Systemic Risk: The Threat to Societal Diversity and Coherence

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Insights from complexity science can be applied to the analysis of social processes in heterogeneous societies. Many features that characterize and influence complex structures in nearly every domain of nature, technology, and society can be derived from simple modeling processes in physics and chemistry. If one applies these features to the structure of social risks, a number of insights are gained that can be subject to further empirical analysis. In particular, they add—to the well-known steering mechanisms of hierarchy, competition, and cooperation—the contribution of self-organization, the effect of which is underestimated in almost all theories of social science. But in view of the crises facing modern democracy, such as migration and populism, it is precisely this mechanism of dynamic structure generation that is decisive for an effective and fair risk governance. In this article, we analyze the threat to societal diversity and coherence on the basis of complexity science.

KEY WORDS: Applying insights from complexity research to sociopolitical questions; cohesion; integration; migration; patterns of societal orders

1. INTRODUCTION

Societies are complex systems. Therefore, processes of societal change can only be understood if they are considered as dynamic processes of structure generation in interconnected environments. In this article, we discuss the societal change that has been triggered by contemporary global transformation processes, with special focus on the systemic risks they entail. In this context, we build on insights and instruments from complexity science (see in this volume: Klaus Lucas *Theory of Systemic Risks*) and fo-

cus on the risks that threaten the existence of societal coherence and integration of plurality and diversity.

The concept of systemic risks has so far only been rarely applied to questions regarding political and social cohesion (exceptions are Baumgartner, 2006; Underdal, 2009; Kambhu, Weidman, & Krishnan, 2007). To us, combining insights from complexity research with conceptual considerations from the debate on systemic risks appears to be a new yet fruitful approach to better understand current processes of integration and disintegration of democratic societies and to learn lessons for the political shaping of processes of integration. How do people and societies deal with complex situations in their social environment and how can we learn something about the basic characteristics of complex systems from the insights gained in complexity science? And how can we apply that knowledge to the systemic risks of the loss of societal diversity as well as social disintegration?

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2. SOCIETIES UNDERGOING CHANGE

2.1. Globally Effective Transformations

The world we live in today is characterized by rapid change. Anyone who has lived during the mid-20th-century, for example, would find life surely difficult today. The Internet, computer, mobility, communication, robots are only few of the modern side effects of this change. Beyond technological changes the world faces major ecological challenges such as climate change or loss of biodiversity, economic crises, and social tensions, including increase of inequality with respect to access to basic resources, and threats to democratic governance by authoritarian, populist movements across the world (Keys, Galaz, & Dyer, 2019; McIntyre, 2018; World Economic Forum, 2020)

The developments in politics, society and economy are in our opinion currently determined by three large, globally effective transformations, namely (Renn, 2019):

- Globalization,
- Digitalization, and
- Sustainabilization

These three waves of transformations run parallel to each other and reflect social changes that are actively pursued by powerful actors in society. Although almost all countries have programs and policies to support and design but also regulate these transformations, they are often perceived as changes that do not allow those affected by the consequences to be agents or co-designers of their livelihood (Guryanova, Smotrova, Makhovikov, Koychubaev, 2019; Helbig, 2013). Furthermore, these three waves of transformation evoke breaks and contradictions in themselves as well as among each other. They pose risks for society that can be described as threatening its coherence and diversity.

This is particularly obvious in the case of globalization. In increasingly large parts of society, we currently witness strong counter movements advocating nationalization, revival of national and ethnically defined independence and protectionist trade policies (Stanziani, 2018). At the same time, there is significant erosion of trust in the societal institutions, especially the democratic pillars of parliaments, political parties, and the judicial sector (Foster & Frieden, 2017). Political fatigue, increasing popularity of populist movements, and societal polarization are threats

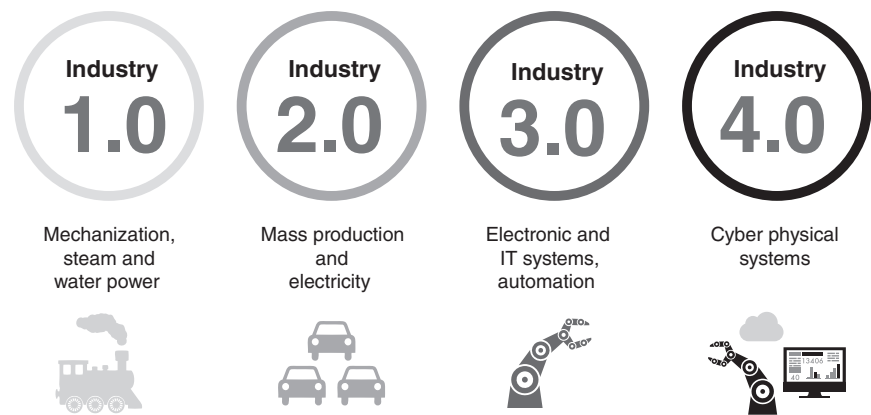to societal diversity and coherence that are already visible.

