A Meta-Analysis of Social Conflict: The Social Simulation Comprehensive Approach

Armando Geller[1], Martin Neumann[3], Armano Srbljinovic[4], Nanda Wijermans[5], and Frédéric Amblard[1]

[1] George Mason University ageller1@gmu.edu
[2] Universität Bayreuth martin.neumann@uni-bayreuth.de
[3] Institute for Research and Development of Defence Systems Armano.Srbljinovic@kc.t-com.hr
[4] University of Groningen F.E.H.Wijermans@rug.nl
[5] Université de Toulouse 1 frederic.amblard@univ-tlse1.fr

Abstract. We discuss the field of formal, in particular computational methods to study social conflict, in order to approximate the Weberian notion of *verstehen*. While traditional theoretical distinctions, such as structuralist and interactionalist approaches, can be revealed in classical formal methods, agent-based modeling can be couched in such terms as complexity, analytical sociology, and critical realism. The self-understanding of these research traditions – methodologically as well as theoretically – might be able to induce impulses to orthodox conflict research's research designs and might also shed light onto the nature of the generative processes related to social conflict. So far such promises remain under-explored.

Keywords. Social Conflict, Formal Methods, Meta-Analysis.

1 Introduction

The foundation of the Special Interest Group on Social Conflict and Social Simulation (SIG-SCSS) within the European Social Simulation Association (ESSA) is an occasion to undertake a meta-analysis of social conflict from a social simulation perspective. What is the potential contribution from social simulation to the field of conflict studies? Denoting a manifold of social conflict phenomena – such as inter-state war, civil war, genocide, terrorism, crowds and riots, or conflict in and amongst primate groups – it is doubtful that creating a unified understanding of what social conflict is, is feasible and even desirable. Given the heterogeneity of phenomena of social conflict, it is not surprising that a variety of methodological and theoretical approaches have been applied to study ranges from formal game theoretic models to the hermeneutics of narratives. New paradigms made their appearance in the social sciences, in particular complexity, and the development of new methodologies for studying social phenomena, in particular agent-based social simulation. The paradigm and method changes underline the need of reconsidering how social conflict is understood and how it is studied.

In general, a complex system can be characterized by a decentralized and non-linear nature and that many processes that occur within them can be characterized through the notion of emergence [19]. Emergence does not only relate to a condition in which agent state, behavior and interaction combine to generate macro-level outcomes that could not be predicted from knowledge of the agent state, behavior and interaction alone, and result in sporadic volatile episodes the timing, magnitude, duration and outcomes of which are themselves unpredictable [8]; it also refers to the idea that agent state, behavior and interaction depends on and are shaped by the macro-level outcomes [19]. Such a combination of micro-macro and macro-micro dynamics is one of agent-based social simulation's virtues to study complexity. It is also a kind of understanding of social science that is prevalent – and practiced – in domains influenced by complexity theory, analytical sociology, and critical realism. In a broader sense it can be argued that the "true" understanding that is sought of the mechanisms underlying the social phenomena constituting the objects of investigation is conceptually related to the Weberian notion of *verstehen*. By *verstehen* Weber [24, 547] meaning that the only reality of individuals is the one that is perceived and elaborated on, i.e. subjectivity. [6].

The purpose of this contribution is to evaluate the scope of "verstehen" (comprehension) of social conflicts that can be achieved by the particular method of social simulation. In what ways does social simulation re-define our perception of the object of our studies, i.e. social conflict, and how does social simulation influence the way(s) in which we understand it? We argue that research traditions such as those mentioned afore – complexity, analytical sociology, critical realism, etc. – provide a distinct analytic access to the study of social phenomena for which social simulation – and in particular agent-based social simulation – is especially useful.

We do not seek unification where there "naturally" is none. But it should be possible to identify mechanisms and principles of particular interest to the scholar of social conflict. This includes distinguishing social conflict from other forms of conflict. The aim of this meta-analysis is thus to bring the overwhelming chaotic and complex amount of empirical research under the perspective of what we have learnt about social conflicts from these studies. Ideally, we aim to encourage generalization while at the same time not losing touch with both the specialist/idiographic and the gradualist critique of the generalist approach [7]. Our efforts have been guided by the desire to "comprehend" social conflicts using social simulation methods.

