



Martin Neumann, Andreas Braun, Eva-Maria Heinke, Mehdi Saqalli and Armano Sbrljcinovic (2011)

Challenges in Modelling Social Conflicts: Grappling with Polysemy

Journal of Artificial Societies and Social Simulation 14 (3) 9
<<http://jasss.soc.surrey.ac.uk/14/3/9.html>>

Received: 03-May-2011 Accepted: 06-Jun-2011 Published: 30-Jun-2011



Abstract

This discussion paper originates from the preceding annual workshop of the Special Interest Group on Social Conflict and Social Simulation (SIG-SCSS) of the ESSA. The workshop especially focused on the need to identify and examine challenges to modeling social conflicts. It turned out that the polysemous nature of social conflicts makes it very difficult to get a grasp of their complexity. In order to deal with this complexity, various dimensions have to be taken into consideration, beginning with the question of how to identify a conflict in the first place. Other dimensions include the relation of conflict and rationality and how to include non-rational factors into conflict models. This involves a conception of organized action. Finally, guiding principles for model development are being discussed. We would like to invite readers of the *Journal of Artificial Societies and Social Simulation* to 'sow the seeds' of this debate.

Keywords:

Social Conflicts, Conflict Models, Modelling Challenges, Polysemy, Rationality, Emotions



Introduction

- 1.1 The European Social Simulation Association (ESSA) Special Interest Group on Social Conflict and Social Simulation (SIG-SCSS) was formed in 2008 with the aim to promote and strengthen the field of social simulation in the domain of conflict research. A further aim was to provide an organisational platform for researchers who work on social conflict and social simulation to share, discuss and disseminate their work. The group has, among others, established a short but lively tradition of annual meetings, starting with the first workshop in Toulouse, France, in 2008; followed by the meeting in Zagreb, Croatia, in 2009; and the latest one in Aachen, Germany, in December 2010.
- 1.2 This paper starts with a summary of presentations from this latest gathering. We should emphasise that the topics of the presentations are somewhat arbitrary as they primarily reflect current research preoccupations of the workshop participants, and by no means provide a comprehensive review of approaches to modelling conflict. Yet, some of the issues that "emerge" from interactions among the participants address more general challenges for social conflict modellers, and may arouse interest and encourage further discussion among a wider community of social modellers. The ultimate goal is to stimulate a discussion about directions for future research.
- 1.3 We regard this account as being compatible with a number of recent attempts to describe problems and clarify the conceptual foundations of social simulation. Whilst for instance the ODD protocol (Grimm et al. 2006; Polhill 2010), or the common protocol, (Richiardi et al. 2006) are attempts to provide solutions rather than to describe the problems, other attempts focus on describing pitfalls and problems (e.g. Hamill 2010). Here we concentrate on describing the challenges with a special focus on social conflicts: does this particular field of research lead to the identification of new problems for social simulation that are unique to this topic? Or does it reveal problems that are more general in nature? We turn to such issues and challenges in the second part of the paper.



Summaries of selected presentations

- 2.1 In the presentation "pathways to ethnic homogenisation" a model of conflict escalation was described. Based on events in former Yugoslavia, the model concentrates on a certain type of conflict escalation: ethnic homogenisation in a multi-ethnic

society. Whilst an atmosphere of violence was stimulated by nationalist politicians, the ethnic homogenisation was often undertaken by citizens. This is represented in the model by two types of agents: politicians with a rational motivation to escalate the conflicts, and citizens, who possess an ethnic identity. Political conflicts provide the opportunity for ethnic homogenisation. Mobilising ethnic identities provide the motivation. It is intended to generate emergent entities and emergent properties through the interaction of culture and politics: namely ethnic homogenisation (emergent property of the model) undertaken by paramilitary militia (emergent entity).