The second large issue is digitalization. Three "A"s are of particular importance in the context of digitalization: automation, algorithmization, and autonomization. Automation has shaped industry already for decades but reaches a new kind of quality today. Algorithmization refers particularly to "artificial intelligence," which develops independent logics of behavior on the basis of algorithms and translates them into independent decisions. Systems increasingly communicate with each other autonomously, make decisions and thus carry out actions as independent systems. The evolution of these processes in industry is depicted in Fig. 1.

In digitalization, one can also observe conflicts, breaks, and risks that pose a threat to societal cohesion. Part of society benefits from high gains in comfort and efficiency while another part suffers from limitations of personal freedom and identity (Floridi, 2018). Furthermore, digitalization, in particular, the social media, can limit autonomy of the individual user, condition his or her behavior toward standardized behavioral patterns, including cyber-addiction, threatens personal privacy, and promote a lack of accountability (Zuboff, 2019)[1]. Cyber risks threaten to melt down entire functions of society. Also, the potential abuse of power and loss of human control by an increasing algorithmization are some of the systemic risks resulting from digitalization (Kamolov, 2017). At the same time, digitalized processes provide the opportunity to strengthen democratic structures (transparency, easier access to political participation, e-democracy) but also pose the threat of weakening them significantly (bots, latent manipulation, echo chambers). Digitalization usually has a positive effect on globalization (and vice versa) but can also provide effective instruments to create and strengthen regional, sectoral, and political niches. Here, too, breaks and conflicts are inevitable.

The third global transformation process is "sustainabilization." This is about bringing sustainable principles and developments into the realms of politics, economy, and societal behavior. Similar to digitalization, there are also breaks, contradictions and many connected risks in this context (WBGU, 2011).

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[1]This topic is the main point in the 2020 documentary: the Social Dilemma. See: https://theconversation.com/netflixs-the-social-dilemma-highlights-the-problem-with-social-media-but-whats-the-solution-147351

Fig 1. The evolution of IT's permeation of industry: from industry 1.0–4.0.
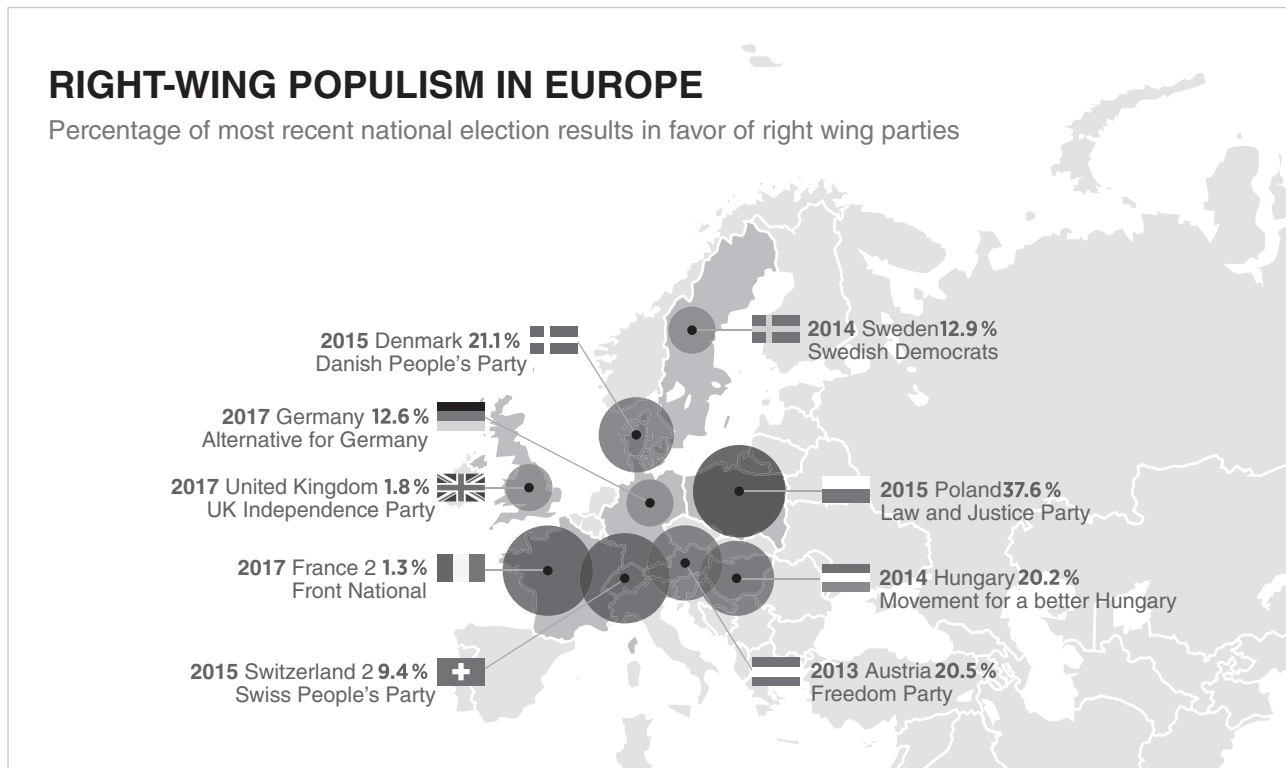

Fig 2. Overview of the UN sustainable development goals.