An uncontroversial characteristic of conflicts is their inherent dynamics. The term "conflict" merges a number of actions (be it merely speech acts) undertaken by a number of individual actors that only by an interpretation can be subsumed under the notion of "conflict". Semantics unites the stream processes to the structural concept of conflict. Here we arrive at the dichotomy of process theories and structural theories in the social sciences [20]. The study of processes is the

[6] "Erfassung des Sinnzusammenhangs, in den seinem subjektiv gemeinten Sinn nach, ein aktuell verständliches Handeln hineingehört"

very domain of simulation approaches. Hence, simulation captures this essential aspect of the phenomenon of social conflict. Input structures are represented in terms of differences in agent properties or type of interactions an agent can have.

Social simulations can reveal "new" macro level properties as an output structure that emerges from lower level processes. Output structures of complex systems appear as global patterns of particular (combinations of) attributes of the input structures (the agents and their relations). However, when the differences between agents are interpreted as seriously violating, what in BDI (Believe – Desire – Intention) terms could be denoted as intentions, the output structure is shaped in the form of a conflict. This might happen due to various causes: for instance, the differences in attribute values might be interpreted by agents as seriously departing from the "normal" course of interaction, to a resistance of the intentions to belief revision, or to an input structure which is shaped in the form of a dilemma. This refers to the conceptual diversity outlined above.

Section Two provides a general overview from the perspectives of various research clusters, including game theory, system dynamics, and agent-based modeling. Section Three focuses on what members of the European Social Simulation Association's (ESSA) Special Interest Group on Social Conflict and Social Simulation (SIG-SCSS) have contributed to the field in order to situate the SIG-SCSS in a broader context – if possible at all –and to develop a notion of social conflict within the SIG-SCSS that furthers mutual understanding amongst its members. Section Four poses the question what we have actually learned from these approaches that furthers our "verstehen" of social conflict and if we are ready to formulate a comprehensive conceptual framework of social conflict. Section Five will shed light on various lacunae in research on social conflict.[7]

2 Review of Social Conflict and Social Simulation

2.1 General Overview

Various approaches to the study of social conflict are notoriously hard to classify. The problem is illustrated by a classification attempt conducted by Schellenberg, which ended in a somewhat unwieldy classification of individual characteristics theories, social process theories, social structural theories, and formal theories [20]. Here, obviously, the first three groups of theories have been classified according to a focus on theorizing, while the fourth category, i.e. the formal theories, have been classified primarily according to the method of expression used, i.e. formal method. The classification, however, remains silent as to the focus of the theories belonging to this fourth group.

We attempt to establish the missing link. We review several main formal-theoretical approaches to social conflict and specify to which of the first three

[7] Space limitations force us to present our argument in a condensed fashion and to confine our literature basis, in particular with regard to the German and French tradition. A longer version of this article – in preparation – includes this literature as well as eminent researcher's other than Schellenberg, such as Lewis A. Coser, Ralf Dahrendorf, etc.

Schellenberg's categories, distinguished according to their focus on theorizing, the reviewed approaches come closest to.

We will argue that the game theoretic approach can be characterized as a social process theory, emphasizing interacting individuals. The interacting agents however, are representational agents without individual characteristics. In contrast to the game theoretic approach, system dynamics, econometric methods of studying conflict here labeled as "conflictometrics", as well as the expert systems approach, all highlight the investigation of structural features of a whole system as one and indivisible. Properties of individuals are only barely captured. Finally, agent-based models evade Schellenberg's classification not only by being a formal method that is not restricted to numerical analysis but also by allowing both the representation of interactions of agents with individual characteristics as well as the representation of structure. Social structure is an emergent property that in turn influences the generating level of individual agents. This classification will be substantiated by a brief review of the respective accounts.

2.2 Game Theory

Classical game theory can be described as a mathematical theory of the rational choice of courses of action which are directed toward certain outcomes, provided that all participants – or players – in the game know each others' preferences regarding any possible outcome. The theory conceptualizes and lays down in mathematical formalism the more general approach of rational choice theory which sees aggression as a primarily rational response to given circumstances. Social conflict is thus conceptualized as primarily a conflict of rational interests.