- 2.2** Another presentation focussed on the importance of human emotions for both social conflicts and social order. In terms of agent-based modelling, emotion can be conceptualised as an attribute of human agents influencing their action tendencies, i.e. behaviour. A synchronous change in individuals' emotions at a micro-level may lead to sweeping changes of collective behavioural patterns at the macro-level and, vice versa, the macro-level social arrangements, institutions and policies may influence the emotions of individuals. This might have important implications for conflict resolution and order restoration. It seems, however, that people react more strongly to negative than to positive stimuli, which makes the transition from conflict to peace more problematic than descending from peace into conflict. Other challenges for both agent-based modelling and socio-psychological theories include elucidating the interplay between long-term sentiments and moods and short-term emotional reactions, as well as the interplay between affective and non-affective factors in conflict dynamics (cf. Bar-Tal and Halperin 2011).
- 2.3** A controversial discourse in the (German) sociology of violence, taking place between the quantitative cause-and-effect oriented "mainstreamer" and the qualitative Thick Description oriented "innovators" (cf. Nedelmann 1997; von Trotha 1997), was the subject of a further presentation. This discourse, which can be traced back to a total of eight divergent dimensions (cf. Nedelmann 1997), seems a little bit irritating, in line with Max Weber's (1984: 8) definition of a socio-scientific analysis. Both paradigms set each with a different focus of explanation on social phenomena, although Weber pointed out the linkage of understanding and causal explanation. In terms of a new methodological base, the appliance of fuzzy logic can bridge this gap, also achieving a gain of knowledge within the future sociology of violence. Fuzzy logic is capable to enlarge the analytical space of possibilities regarding the inclusion of gradual crossings (cf. Kosko 1993: 18-43). Violence does not only have to be analyzed in a way of either the one or the other approach, but now can be analyzed as a combination in between. An eight-dimensional fuzzy set cube (for better illustration: eight two-dimensional cubes) is constructed, in which the particular corners of each dimension reflect the number of possibilities (i.e. none approach is able to explain the phenomenon, only one approach is declared to be the best strategy, both paradigms are able to explain the same phenomenon) and the particular vertical and horizontal edges represent the degree of the "mainstreamer" and "innovators" approach. This allows to analyze concrete acts of violence in terms of more or less or as well as (cf. Ragin 2000: 8) being a case of the corresponding qualitative or quantitative part of each dimension. On the basis of school shootings it was shown, that for instance a bivalent perspective of either external dynamics (social structure) or internal dynamics (figuration, process-related momentum of violence) is not sufficient to reflect the complexity of such violent acts: school shootings are influenced by external dynamics as well as internal dynamics. So, here one approach comply with its opposite, what is contrary to the bivalent view in the classic dispute over method. Using the combined strength of both paradigms a polyvalent perspective of fuzzy violence can be taken into account (cf. Ragin 1989, 2000) without ignoring the existent paradigms (cf. Kosko 1993 18-43). Thus a fuzzy-methodological concept of violence is capable to explain violent acts as a synthesis of a micro- and macro-sociological analysis.
- 2.4** In addition, another presentation introduced a concept which applies the idea of categorising and analysing criminal networks by integrating the principle of bivalence into *fuzzy-thinking*. This concept, called *fuzzy-crime*, is built on the assumption that every description of complex societal phenomena comprises a conceptual uncertainty all of its own. This assumption is based on the fact that it is unrealistic to summarise these phenomena in few words and, similarly, excessive and complicated concepts and theories are often incapable of adequately defining complex phenomena intelligibly, as Hedström points out (cf. Hedström 2008: 14). It seems to be more accurate to focus on classifying a phenomenon gradually among the both bivalent extreme cases of one and zero, of "corresponding to the definition" or "not corresponding to the definition" and to compare it with similar phenomena. Consequently, a certain phenomenon of crime, e.g. terrorism, is categorised within the set of terrorism using verbal labels like "clearly no terrorism", "rather no terrorism", "in between", "rather more terrorism than no terrorism" and "clearly terrorism". Instead of arguing about the question of a group being a terror organisation or not, one could ascertain the membership within the set of terrorism and compare this value to the one of another group. Adopting this approach may simplify conceptualisation and facilitate the analysis of complex phenomena. In addition, this procedure seems to be very constructive as social scientists classify theoretical concepts using vague verbalisations as relations between subsets anyway, for example, "physical violence is rather to be defined as an act of violence than being physical violence".