The United Nations has formulated mandatory goals for international and global politics by passing the sustainable development goals (SDGs; see Fig. 2), which in themselves contain many contradictions (Turker, 2018).

While many of the goals of sustainabilization are shared by all actors globally, such as reduction of poverty or climate protection, other objectives, such as a growing economy, are highly controversial. The traditional distinction between ecological, economic, and social sustainability obscures the emerging conflicting goals of the three dimensions along with their potential for social division. What is seen as sustainable (e.g., fighting poverty) is not necessarily sustainable in an ecological sense. Digitalization can support sustainability (e.g., by intelligent grids) but also hinder it (e.g., by promoting packaging and transport of goods via Internet trade). The same is true for the relationship between sustainability and globalization: on the one hand, sustainability benefits from global norms and standards (e.g., of the World Trade Organization or the International Organization for Standardization), on the other hand, principles of sustainability are violated as a result of globalization (e.g., ecological overexploitation or social inequality). The implementation of sustainabilization itself is connected to many systemic risks: will it, for example, be possible to largely decarbonize the energy

RIGHT-WING POPULISM IN EUROPE

Percentage of most recent national election results in favor of right wing parties

2015 Denmark **21.1 %**
Danish People's Party

2017 Germany **12.6 %**
Alternative for Germany

2017 United Kingdom **1.8 %**
UK Independence Party

2017 France 2 **1.3 %**
Front National

2015 Switzerland 2 **9.4 %**
Swiss People's Party

2014 Sweden **12.9 %**
Swedish Democrats

2015 Poland **37.6 %**
Law and Justice Party

2014 Hungary **20.2 %**
Movement for a better Hungary

2013 Austria **20.5 %**
Freedom Party

Fig 3. Votes for right-wing populist parties in EU member states.

system without endangering societal well-being and social cohesion?

The above-described transformation processes necessarily set societal processes into motion by which societies adapt to their self-created and new living conditions. The risks associated with these processes of adaptation, especially the threat to societal diversity and coherence, fulfill all of the characteristics of systemic risks presented in the introductory chapter of this issue: they are complex, interconnected, and stochastic in the relationships between drivers and consequences, and to a strong degree nonlinear with tipping points. In general, they bear the risk of an entire system collapsing due to mechanisms of dissemination of initially local events (Lucas, Renn, Jaeger, & Yang, 2018). For example, starting with a local event, the public opinion of parts of society can suddenly and unexpectedly tip in one direction or another, the result being a dramatic redirection of society. The recent success of political parties that have not even existed five years ago, along with the demise of established parties in many European countries (Greece, France, and Italy), is evidence that relatively stable conditions

can collapse out of the blue or even be turned upside down. Fig. 3 provides an overview of the increase of populist parties in Europe.

2.2. Different Visions of Society

In the context of the societal change that has been triggered by these transformations, many individuals have reacted with confusion and a feeling of insecurity and unease (Sarraf, Woodley of Menie, Michael, & Feltham, 2019). Increased uncertainties about future developments triggered, on one hand, the perception of increased opportunities for economic, cultural, and social development and, on the other hand, feelings of anxiety and discontent with the rapid transformations (Blühdorn, 2014). Out of the plurality of coping and adaptation mechanisms, two are particularly prominent as they embody the extremes of a spectrum between a vision of society as a homogenous, value-preserving entity versus society as an open, vibrant, and dynamic structure of continuous change and adaptation (Fraser, 2017).

The first vision of society corresponds to the ideal of a homogenous society, globalization is strongly

Fig 4. Demonstration against refugees.

restricted and replaced by an intentionally national policy of isolationism. Openness, be it toward people or simply ideas, is met with skepticism and prevented if necessary. Digitalization is tolerated as long as it serves the national competitiveness and simplifies communication. Instead of an obligation toward sustainability, global threats to the environment are considered less relevant and sacrificed for national interests. This initial reaction to the three big transformations is characterized by concepts such as nation, isolation with regard to foreigners, return to traditional values, and a focus on the own culture. This model of society is associated with efficiency, security, reliability, civil wellbeing, and prosperity, not only by its supporters from the right-wing populist milieu but also by a lot of people in the middle of society. For advocates of the homogenous society, a model of society that is characterized by diversity and plurality is associated with chaos, insecurity, fear of foreign infiltration, and loss of welfare (Schoen & Garvas, 2019). And they clearly express these fears in public demonstrations (see Fig. 4).

The second vision of society is characterized by the idea of a pluralistic society. Globalization is understood as a big opportunity of modernization for everybody. Digitalization is helpful in organizing and efficiently ordering the complex interactions in a global space, and the rules of sustainability ensure that these developments are in accordance with the limited amount of natural resources, space for economic development, and within the framework of hu-

mane living conditions for current and future generations (Schlenker & Blatter, 2016). In particular, this vision embraces technological and social innovations as a means to adapt society to changing natural, social, and cultural conditions. Keywords are diversity in view of ethnic heritage and culture, religious and sexual orientation, also toward minorities, openmindedness for permanent change and innovations, tolerance, and awareness with regard to sustainability. The idea of a pluralistic society assumes that diversity and plurality enhance societal life and that a global openness toward migrants as well as new ideas, lifestyles, and worldviews improves the cultural and social quality of a life together.