In terms of Schellenberg's classification, game theory is clearly more process- than structure-oriented, by emphasizing the opposition of individual interests. On one hand, this emphasis on interests opens wider possibilities for conceptualizing conflict, but, on the other hand, the conceptualization is often cast in an overly mechanistic and inherently static mathematical form.

When some of the requirements of classical game theory are relaxed, the approach becomes more dynamical. For example, in evolutionary game theory replication is introduced into a population of players, with players' replication rates roughly proportional to their payoffs in repeated rounds of the game. Evolutionary game theory treats strategic interactions as dynamical systems, and it closely approaches system dynamics methodology to which we will turn next. Extensions of the classical game theory often, however, come at the cost of analytical tractability. The use of computer simulation helps to enhance game theoretical methods beyond the limits of mathematical tractability.

2.3 System Dynamics

The systems approach is generally concerned with a system as a whole. The emphasis is usually on the way elements of the system connect and interact with each other as well as on the way they function together. System dynamics provides a framework in which the systems approach is applied to social and

economic problems by describing behavior of a system using a set of differential equations. This set of equations may be quite complex and it usually has to be solved numerically. Given initial conditions, the solution describes evolution of the system with time. Numerical calculation of the solution values in time is usually performed by computers and it is referred to as a simulation of the system.

A system in the system dynamics approach is described using macro-variables specifying the state of the system as a whole. The macro-variables are suitable averages over micro-variables specifying the behavior of individual elements. Due to such a holistic conceptualization of a system, system dynamics cannot directly address conflicts between system's elements. Rather, when system dynamics methods are applied to conflicts research, conflicts are usually conceptualized as special, "dysfunctional" modes of system's functioning. The task of system dynamics then becomes to identify ranges of system parameters, which characterize such "dysfunctional" or "unstable" modes of functioning.

Schellenberg classifies systems theory as a process-based approach on the grounds that it attempts to develop "a general method of analysis which could apply to the study of processes of organization, wherever they may be found" [20, 72]. However, the "processes of organization" considered by the systems approach in the social sciences are generally the larger-scale processes running at higher (sub-)systemic levels of a social system. In sociological tradition these higher systemic levels of social systems have been, more or less consistently, associated with the term "structure". Therefore we decide to depart from Schellenberg's choice of classifying systems approaches, and we classify system dynamics as primarily structure-oriented.

2.4 Conflictometrics

By "conflictometrics" we assume applying quantitative, most often statistical methods to the study of social conflicts in a manner which is similar to the ways econometrics is applied to the study of economic phenomena. Conflictometrics studies are usually based on datasets obtained from one or more large conflict databases containing data on the attributes of social entities, the relationships between and among entities, and the behaviors that these entities manifest *vis-á-vis* one another. The most common social entities on which data have been recorded, are nation-states. The relationships are usually international relations, and the behaviors are various political actions and events related to the occurrences of crises and conflicts. The application of statistical methods to the datasets enables scientific examination of various conditions which precede and/or co-vary with fluctuations in the incidence of conflicts [9]. The general intention is to uncover statistical relationships among the various variables on which data have been recorded, hoping that a better understanding of those relationships will enable development of more reliable forecasting procedures. For example, it has been argued that "the close monitoring of pre-specified events believed to be contributing factors to genocidal violence gives us a tool to predict the onset and magnitude of genocide" [10].

Conflictometrics studies are predominantly structure-oriented. Their focus is on statistical and thus correlational – some would say causal – relationships between the background conditions leading to social conflicts and the outcomes of social conflicts on the structural level. In contrast to individual-interactional approaches like game theory, both the system dynamics and the conflictometrics approach point to a broader social background within which individual interactions take place. While system dynamics employs differential equations for modeling relationships between variables under consideration, conflictometrics studies use primarily statistical techniques.

2.5 Expert Systems

The technology of expert systems has been developed by and was an important product of research in the field of artificial intelligence. Like system dynamics, it attempts to describe whole systems. However, the specific property of expert systems is a rule or knowledge-based approach. Broadly speaking, expert systems seek to transform the knowledge of domain experts into (a web of) if-then relations. In the 1980s a number of decision centered models have been developed by means of the expert system paradigm to analyze large scale social conflicts such as the Cuban crisis or military dictatorship in Latin America. [2], for instance, applied a rule-based approach to model how the cognitive schemata of Latin American military leaders result in typical schemata of their social action. This can be described as a set of if-then relations. Simulation then reveals that the dynamics inherent in these assumptions generates a stabilization of certain structural patterns.

