

Preface

Arguably, there is nothing more complex than the human mind. The myriad of thoughts and feelings, constantly evolving and reconfiguring into new meanings, has no parallel in natural phenomena. The complexity of human experience is even more enhanced in social contexts, where social and cultural elements are created and undergo change as individuals interact. The social sciences, which focus on human experience and behavior, have dealt with the complexity of human and social phenomena by developing qualitative theories focused more on understanding than prediction. Precise, quantitative models originating in traditional physics were not suited to grasping the dynamics of psychological and social phenomena.

This has changed dramatically as recent advances in the natural sciences have enhanced the capacity of the natural sciences to study not only physical and biological systems but social systems as well. The rise of complexity science can be traced to the development of new theories in natural sciences in the early 1980s. Such themes as deterministic chaos, artificial neural networks, genetic algorithms, emergence, and self-organization have not only profoundly transformed the natural sciences but also have captured the attention of the popular press and thus the general public.

Currently a revolution is occurring in the social sciences. The current advances in understanding how complex systems work has made psychological and social phenomena amenable to analysis with the tools of the natural sciences. Precise formalisms, including networks, agent-based models, and nonlinear dynamical systems, have started to transform our understanding of the psychological and social sciences. Social phenomena are increasingly at the center of the emerging interdisciplinary complexity science. As computer simulations became the primary tool of the complexity approach to social phenomena, models of social processes began to become precise and acquire predictive power.

The emerging complexity science is increasingly focused on social phenomena. Such issues as opinion dynamics and dynamics of social networks and financial markets are now at the center of interest of physicists and computer scientists. New technologies have provided unprecedented amounts of data, from the Internet, mobile phones, and sensors, concerning patterns of activity, locations, and movements, as well as communication between individuals. Complexity scientists are developing new, quantitative theories of social processes.

The new, complexity-based social theories have very limited awareness of the relevant knowledge existing in the social sciences. Correspondingly, the social sciences have only recently started to be interested in the contributions of complexity science to social phenomena. As a result, the two approaches to studying social phenomena are developing in large part on parallel tracks. The vast majority of research that takes the complexity approach to social phenomena comes from the formal sciences and follows their standards.

This book presents theories and research conducted in psychology that fall into the domain of complexity science, but from the perspective of the social sciences. It contains both reviews of the relevant literature and original empirical results. It discusses psychological and social phenomena in a way that makes them amenable to analysis by the tools of the natural sciences and shows examples of the use of these tools. It goes beyond the social topics most often discussed in the complexity approach to the social sciences, such as opinion dynamics. It concentrates on such issues as emergence of brain functions, detection of patterns in cognitive systems, dynamics of interpersonal attraction, dynamics of involvement in sport, group dynamics, and dynamics of conflict.

It shows how phenomena occurring at different levels of psychological and social reality, from brain to society, can be understood from the perspective of complex systems. On the one hand, processes occurring at all levels can be seen in a similar way, as produced by elements influencing each other in time. Whether the elements are neurons, thoughts, individuals, or social groups, the processes at each level are revealed as each element changes in time, responding to multiple influences of other connected elements of the system. Higher-level phenomena emerge from the interaction of lower-level elements. Neurons are interconnected by synapses and thoughts emerge as neurons change their frequency and pattern of firing in response to influences of other neurons. Cognitive elements are interrelated by functional and associative links and their interactions emerge as cognitive functions, such as pattern recognition, language, and consciousness. Social relations interconnect individuals in social networks. Processes occurring in these networks, such as social influence, flow of information, and social interdependence, produce dynamics of dyads, groups, and societies. The pattern of these influences determines the dynamical properties of emergent phenomena at the higher level. Synchronization of neuronal activations underlies recognition. Patterns of interaction of thoughts, feelings, and behaviors determine sport involvement. Patterns of interaction between individuals or groups set the stage for escalation or de-escalation in interpersonal and societal conflicts.