Both concepts of society are currently competing in the democratic decision-making process and play a prominent role in the political discourses of many nations (McCoy, Rahman, & Somer, 2018). Between these two extremes, there are, of course, many other positions. Just as there are contradictions and inconsistencies within the transformations, the followers of each of the two models of society are divided on many issues and by no means share the same opinion on everything. In the current situation, however, one can increasingly distinguish between these two polarized camps. For example, a high degree of polarization can currently be observed in the United States (Graham & Svolik, 2020; Smith & Mayer, 2019). Supporters of one concept reject the followers of the other side emotionally and ideologically, sometimes even aggressively (Iyengar, Sood, &

Lelkes, 2012). Conflicts occasionally erupt into violence on the streets. Yet, both are initially variations that can be taken seriously, with different opportunities and risks which may fit different societies.

It has been empirically proven that in societies that are highly developed with regard to economy, culture, and civilization, the pluralistic model of society prevails in the course of a natural evolutionary process. There are different reasons for this that have to do with the specific characteristics of pluralistic societies, and which can be understood in the framework of complexity science (Mitchell, 2004). These even go as far as counterintuitive phenomena. For example, a larger diversity in opinions on one issue can improve the quality of a decision, even if seemingly unqualified opinions are taken into account as well. In complex situations, diversity is often more decisive for success than the involvement of a limited number of experts even though this contradicts intuition. Dealing with different opinions, cultures, and traditions overall leads to a process of optimization that cannot be replaced by any individual expert (Helbing, 2015). Therefore, the diverse society is basically the more flexible and stable model of a modern society.

However, this pluralistic form of society with its diversity and coherence is being threatened by the globally effective processes of transformation that interact with the evolution of the models of society. Diversity is too simple a slogan to gain a better understanding of the opportunities and risks that are associated with diversity and pluralism. To understand this on the basis of complexity science and to develop adequate governance measures to control the respective systemic risks, it is necessary to consider the main characteristics of complex systems.

3. CHARACTERISTICS OF COMPLEX SYSTEMS AND APPLICATION TO SOCIAL PROCESSES

3.1.   Basic Features

One basic characteristic of complex systems is their openness. They interact with their environment beyond their system boundaries. This interaction involves matter, energy, and information, and the environment is included in these processes of interaction as well. On the one hand, disruptions can be transported across system boundaries and destabilize the system. On the other hand, adequate governance mechanisms can be brought in from the outside and counteract the internal stress.

The dynamic structures generated in complex systems result from the characteristics of and interactions between elementary effect sizes, the so-called agents of a system. These interactions are nonlinear. As a consequence, small causes can show unexpectedly large effects, and the dynamics of the entire system cannot be derived from the dynamics of its components. The development of a system over time is thus difficult to predict, partly counterintuitive, and bears hardly calculable risks for its future.

The emergence of macroscopic structures from a chaotic number of elementary interactions is due to selection through competition. In this context, the macroscopic patterns, the so-called modes, produced by the agents' actions react in a way that the respective pattern is strengthened selectively and thus the macroscopic structure is stabilized. This so-called circular causality is constitutive for the dynamic structure formation and can be observed in all domains.

Dynamic structure formations in complex systems are the result of leaps and continuous processes that are characterized by path dependency and historicity. At first, the system develops gradually under continuous change of external and internal parameters until it reaches an unstable condition when exceeding threshold values. This unstable condition can lead to sudden leaps—so-called phase transitions—by which the system enters a new state. The dynamic development is in the long-term path-dependent in an unpredictable way, thus dependent on the previous history of the respective system.

Unstable system states in complex systems are announced by early warning indicators. In general, complex dynamic systems become unstable when the interactions between their elements are stronger than the friction effects or when damage of individual components of the system occurs more rapidly than repairing it is possible. Aside from that, delayed processes of adaptation can also cause instability. The respective parameters formally put promoting and hindering factors in a dimensionless relationship.

In unstable conditions, small fluctuations, which would not have any consequences in stable system states, would suffice to transform a system into a new state. In the sense of the socially desired development this entails an unexpected and dangerous sensitivity that is addressed in chaotic systems with

the well-known butterfly effect.[2] Moreover, different time scales become visible during this process: a slow approach to an unstable state unexpectedly and suddenly results in a turnover of the entire system.

Complex systems and dynamic structure formations do have emergent characteristics, that is, the ability to create structures in the process of self-organization, which cannot be explained by the isolated behavior of the system's components. While individual people often have moderate political views, under certain internal and external influences in the context of mass events these can erupt into radical and in part also irrational hysteria.

3.2. Application to the Threat to Societal Diversity and Coherence

In the terminology of complexity science, processes of societal change occur in the wake of transformations and as phase transitions from one equilibrium state to another. The transition phases, however, are often characterized by chaotically occurring perturbations (Cairney, 2012). The systemic risks that appear in this context follow the laws of emergence of dynamic structures in complex systems. Here, we analyze the systemic risk of the collapse of pluralistic societies, that is, the loss of societal diversity and coherence.