By being based in Artificial Intelligence this approach to simulation shares a number of features with agent-based modeling. In particular, unlike game theory or system dynamics, expert systems provide a straightforward framework for knowledge representation. The representation of individual actors, however, is rather limited. Thus, comparable to the system dynamics approach, also expert systems can be classified as focusing primarily on the structure of a system. The ultimate purpose of expert systems is the diagnosis of a system status. This delimits the capacity to represent the complexity generated by a vast number of individual interactions of different actors. This, however, is the particular strength of the object oriented programming technology that became popular in the early 1990s. Hence, agent-based modeling extended the artificial intelligence paradigm of expert systems to the paradigm of *distributed* artificial intelligence.

2.6 Agent-based modeling

The agent-based approach was developed in the 1990s together with the rise of object-oriented programming languages. Agent-based modeling can be traced back to distributed artificial intelligence. A noteworthy feature in the design of agent-based models is that not a whole system is modeled, but rather individual agents can be represented as separate objects. Thus the properties of the system need not be known beforehand. This modeling approach is not restricted to

numerical equations. Wooldridge and Jennings [26] describe agents as objects that dispose of a) autonomy, b) sociality, c) reactivity and d) pro-activity. For this reason, agents can generate their particular interaction history and simulation is not restricted to representative actors. Agent-based modeling has emerged as the leading paradigm of social simulation.

Since the structure of the system is not built-in, the macro-properties of the system emerge over the course of the simulation. The number of interactions of heterogeneous agents, who are engaged in overlapping patterns of relationship, generates complex systems that cannot be analyzed otherwise. Complexity can thus be regarded as one defining feature of agent-based models. This complexity of local interaction, however, is the source for the generation of emergent patterns on a global level, i.e. social structure, which in turn determines the interactions on the micro level. Agent-based models are thus a means to study both structure and interaction. This particular feature is beyond the classification of theoretical approaches as process or structure oriented. Agents produce, and are at the same time a product of, social reality [5].

Unfortunately, agent-based models of social conflict rarely follow the generative socio-scientific approach. Instead of being a true complementary approach, most agent-based models of social conflict replicate dominant approaches to social conflict, such as equation-based modeling (system dynamics) and game theory or combinations thereof [15]. Agent-based modeling examples that truly follow the paradigm's essentials – as described afore – are more rare. An example is [6]. [6] is such a compelling example not because of its empirical accuracy, but because of the modeling philosophy applied.

3 SIG-SCSS Research

3.1 Contribution of the SIG's members

How can the SIG-SCSS (potentially) contribute to this research field? First and foremost the group is concerned with agent-based simulation. Methodologically, the SIG thus appears to be rather homogeneous. The methodological viewpoint can be characterized by an emphasis on social complexity.

SIG members contribute to the study of conflict from a variety of fields such as Economics, Computer and Cognitive Sciences, Social Psychology, Political Science, Sociology, etc. The thematic background of the members of the SIG reflects the heterogeneity of social phenomena encompassed by the notion of social conflict. For instance, research on economics might motivate an investigation of conflicts about natural resources [14] such as water resources. Moreover, questions arise if and how economic governance might support structural violence or social reconciliation [16]. Is the labor market shaped by an inherent conflict structure? These are examples of how an economic perspective reveals the problem of social conflict. Cognitive Science and Social Psychology shed light on how micro and meso social relations might or might not lead to trust or distrust and even violence. How can extremist opinions prevail [1]? How are dominance

structures established [13]? What is the role of norms [4] and reputation [17] for both peaceful interaction or violent confrontation? What mechanisms play a role in crowds that turn into a riot [25]? Such questions motivated the study of conflicts from the perspective of Cognitive Science and Social Psychology. Finally, a minority of researchers have a research focus on topics such as ethnic [23] or armed conflicts and power structures [8] which are at the core of "orthodox" conflict studies.

