phenomena, and as pendulum oscillations. In fact, the concept used from Galileo to Newton to express such kind of movement is "revolution", namely "orbits", "periods". In contrast, complexity science focuses on sudden, unpredictable, irregular, aperiodic, irreversible movement. It is exactly this type of movement that is explained by the concepts and rods mentioned above.

Classical science is science of control and prediction, the prevalence of causality, determinism and reductionism[32,138], and normal distributions. In contrast, the sciences of complexity concentrate on power laws, emergence, surprise, order through fluctuation, among others. The concept of degrees of freedom is central to the understanding of complex phenomena. Modeling and simulation allow working with counter-intuitive relations, bursting and networks, and the Hilbert space is useful in this context. More radically, complex systems are non-algorithmic[139,140]. The political consequences of complexity science have been highlighted by [141].

We would like to suggest that complexity science is not just about explaining and understanding non-linear, self-organized and emergent phenomena and systems. Additionally, it is additionally about complexifying systems, behaviors and phenomena.

Let us focus on the concept of degrees of freedom. Anarchist thinkers in general have argued in favor of a complexification of phenomena exactly in terms of increasing degrees of freedom, even though many of them may have not used the technical expression. A spirit of anarchy pervades complexity science even if: a) it has not been explicitly thematized, or b) it has not been the explicit concern of researchers and scholars working in the field. A system or behavior that gains degrees of freedom is said to be of increasing complexity, and nonlinearity serves as an adequate expression, for we are forced to work with the n solutions the system has, simultaneously, i.e., without maximizing, choosing, or selecting a particular solution from the set available in and by the system.

We would like to stress this point: complexity theory is about both understanding and explaining phenomena whose behavior entails gaining degrees of freedom, and striving to enhance or produce (harness) increasing complexity in the world. Thus, sooner than later the concept that emerges along with degrees of freedom is randomness. According to Kolmogorov[61] and Chaitin[62] a complex system is ultimately a random one.

Besides, one of the key concepts in complexity science is bifurcation. A bifurcation is the change of the history of a given phenomenon, or also a qualitative change of a system. Bifurcations take place via two main roads, so to speak, thus: as first order phase transition or second order phase transition[134]. Hence after, bifurcations go hand in hand with non-linearity and, as a consequence, the system under consideration gains degrees of freedom. Such a process can be literally said as the very process through which the system liberates from control and rigidity.

In other words, as complex systems increase their degrees of freedom via bifurcations, they are pushed to the edge of chaos and become less feasible to be controlled. In the study of living beings, it has been argued that evolution [54,142,143] leads the systems—from the cell to the biosphere—to the edge of chaos. Thus, complexity sciences study systems, phenomena and behaviors of anarchic nature. Organization, structure and dynamics that are the result of self-organized interactions do not follow any teleological end. It is important to recall that anarchy does not imply a lack or absence of organization, at all. Anarchy is that kind of organization: a) that emerges bottom-up and is linked and supported by local interactions; b) that both allows and is the outcome of increasing degrees of freedom.

There is, as it happens, a positive feedback loop between self-organization and anarchy. Now, vis-à-vis a controlled movement, emergence and self-organization could be taken, particularly in the framework of human society as (symptoms of) crises or as a disruption. Pyramidal powers have since ever feared emergence, self-organization, increasing degrees of freedom, sudden and unpredictable change. We strongly suggest that systems science and not complexity sciences are much more suitable to established powers and control.

How complexity pervades anarchy

Along the way as there is not one single definition of anarchy, in the same tenure, there is no a unique definition for complexity. Complexity just like anarchy lacks any—singular or fundamental—ruling principle. Notwithstanding, both, anarchy and complexity share almost the same guidelines, so much so that it is plausible to state that complexity, as a scientific problem, and the sciences of complexity that deal with it, are sciences of the anarchic, i.e., of those systems characterized by increasing degrees of freedom, self-organized and even in self-organized criticality, non-algorithmic.