Challenges for modelling social conflicts

- 3.1** Based on these presentations, several challenges to modelling conflicts have been identified. These will be examined in this section.

The polysemous nature of conflict

- 3.2** Not only do different disciplines view social conflict from different perspectives, but the meaning of the term is often interpreted differently by researchers within the same field of research. There are many areas around which there are varying definitions

of social conflict, including:

- latent vs. manifest (often also expressed as motivation vs. action);
- regulated vs. unregulated;
- indirect (parallel striving) vs. direct (mutual interference);
- unconscious vs. conscious;
- impersonal vs. personal;
- continuous vs. intermittent;
- communication absent vs. communication present;
- high communication vs. low communication;
- peaceful vs. violent;
- large admixture of co-operation vs. relatively pure antagonism;
- object-centred vs. opponent-centred;
- third party controls goal vs. opponent controls goal;
- origins of scarcity vs. origins of incompatibility/inconsistency;
- economic goals vs. non-economic goals, and
- non-disruptive vs. disruptive (Fink 1968; see also Amblard et al. 2010).

3.3 This multitude of possible conceptual approaches to social conflict is often perplexing and researchers from different research backgrounds or disciplines may even be unaware that the phenomenon they study can be viewed as social conflict. For this reason, conflicts can at best be regarded as a node within a web of different issues. Therefore it seems futile to search for a definitive interpretation of this inherently cloudy concept, drawing the conclusion that the notion of conflict is polysemous.

3.4 Having accepted this notion, it follows that conflict should be assessed using a concept that embraces this characteristic; the variation in concepts should not be challenged or overlooked, but instead this heterogeneity should be used to inform the research process. One possible solution for implementing this could be the application of a fuzzy scaled concept of conflict^[1], which ranges from "clearly non-conflict" at one end of the scale to "clearly conflict" at the other end.

How to recognise a social situation as a conflict?

3.5 An important challenge in the research on social conflicts is the question of how agents representing parties involved in a conflict actually begin to interpret their relationship as confrontational. The question is important since experiencing^[2] the relationship as confrontational may lead to these parties resorting to more extreme measures of conflict "resolution" such as violence. Without having had the experience of a confrontational relationship, it is hard to imagine using violence as a means of settling unresolved issues. In other words, violence implies conflict while violent conflicts comprise only a subset of all possible conflicts.

3.6 Paraphrasing Clausewitz, escalating conflicts to violence can be regarded as politics by other means. Meanwhile, some points may be highlighted as common properties for identifying social conflicts from the observer perspective:

1. 1. *Connexion*: Relational proximity (Godard 2005) is an important factor in identifying potential conflicts or tensions: stakeholders should be linked.
2. 2. *Brutal Change*: Competition leads to conflict if something new happens or changes occur. In practice, this may mean the emergence of a new player or a new connection (Schmidt-Lainé and Pavé 2002).
3. 3. *Commitment*: The engagement and even the "credible commitment" of stakeholders distinguishes conflict from tensions (Kirat and Torre 2004). It means thereby the occurrence of a prior self-assessment by the stakeholders interpreting their relationships as confrontational.
4. 4. *Open game*: Social conflicts may be settled only in cases where stakeholders can challenge and/or question the strength and/or the legitimacy of the powers-that-be (Weak states Mechanism: Hagmann 2005).

Conflicts and rationality

3.7 Clausewitz is a protagonist of an approach to violent conflicts that emphasises their rational aspects, i.e. to regard the utilisation of violence as a means of reaching certain goals. This implies subjectively, at least that a rational "means to an end" calculation takes place. A prominent approach to conflict analysis, Realism and Neo-realism (Morgenthau 1948; Waltz 1965), emphasises this aspect of the analysis of social conflicts. An opponent estimates that a current situation should be changed and an outcome can be achieved. This is guided by the principle of (state) interest. This approach is typical for sciences such as economics, geography or political sciences. The analysis concentrates on goals such as access to resources and a calculation of appropriateness of means by an evaluation of relative strength of e.g. military power. Conflicts can arise from the assessment that a resource is scarce or threatened (a resource can be water or media, or a bright future, or God).