Open systems: The complex system to be observed here is a society, for example, that of the Federal Republic of Germany, the United States, or France. It is an open system, and people and information from its surroundings enter and leave the system by crossing the system's borders. Incoming people are in the current situation, for example, especially migrants; incoming information is, for example, represented by ideas and concepts of how societies deal with complex challenges such as the refugee crisis. Open, pluralistic and diverse systems show in principle a basic superiority over homogenous systems. Diversity provides better opportunities for adaptation to changing environmental conditions and expands the potential of creative solutions for social welfare, security, and societal coherence. Especially

in times of change, in times of the large transformations of globalization, digitalization, and sustainabilization, isolation is an inadequate means for the stabilization of one's own system. In contrast to what one would intuitively assume, it is rather openness and cooperation that can ensure stability in a dynamic environment. In spite of and precisely because of their unpredictability, coping effectively with complex systemic risks are dependent on open systems of governance. There are several specific characteristics of complexity that are relevant in this discussion on social cohesion:

Nonlinear interactions: The interactions between citizens of a society are nonlinear. The herewith associated unpredictability is a fundamental phenomenon of societal change. Small causes, for example, fake news about alleged criminal behavior of migrants, have the ability to abruptly divide the public in the formation of their opinion and to threaten diversity.

Selection by circular causality: Dynamic structure formation, that is, in this context the emergence and destruction of a pluralistic society, is significantly influenced through selection by circular causality. Here, social media with their susceptibility to manipulation and social conditioning play an important role. In pluralistic societies, different rules and thus different conceptions are always in competition with each other. Whoever wins this competition is largely determined by circular causality, and thus not least by the reaction of the media to the different models of society. The rules that are utilized in social media for the purpose of steering the interactions play an important role for stabilizing behavior. In principle, this can increase coherence and solidarity among individuals and groups. However, polarization of the media as well as the growing number of echo chambers in social media run counter to the integration efforts that are necessary in order to adequately address the challenges of the transformations. Nonlinearity as well as the circular causality are often closely connected to the availability of mobile information systems, including social media. By their speed of dissemination of news, spirits, and emotions, they are able to confirm and reinforce existing norms and values, but they can also trigger spontaneous, radical, and irrational actions. Facing the situation of becoming divided and polarized by contentious political issues such as the refugee problem in Germany, it can be observed that the mass media, complemented by the social media with their inclination toward fake news, are widely responsible for the circular causality

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[2]The concept of the *butterfly effect* was coined by the American meteorologist Edward N. Lorenz, who held a speech before the American Association for the Advancement of Science entitled "Predictability: Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas?" From: http://de.wikipedia.org/wiki/Schmetterlingseffekt (accessed November 28, 2020). Printed in: Lorenz, Edward, N. 1995. The Essence of Chaos, *University of Washington Press*, Appendix 1, pp. 181–184.

effects promoting polarization, social alienation, and civil unrest (Schröter, Jovanovic, & Renn, 2014). Appropriate governance strategies in a democratic society aim at regulating social media by democratic institutions and making populist distortions of facts visible. While frequently of limited effectiveness and highly contested, this strategy is pertinent in principle and is directed toward a better performance. Thus, political action is required to regulate social media and other digitals services in order to reduce losses of sovereignty and agency for one's own life and to disprove fake news.

Historicity: Societies have a memory. Each societal change can therefore only be understood by taking the society's previous history into account. Because of the specific prehistory of, for example, Germany in the first half of the 20th century, there is a certain affinity toward authoritarian structures among parts of society while others strictly oppose them, even to the degree of endangering domestic security.

Early warning indicators: There are early warning indicators that announce the transition of a system into an unstable state. Early warning indicators have the form of dimensionless parameters that put promoting and hindering effects into relation, be it as influencing factors or time scales. Particularly the disruption of the time scale separation between the hierarchical levels of organization in a society promotes instability. Therefore, it is a special task of the governance of systemic risks to develop appropriate early warning indicators for the here discussed social risks and to continuously measure them. However, in complex systems early warning signals are difficult to determine since weak signals may easily be overlooked although they can trigger major impacts on system performance in nonlinear relationships (Diez, Tomico, & Quintero, 2020). Computer simulations can help to identify and validate these indicators and to identify critical threshold values.

Sensitivity: In unstable states, possible and, under normal conditions, irrelevant events are able to disrupt a system's balance. One should not be deceived about this sensitivity by a slow approach toward the boundary to instability. The leaps when crossing the threshold values (tipping points or areas) can occur unexpectedly and suddenly and then be irreversible. This is precisely one of the outstanding characteristics of systemic risks.

Emergence: The formation of new societal structures in a complex system is a phenomenon of emergence. This means that, by looking at existing structures and agents of a system, nothing can be said about its future development. Typical for systemic risks is the existence of tipping points that can occur in both homogenous as well as chaotic states in systems dynamics. Often the exact location of these tipping points (or corridors) is not known or highly uncertain (Lucas et al., 2018). Even in an open and pluralistic society with a high degree of education and intelligence, external and internal random processes can lead to a new state of society that most of the population did not want, for example, a society divided into its individual parts.