Quite naturally, a large proportion of SIG members have a professional background in Computer Science. (Distributed) Artificial Intelligence is in itself requested to study conflicts to understand the cognitive mechanisms it aims to investigate. There is an intrinsic relation between Artificial Intelligence and Cognitive Science.

This is a brief sample of research questions that are studied by members of the SIG-SCSS. While neither being an exhaustive enumeration of research within the SIG, nor attempting to cover the whole field of Conflict Studies, it nevertheless indicates the various problem areas underlying social conflicts of all sorts as well as the manifold perspectives to study such phenomena. It possible to identify underlying patterns in these various research fields? And does the methodological tool of agent-based modeling afford developing an interpretative framework for the phenomenon of conflict? The sheer diversity acquainted with these questions suggests reference to a consequence of the Weberian notion of *verstehen*, namely to conceptualize the complex amount of data, topics, and perspectives in a way comparable to the Weberian ideal type.

A natural conclusion from this is that a potential common understanding of social conflict and how the study of which should be conducted can hardly be derived idiographically. Let us therefore look at some of the more generalized knowledge produced over the last years.

4 What have we learnt so far about social conflict?

4.1 From an orthodox perspective

Each of the approaches reviewed in Section 2.1 has its merits and each contributed to a better general understanding of social conflicts. At the same time, however, neither of these approaches provided for an all-encompassing, holistic scheme for studying social conflict.

Game theory provided important insight into instrumental and strategic aspects of conflicts. The theory of zero-sum games, in particular, has yielded insight and advice on the strategy of pure conflict. However, when "mutual dependence is part of the logical structure and demands some kind of collaboration or mutual accommodation" between players, traditional game theory has been less successful [21, p. 83]. Unfortunately, most of the real-world situations of interest involve the very interplay between conflict and mutual dependence.

Unlike game theory, which seeks to explain social conflict in terms of clashes of individual preferences and interests, system dynamics aims at identifying

broad, systemic conditions under which conflicts may arise or intensify. Some authors have, for example, found it useful to characterize the onset of war as the transition from non-chaotic to chaotic behavior in a non-linear system dynamics model representing the interactions between the competing nations of the system [18, pp. 98-99]. Such an approach enables to identify attractors of conflicts.

While system dynamics studies often use roughly estimated parameters as inputs, the "conflictometrics" approach emphasizes the value of empirical research. Conflictometrics has also brought to the focus of scientific attention the probabilistic character of the relationships between various factors and the incidence and intensity of social conflicts. Conflictometrics researchers argue that the field has advanced "at least to the stage of weather forecasting – that is, we can assert with some plausibility that certain conditions and actions lead to likely outcomes" [11, p. 102]. By combining such statistical model-based with Delphi-type expert assessments, the accuracy of forecasts can allegedly be brought beyond the 80% threshold, which is "good enough for some types of forecasts" [22, p. 303]. Critics of the conflictometrics approach point to the relatively weak explanatory power of such studies due to their inability to specify *how* the independent variable causally affects the dependent variable.

4.2 From a Social Simulation perspective

A paradigm shift in the perception of conflict in the international system occurred due to the introduction of the notion of complexity. So was fore example the idea of states as "billiard balls" contested by Cederman who adopted Per Bak, Chao Tang and Kurt Wiesenfeld's sandpile model as a model for the data generation process of inter-state conflict [3]. Strikingly, he was able to replicate the statistical signature (a power law) of previously collected empirical data. After an initial hype, the usefulness of complexity theory as applied by sociophysicists has been questioned and alternative explanations have been sought. In this task agent-based modeling has been most useful, not least by enabling a combination of a non-numerical description of the systems' generating elements (i.e. agents) with the possibility of a rigorous numerical analysis of the systems' properties. While difficult to couch in any kind of theoretical approach such as structuralism and interactionism is most fruitfully couched into an emergentist and critical realist framework [e.g. 2]. The complexity of agent-based models generates emergent structures which allows to study a mixed reality in which structure shapes agency and agency shapes structure. Epstein's [6] model on civil conflict is an important example for how the focus can also lie on explaining social conflict from an individual and group perspective. Inherently social processes such as ethnic cleansing and peacekeeping (though stylized) become of importance.