Several authors have argued in favor of understanding complexity science vis-à-vis the most complex systems known to-date, life, i.e., living beings. Thus, besides gaining degrees of freedom, complexity is about life. According to [144], in a political context, life can only become possible in social spaces that allow far-from-equilibrium interactions among individuals, which can only take place beyond the constraints of institutions, and far from a Newtonian-based language in politics focused on the concepts of force, power and law, mass, action-reaction, for instance. In other words, an increasingly complexifying world can only evolve in harmony if its environment admits increases in degrees of freedom—evolution, adaptation and learning. Table 3 evidences the later features in anarchy and contrasts them with traditional political systems.

Attributes	Anarchy	(Centralized) Political Systems
Order by means of	Self-Organization	Imposed Normativity
Information Processing	Bottom-Up Interactive Decentralized	Top-Down Algorithmic-like A central (unit) processor
Topology Distribution of power Composition of the networks	Complex networks Nested heterarchies Heterogeneous	Tree topology Hierarchical Homogenized
Evolution via Structure Nature of crisis	Adaptation and learning Antifragile Unpredictable	Reforms Robust/Fragile Predictable
Outcomes of crisis Tools for decision-making processes Future dynamics	Learning Local consensus, metaheuristics, modeling and simulation Autonomy, freedom, autarchy	Dwindling Deliberation processes in closed and isolated political regimes Control and manipulation
Relation with Nature	Harmonic	Exploitation, Predatory

Tabel 3 *Attributes of political systems*

Correspondingly, anarchic political organizations are highly complex arrangements. Complexity science and anarchism share a common salient feature, namely naturalization of the world and of epistemology. Nature, it has been said, works in parallel, and does not put all eggs in one and the same basket—and plays (kicks off) with the basket. Naturalizing society, i.e., the social organization of human beings is a claim that either nurtures from anthropology and history, or also from biology, ecology and evolution theory. It can be said that nature's topology is a flexible and adaptive one, essentially open and ever-learning.

Because anarchic political organizations arise from local, i.e., self-organized, interactions, groups of individuals in anarchism would probably follow preferential attachment formation processes. The resulting political structure in anarchism would thus become a complex network [82] in the sense precisely as complex networks have been studied and characterized in the literature.

Since imposed order is opposite to anarchism, anarchies are propitious for self-organization and diversity to flourish. It is generally thought that centralized control and vertical structures are necessary to rule human societies. However, there are many successful examples [104] of self-organization and non-centralized dynamics as the best way to organize complex systems. Life in general, a self-organized phenomenon, is probably the best example.

There is indeed a strong correlation between self-organization and surprise [145]. Self-organized behaviors or phenomena result in emergent properties that cannot be directly traced back to the sum of the properties or systems from where they emerged. Self-organized systems are incredible innovating, as they are constantly adapting to fluctuations in the environment and within them. Most of time, such fluctuations are unpredictable, whence self-organization becomes the best way to deal with surprises.

Reasonably, human social systems can share the same topology, i.e., architecture as nature. Harnessing complexity and complexifying phenomena provide a further rationale for and around complex systems. Anarchy would indeed be feasible to be described with properties of complex systems, such as openness, learning, evolution, adaptation, self-organization, among others. Anarchic systems of decisions would be self-organized, decisions would be synthetized bottom-up, and information processing would be interactive.

Concluding remarks

We have argued in favor of anarchy and claimed that the sciences of complexity share a common wave-length, so to speak, with an *an-archic* spirit. Anarchy entails cooperation and solidarity over against violent powers and has been historically a response or space for freedom, autonomy and independence, rooting in or emerging from self-organization. It can be safely said that the history of hierarchical systems corresponds with, and is a cause of, violence in human history. The basic reason is that generally they only know and care about themselves. One aspect for embracing the sciences of complexity when theorizing about political organization is that complexity science allows highlighting harmony as stated by [146]. A tacit till-now relationship between anarchy and complexity theory can hereafter become an explicit issue for the community of complexologists. The issue encompasses the human scale and the understanding of nature, as well as epistemological assumptions that have not been explicitly thematized, so far.

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