4. THE DOMINANT CONTRIBUTION OF SELF-ORGANIZATION

4.1. The Coherence of Central Steering and Self-Organization

Complexity science demonstrates that the formation of dynamic structures depends on the interactions between the agents. It is decisive that dynamic structures are not created by a central steering but by the interactions between the agents involving the mechanism of circular causality. Thus, higher structural orders are achieved even though there seem to be no external steering elements. This is the principle of self-organization as a fundamental principle of complexity science. In many systems, though not all, however, it is possible to steer the rules of interactions from outside the system by using appropriate measures.

The primary agents in both models of society are the citizens. Their actions are steered and limited by central regulations and institutions, for example, laws and their monitoring by the police, the judiciary, and government. Added to this are interactions with other agents according to the principles of self-organization.

In the homogenous vision of society, the central steering of actions in the process of structure formation is in the foreground while mechanisms of self-organization are hardly taken into account. Unforeseen systemic risks, that is, leaps to new system states that cannot be predicted, are characteristics of self-organization. In the case of central steering, however, these are not to be expected but rather limited and even prevented by conscious steering. The system does not have an equivalent in the natural world. The interactions take place in the linear realm, that is, they cause predictable types of structure formation, namely, those that are desired by central steering.

In the pluralistic vision of society, on the other hand, self-organization is the dominant factor. The interactions between the agents are nonlinear, their systemic effects react back to them according to the mechanism of circular causality, for example, through resonance of different media. This leads to structures that cannot be predicted individually. Thus, through emergent structure formation different layers of societal order are developed according to the principle of self-organization (e.g., political parties, citizen initiatives, etc.). The formation of public opinions, too, is an example of emergent structure formation. This process of emergence of structures through self-organization is analogous to nature and thus creative. It has the potential to adapt to changing environmental conditions and is therefore relatively stable as long as thresholds of internal and external influencing factors are not crossed.

4.2. The Emergence of Order

Precisely because of its diversity, there are systemic risks in a pluralistic society of tipping into a homogenous one, even of the destruction of basic democratic order. Complexity science points out instruments in order to limit these risks and to stabilize the model of a pluralistic society. In this context, especially self-organization comes into focus again. It is constitutive for stability, as well as for achieving unstable system states from which phase transitions, for example, to a homogenous or postdemocratic model of society can occur.

The insight that, in a diverse society, self-organization is the essential organizing principle justifies influencing processes of societal change by controlling the rules of interactions between the agents. It is thus expedient to take a closer look at the different forms of interactions among people in a society and to analyze them according to the logic of complexity science.

The functional relationship that is created by the interactions between the agents of a complex system, in this case the citizens of a society, can be defined as order (Büschges, Abraham, & Funk, 1998). Orders are obviously in balance if the relationships are permanent and variations of action and reaction are manageable (Forst, 2011). If disruptions occur that strongly change the time schedule and cause variations beyond a tolerable threshold, it depends on the resilience of the system of order how flexibly the system can deal with deviations (Fath, Dean, & Katzmair, 2015). The higher its resilience the more robust

Table I. Basic Principles of Societal Order

Principles	Set of rules
Hierarchy	established rules for subordination and superiority
Competition	binding rules for determining the conditions under which all participants interact and interchange services with each other
Cooperation	a. Cohesion on the basis of relationships (kinship)
	b. Cohesion on the basis of common values, worldviews and convictions
	c. Cohesion on the basis of self-organization

the order is with regard to disruptions from inside and outside. A particularly well-known example of a self-organizing system of order based on few rules is the emergence of fish swarms (see Fig. 5).

The long-term stability of such systems is largely determined by the capacity of buffering and adaptability. If this capacity is overstretched or crossed, the system enters an unstable state. As a result, there are often unpredictable, chaotic reactions of the individual elements which cause an imbalance. After a certain phase of chaotic transition there is a new balance with new rules for relationships and structural order (Linkov et al., 2014). It is by no means predetermined whether the new balance is of a stronger or better functionality than the old one. In the framework of natural conditions of evolution (competition and evolutionary pressure), the new system is usually better adapted to the environmental conditions than its predecessor. In stable system states, the degree of disruptions remains limited. These are the potential random fluctuations without any impact on the macroscopic system state. However, larger disruptions can cause an instability of the system, especially when the capacity of buffering and adaptation is exceeded, which can prompt a new system state.

Orders in the framework of a system are based on organized relationships, in this case the interactions between the citizens of a social system (Benz, Kuhlmann, & Sadowski, 2007; Snow, 2015). These can be of *hierarchical, competitive, or cooperative nature* (Table I). Element A can steer Element B (hierarchy), or Element A can under certain conditions compete with Element B (competition), or Element A and B join forces to solve a task together (cooperation). In natural systems, these relationships are largely predetermined. Individual agents do not have the freedom to select the rules of their relationships with each other. In spite of the complexity of the

Fig 5. Spontaneous order in a fish swarm.

patterns of relationships, this makes the analysis of natural systems easier than to study social systems. Individuals, like organizations, in social systems can, to some degree, determine these rules themselves, adapt them to external conditions, change them over time, or secretly apply other rules than they pretend to the outside world. This possibility of a flexible and adequate adaptation is characteristic of the high degree of resilience of social systems (Boyd, Nykvist, Borgström, & Stacewicz, 2015). Resilience in this context denotes the ability of social systems to remain the functionality of critical services (such as energy, water supply, health care etc.) in times of severe stress (Reid & Botterill, 2013)[3] At the same time, this bears risks: if the rules are moved in the wrong direction or if they cannot cope with the internal and external requirements, instability or even collapse of the system can be the result.