For some reasons not known to us the explanatory power of social mechanisms has not yet reached agent-based models of conflict (let alone other conflict modeling approaches). The diversity of academics interested in these kind of explanations promises not only the emergence of a lively future discourse, but also the elaboration of a great variety of mechanisms explaining social conflict.

Accordingly, instead of couching social phenomena into the polar opposition between structure and agency, experimental studies with agent-based models of the various kind of topics investigated by members of the SIG reveals the relativity of levels. In some cases the phenomena generated in agent-based modeling would be called as "meso" from a more general perspective. For example, Schelling's simulation of segregation patterns in the, if interpreted as segregation in cities, would be a typical example of a meso-phenomenon. Comparably, models of crowds and riots [25] generate phenomena of a different scale than long lasting dominance structures between different genders [13]. Conflict about natural resources is of a different character than prevalence of extremist opinions [1]. Other models study anomic freezing of whole countries. Levels of macro and micro are only of a relative nature but can be dissected by the same methodology of emergence in complex systems (cf. [12]). Various conceptualizations of the micro-macro gap can be captured by the methodological approach of complexity.

5 Instead of a Conclusion: What is wanting?

It is highly unlikely that a unifying notion of what social conflict is will ever be formulated. Instead, an analytical standpoint should be adopted. Such a view does not have to be in contrast to those approaches discussed in section 2. By contrast, social simulation conducted by means of agent-based modeling is a natural epistemological extension to other simulation approaches. (As is social simulation to qualitative and quantitative approaches.) The key differences, as laid out ever so often by various scholars, are rooted in the advantages of agent-based modeling in combination with the idea of societies as complex (adaptive) system. In fact it is this combination that creates what is known by now as agent-based social simulation. Agent-based social simulation of social conflict either adds or at least underlines a variety of, in our opinion fruitful and promising research questions to the field of conflict studies' research agenda. We would like to point out three:

- The notion of emergence affords scrutinizing the important relationships between local processes and structures ("localisms") and macro processes and structures ("the conflict").
- There is, however, a layer in between the micro and the macro, the meso level. Social mechanisms, patterns of individual or organizational behavior that regularly lead to similar outcomes, appear to be a useful analytical concept to explain what is happening between the micro- and macro-level.
- This kind of reasoning brings forward the need of mid-range theories of social conflict.

One of the difficulties besetting modeling approaches to social conflict reviewed in Section 2 is that some of these approaches have been developed relatively independently and separately from others. The challenge to, as well as the potential of agent-based social simulation is to facilitate crossfertilization of different approaches. One may attempt to build models populated by agents

simultaneously acting as game-players in regard to a certain aspect of reality (concerning e.g. competition for resources), and behaving as social conformists in other contexts (concerning e.g. ethnic prejudice transmission). Moreover, certain relations between particular game-playing strategies and susceptibility to prejudice (and vice versa) can be postulated, just as game-playing (i.e. agency-enabled) and prejudice-hosting (i.e. structurally constrained) "traits" are often intertwined within the same individuals. These multifaceted agents might be implemented using expert-systems-style rules. Resulting models might be used to generate system-dynamical functional/disfunctional modes of a society, and/or to replicate statistical patterns established by conflictometrics approach.

Last but not least, an agent-based social simulation approach can underline the importance of adopting an interpretative framework in the analysis of conflict. Combining the expressive accuracy of qualitative narratives (particularly on the model building stage) with the precision of numerical analysis (in the simulation analysis) is possible, although rarely conducted. Such an approach is an homage to the problem-driven school of the social sciences and a farewell for studies too rigorous to capture a conflict's – or any other social phenomenon's – peculiarities that eventually make it a product of human behavior.

Acknowledgements

We would like to thank Frédéric Amblard and the Université de Toulouse 1 Sciences Sociales for enabling and hosting the first SIG-SCSS workshop.