On the other hand, each level of social reality is unique, with vastly different elements and very different relations between elements and different ways in which the elements influence each other. The specific nature of the elements and their relations defines the content, the psychological as well as the social nature of the processes occurring in the mind and in society. This aspect can be understood with the use of the insights of psychological and social theories. Although the dynamics of self-esteem, involvement in sports, and conflict may be understood in common terms of attractor dynamics, the nature of each of these three phenomena is completely different and without appreciating these differences, constructing meaningful theory of each of them is impossible.

This book is intended to bridge the gap between the understanding of social processes from both the perspective of the social and the natural sciences. For social scientists, it highlights insights in the understating of psychological and social processes that can be achieved by adopting the perspective of complexity science. For the readers with background in the formal sciences, it presents relevant theories of the social sciences and highlights the way they can be amenable to analysis with the tools of the formal sciences. It also shows which of the tools developed in the formal sciences have proven to be more useful for investigating social phenomena.

This book describes psychological and social processes occurring at different levels of reality. It starts from the level of the brain then progresses through the levels of an individual, the dyad, the social group and ends up at the societal level. On each level, it concentrates on specific selected topics analyzed from a complexity perspective. It does not aim at a comprehensive description of all the phenomena occurring at each level that have been or could be analyzed with the tools of complexity science. We hope that the provision of specific in-depth examples of complexity-inspired social theories serves better the purpose of showing ways to apply complexity science to psychological and social dynamics than would a textbook-oriented approach.

The chapters of this book reflect lines of research conducted by the researchers in the Centre of Complex Systems of the Institute of Social Studies, at University of Warsaw. The majority of the researchers of this center, in contrast to most complexity-oriented research groups, have their background in psychology and sociology, some in computer science and biology, physics, engineering, and mathematics. The research group has a clearly interdisciplinary focus. It is involved in a lot of international interdisciplinary collaboration, mainly in the area of future and emerging technologies. In most cases, the members of the group collaborate with physicists and computer scientists providing expertise in the social area. The researchers from the Warsaw group combine in their research social theory and computer simulations, but also include empirical work with human participants.

This book presents simple models of complex psychological and social phenomena. The models presented follow the principle of *Dynamical minimalism* (Nowak 2004). In complex systems, even very simple rules of interaction between simple elements may lead to the emergence of complex properties at the level of the system. It follows that at least some complex phenomena may have very simple explanations. Computer simulations are used to explore which simple rules may

explain the complex phenomena that have been observed. Simple elements must interact in time for complex phenomena to emerge. Minimalist theories based on emergence must be dynamic. In this approach, unlike approaches in the traditional social sciences, one tries to concentrate on the most essential properties of the phenomena to be explained, rather than trying to capture the phenomenon in its naturally occurring complexity. The task of the researcher is to try to find the set of the simplest possible, but realistic, rules that can reproduce the essence of the phenomena to be explained.

The chapters are arranged in the order dictated by levels of description: starting from the brain and ending at the societal level. Although the topics of the chapters are very diverse, several concepts coming from the formal sciences are central to our understanding of the psychological and social phenomena. The concept of attractor, for example, allows us to understand how stability can be combined with constant change in understanding the dynamics of attitudes, self-esteem involvement in sport, and conflict. Synchronization is central for our understanding of such diverse topics as how brain activity produces perceptions and thoughts, interpersonal attraction, and how individuals interact in groups. Networks provide formalisms to describe the functional connectivity in the brain, cognitive representations in the mind, and patterns of influences in social groups.

Reference

Nowak, A.: Dynamical minimalism: why less is more in psychology. *Personal. Soc. Psychol. Rev.* **8**, 183–192 (2004)

Complex Human Dynamics

From Mind to Societies

Nowak, A.; Winkowska-Nowak, K.; Brée, D. (Eds.)

2013, X, 242 p., Hardcover

ISBN: 978-3-642-31435-3