4.3. Different Principles of Order in Societies

In human societies, all three principles (hierarchy, competition, and cooperation) are present, sometimes also in hybrid form (e.g., hierarchy in an organization with rules of competition as mechanism for promotion at each level). These principles determine the rules by which collective actions are guided and coordinated. They do not specify the actors or

institutions who set the rules but categorize the rules into different patterns.

The proponents of a homogenous vision of society are rather convinced by rules that are based on hierarchy and competition. However, cooperation is also high on their list as long as it is about like-minded individuals. In complexity science, these kinds of interactions are considered linear special cases. Interventions lead to predictable consequences for societal change. As a result, the typical characteristic of complex systems, namely, the unpredictability and creativity, is limited.

The classics of sociology were convinced that cooperation has to either depend on social recognition in the sense of "kinship" (family, clan, nation) or on value commitment in order for it to emerge in the first place and to unfold its effect (Lowi, 1964; Parsons, 1951; Parsons & Shils, 1951; Schweizer & White, 1998). However, if new agents enter the system and are not able to develop relationships with already existing agents via ethnic heritage, common values, convictions, or kinship, proponents of homogenous societies only see one steering element of linear interaction left: hierarchy, and if the rules are correspondingly harsh, competition. A set of rules that is aimed at cooperation and basically introduces nonlinear interactions is, from this perspective, impossible and unwanted.

The proponents of a pluralistic vision of society, on the other hand, argue that the new agents, in the course of becoming familiar with the new system, will develop social relationships (marriage,

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[3]This understanding differs from the resilience concept in ecology and engineering (Berkes et al., 2003; Haimes, 2009; Holling, 1996;)

Fig 6. Multicultural impressions on a street in London.

friendships, etc.) and share common convictions and values such as dignity and honor insofar as cooperation is offered to them in an honest way. In the understanding of complexity science, this result is not certain due to the unpredictability of nonlinear effects, but chances are that it can be achieved. With these new agents, the argument continues, the system's capacity toward increased resilience could benefit because the diversity of the new agents could be used to improve the flexible ability to adapt. In the concrete case of immigration, this could encompass overcoming the shortage of specialized workers, skillfulness in dealing with other cultures, or the improvement of mutual learning ability.

4.4. Self-Organization and Societal Coherence

What follows from these considerations with regard to the question about cohesion in modern societies? The lessons from complexity science clearly point in one direction: Cooperation is beneficial to a society even if there are no common values and convictions, kinships, or cultural proximity at the outset. The proponents of the homogenous concept do not recognize the potential of self-organization not only for the improvement of the system's stability but also its significant contribution to more creativity and flexibility (Balconi, Crivelli, & Vanutelli, 2017). And there is plenty of evidence that this can also be achieved if cooperation is not defined via social proximity and value commitment. Dynamic structures that enable creativity and innovation require

openness and diversity, as can be observed in nature with its constant development and decay (Bollige et al., 2011). Social diversity promotes selectively strengthening feedback in the interactions of humans of different ethnicities, cultures, religions, and so on. Fig. 6 depicts such diversity in the streets of London. According to complexity science, such feedback is constitutive for the emergence of dynamic structures and creative solutions to problems (Mitchell, 2004). Given adequate rules, the increased capacity of collective intelligence and resilience provide augmented opportunities for stable structures of welfare and security.

Wherever there are opportunities, the risks are not far. The development of self-organizing systems depends on the validity of the rules determining the system. Similar to nature, creative solutions in the sense of self-organization depend on the fact that there are cooperative arrangements at the microlevel, which are, however, subject to competition at the macrolevel (McAlpine et al., 2015). Applied to the current political situation, this means that persons newly entering the system should be offered every opportunity for cooperation that they need to develop and unfold their potential. At the same time, the rules of the competition and hierarchy should be applied if these cooperative arrangements do not go anywhere in the sense of integrity and stability of the system or if they become counterproductive. This insight is not an invitation to Social Darwinism whose boom is over for good reason (Mersch, 2018; p. 195f). It is not about selecting good immigrants from less

good immigrants or, worse, resilient ones from less resilient ones. Complexity science shows that creative solutions and unusual processes of adaptation often result from those elements from which one would least expect it. Systems theory has taught us that it is not about individual selection (Preiser & Cilliers, 2010). Rather, the system needs to be constituted in a way that relationships between agents develop in the process of self-organization so that they, at least in the statistical average, entail, and maintain successful processes of adaptation to changing conditions. This implies that cooperation without hierarchy and competition can indeed prevent or threaten cohesion. It depends on the right mixture, and especially on the temporal and structural steering.