References

1. Frédéric Amblard and G Deffuant. The role of network topology on extremism propagation with the relative agreement opinion dynamics. *Physica A: Statistical Mechanics and its Applications*, 343:725–738, November 2004.
2. S. Banerjee. Reproduction of social structures: An artificial intelligence model. *Journal of Conflict Resolution*, 30:221–252, June 1986.
3. Lars-Erik Cederman. Modeling the size of wars: From billiard balls to sandpiles. *American Political Science Review*, 97(1):135–150, 2003.
4. Rosaria Conte and Cristiano Castelfranchi. The mental path of norms. *Ratio Juris*, 19:501–517, 2006.
5. Guillaume Deffuant, Scott Moss, and Wander Jager. Dialogues concerning a (possibly) new science. *Journal of Artificial Societies and Social Simulation*, 9(1), 2006.
6. Joshua Epstein. Modeling civil violence: An agent-based computational approach. *Proceedings of the U.S. National Academy of Sciences*, 99(3):7243–7250, 2002.
7. Clinton F. Fink. Some conceptual difficulties in the theory of social conflict. *Journal of Conflict Resolution*, 12:412–460, December 1968.
8. Armando Geller and Scott Moss. Growing *qawm*: An evidence-driven declarative model of Afghan power structures. *Advances in Complex Systems*, 11(2):321–335, 2008.
9. J. David Singer Geller, Daniel S. and. *Nations at War*. Cambridge University Press, Cambridge, 1998.

10. Barbara Harff. *Journeys Through Conflict. Narratives and Lessons*, chapter Could Humanitarian Crises Have Been Anticipated in Burundi, Rwanda, and Zaire? A Comparative Study of Anticipatory Indicators, pages 81–102. Rowman & Littlefield, Lanham Boulder New York Oxford, 2001.
11. Barbara Harff and Robert Ted Gurr. *Ethnic Conflict in World Politics*. Westview Press, Boulder, 2004.
12. Peter Hedström. *Dissecting the Social. On the Principles of Analytica Sociology*. Cambridge University Press, Cambridge, 2005.
13. Charlotte K. Hemelrijk and Lorenz Gygaz. Dominance style, differences between the sexes and individuals: An agent-based model. *Interaction Studies*, 5:131–146, 2004.
14. Wander Jager, Roel Popping, and Hans van de Sande. Clustering and fighting in two-party crowds: Simulating the approach-avoidance conflict. *Journal of Artificial Societies and Social Simulation*, 4(3), 2001.
15. Lawrence A. Kuznar and William Frederick. Simulating the effect of nepotism on political risk taking and social unrest. *Computational Mathematical Organization Theory*, 13(1):29–37, 2007.
16. G. Müller. *Representing Social Reality*, chapter Marginalization by Long-term Unemployment: A Comparison of Two Models, pages 331–338. Föhlbach, Koblenz, 2005.
17. Jordi Sabater, Mario Paolucci, and Rosaria Conte. Repage: Reputation and image among limited autonomous partners. *Simulation*, 9, 2006.
18. Alvin M. Saperstein. *Dynamical Modeling of the Onset of War*. World Scientific, Hackensack, NJ, 1999.
19. R. Keith Sawyer. *Social Emergence, Societies as Complex Systems*. Cambridge University Press, Cambridge, 2005.
20. James A. Schellenberg. *Conflict Resolution: Theory, Research, and Practice*. State University of New York Press, Albany, 1996.
21. Thomas C. Schelling. *The Strategy of Conflict*. Harvard University Press, Cambridge, 1960.
22. Alex P. Schmid. *Journeys Through Conflict. Narratives and Lessons*, chapter A Comparative Look at Early Warning Indicators: PIOOM, the State Failures Project, and CEWS Cases, pages 291–317. Rowman & Littlefield, 2001.
23. Armano Srbljinovic, Drazen Penzar, Petra Rodik, and Kruno Kardov. An agent-based model of ethnic mobilisation. *Simulation*, 6, 2003.
24. Max Weber. *Economy and Society: An Outline of Interpretive Sociology*. University of California Press, Berkeley/Los Angeles, [1921] 1978.
25. Nanda Wijermans, René Jorna, Wander Jager, and Tony van Vliet. Modelling crowd dynamics. influence factors related to the probability of a riot. In Frédéric Amblard, editor, *Proceedings of ESSA'07 the 4th Conference of the European Social Simulation Association*. IRIT Editions, September 2007.
26. M. Wooldridge and N. R. Jennings. Intelligent agents – theory and practice. *Knowledge Engineering Review*, 10(2):115–152, 1995.