5. FUNDAMENTAL VALUES: BASIS FOR SOCIETAL COHERENCE

From the perspective of complexity science, it is indispensable for the stability of a system that important rules for interactions are predetermined in order to limit the creative opportunities of self-organization so that the maximum possible variations of relationship patterns between agents are not exceeded. In a system that is determined by functionality as well as ethics, these are first of all the fundamental values that are rooted in the constitutions of the respective countries and the civil rights as outlined in the UN Charta. These constitute basic principles of human existence and cooperation. They should also not be relativized vis-á-vis the legitimate demand for openness, plurality, and individual and sociocultural development (Henkin, 1989). While discussion is necessary, all political powers have to demonstrate a clear commitment to the fundamental values, both internally and externally, and stand by this commitment in everyday politics.

This also implies: In the context of fundamental values, the principle of hierarchy is imperative. Even if hierarchy requires cooperation, this rule cannot be reinforced cooperatively but dependent on hierarchical structures of control. To allow for cooperative models to emerge and flourish relies on the trust in the reliability of the governance system to ensure and, if needed, enforce that all actors play by the rules and that violations are fined. Different from Hobbes vision of the Leviathan in which the political power is legitimized to take over control of all social life as part of a social contract, coherence, and conformity to rules can also, and more prefer-

ably be generated by self-organization and planned cooperation based on value commitments and kinship. Yet, the functionality of these bottom-up mechanisms to work depends on the recognition of basic rules of conduct that make human interactions predictable and calculable. The question of which rules should be identified as a set of obligatory values and norms may enter a political minefield but the call for a consensus on fundamental values and principles of coexistence is essential for maintaining a collective identity as well as for stability in humane living conditions. Of course, there is leeway in the interpretation of the constitutions and occasionally also need for clarification. As in all ambiguous issues and questions, an open discourse on how to appropriately interpret the constitution is also necessary in this case (Donelly & Whelan 2020, chapter 3).

Aside from hierarchy, the principle of competition or, in conjunction with cooperation, also called coopetition (Dorn, Schweiger, & Albers, 2016) is one of the fundamental conditions of the relationships between the elements of a system, subordinate to the fundamental values, however. Complexity science shows that competition in dynamic systems is the motor for effectiveness and efficiency. These are not the only target figures for the functionality or humanity of a societal system but stability in a system cannot be upheld without them in the long term. They create incentives for social learning and motivate individuals to find and test innovative solutions. It is important that these rules of competition are only applied in the context of effective and efficient performances of the system. Often, resilient or fair solutions to problems are called for that come at a price for efficiency (Mirhosseini, Carmody, & Iulo, 2019). But inefficient solutions will not be able to ensure stability of the system in the long run. It is therefore always about finding the right balance.

Then there is still cooperation: with its three-fold manifestation in social proximity, shared convictions, and open self-organization, it enables a diversity of binding forces that provides the best guarantee for creative, flexible, and adapted performances in a complex world with transformations that run parallel. Creating coherence and cooperation out of self-organization has been underestimated in many political science textbooks as well as the self-conception of many political leaders. Thus, the potential of cooperation, also with persons that are not close to one's own society in terms of ethnicity, faith, or convictions, cannot be regarded highly enough. However, the principle of cooperation needs to be involved in

the strict framework of the above-described conditions of hierarchy and competition.

6. CONCLUSION

Today, societal diversity and coherence are threatened in all societies. Populist movements, strengthened by social media with their vulnerability to fake news, endanger welfare, and societal security and are a fundamental threat to democratic values.

An analysis on the basis of complexity science provides insights on the mechanisms by which these threats gather shape as well as the instruments of governance in dealing with these risks. In this context it becomes clear that the condition of open systems, the acknowledgment of circular causality as well as the consideration of early indicators play an important role. Particularly the role of self-organization (and the entailing insight that the shaping of adequate rules in the interactions between agents of a system is essential in containing this risk) is dominant for the understanding and governance.

The dynamic structure generation in diverse societies is subject to self-organization of relationships between agents and the institutional forms of organization. Dynamic processes relate to individual actions, institutional rules, and cultural values and norms. They change in different speed and intensity. Adaptation toward different time scales is one of the major challenges for social systems to remain coherent. Self-organization is precisely the evolutionary fit that proves the necessary connections between diverging frames in time and space. In the social sciences, the function and effectiveness of self-organization has so far been underestimated. This self-organization is based on interactions between the elementary units of a society and in this way generates a macroscopic dynamic. The result depends on the rules of these interactions. In contrast to most other domains, in societal systems, these rules can be influenced by processes of decision making and the formation of public opinion. In particular, rules are needed that steer the self-organized development of structures in the democratically chosen and desired direction. In the case of missing or unenforced rules, unwanted structures can emerge from diversity, for example, parallel societies, social inequality, exploitation, crime, and so on. And especially the tolerable variation of relationships between the elements can be exceeded and thus lead to massive instabilities. To be ethically and functionally secured, cooperative structures building on self-organization need hierar-chical control based on the fundamental values stipulated in the respective constitutions as well as the innovation-inducing competition at the macrolevel.

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