3.8 This line of research coincides neatly with modelling approaches. Consider, for instance, models of resource management: resource management is faced with the problem that a sparse resource has to be distributed among competing actors. Whilst typically these models are not primarily concerned with violent conflicts, such models demonstrate the unpredictability from clearly non-conflict to clearly conflict situations. A rational approach for describing the target system coincides with modelling,

since the design of agents has to provide decision rules. These rules need not be rational per se. However, rational principles provide inter-subjectively traceable guidelines for formulating "what if" clauses in the model assumptions. Yet conflicts imply some other elements (especially when violence occurs). This leads on to a remaining question about how emotional factors should be modelled?

Non-rational factors: how to scale them up?

- 3.9 The problem of integrating non-rational, e.g. emotional, aspects of human deliberative processes, actions and interactions into agent-based models requires richer representations of both individual agents and their (social) environments. The challenge of scaling emotions and their effects up to higher social levels requires further developments in both the theory of emotions and model development.^[3]
- 3.10 For example, the issue of experiencing the relationship as confrontational seems to be related to the social construction of narratives and the question of why some narratives are successful^[4] while others are not. The successfulness of narratives is likely to be dependent on the function of parameters originating from different levels: micro, meso, and macro, and agent-based simulations provide a good opportunity for modelling phenomena on each of these levels and integrating them together (Sawyer 2005).
- 3.11 Some of the micro-level variables influencing the successfulness of a narrative could be the valence (positive/negative) and arousal (intensity) of emotions induced by a narrative within the individual agents representing the narrative's audience. There may well exist a set of narrative patterns (e.g. blaming one ethnic group for hardships experienced by another group) characteristic of social conflicts in the sense that such narratives are particularly successful in evoking negative emotions within its audiences. On the other hand, there may also exist a set of narrative elements by which conflict narratives may be "improved" and transformed into ones inducing more positive than negative emotions within their audiences, facilitating conflict resolution (Sluzki 2003; Cobb 2006).
- 3.12 These features are only occasionally implemented in simulation models so far. Nevertheless, agent-based simulations might be among the most appropriate tools we have at present for modelling the social construction of narratives, the impact these narratives have on their audiences, particularly with regard to conflict escalation, as well as the enrichment of narratives by elements facilitating conflict resolution. Firstly, there exist a number of approved models within a closely related field, namely opinion dynamics (e.g. Hegselman and Krause 2002) and the spread of extremist ideas (e.g. Deffuant et al. 2002). Secondly, simulation inherently accounts for path dependency to reflect the dynamics that is implied by the successfulness of narratives to induce social movements.

Rules, group movements and institutions

- 3.13 Traditionally the mobilisation of social movements has been analysed according to rational choice, in other words, by a calculation of (individual) interests. Following Olson (1965), theories of public choice have developed formal models of collective decisions that can be transformed into simulation models in a straightforward manner. However, the success or failure of group movements also depends on non-rational elements, such as the emotional appeal of certain narratives.
- 3.14 The awarding of the 2009 Nobel prize to Elinor Ostrom for her institutional approach (Ostrom 1990) can be seen as an acknowledgement of the capacities of new computer modelling tools, together with new interdisciplinary methodologies, providing fresh insights into issues at the heart of social, psychological and political research regarding human conflicting relationships. Indeed, social conflicts, as they are reaching crisis point, may be seen as one of the challenges that the social formalisation, analysis and modelling sciences should explore. They involve brutal events where conflicting interests, be they economical or biophysical, are connected with emotions, diffusion of trends and other fuzzy social phenomena that may include "rational" factors as hidden tendencies but also emerging brutal shifts of one population or individuals. This new line of research calls for an examination of the sociology of organised action (Crozier and Friedberg 1977) and requires other tools to determine the balance of wills and powers between stakeholders. In particular, the process of institutionalisation deserves further attention in the practice of model building. To recall an example of one of the presentations: how do new collective actors, such as paramilitary militia, emerge and become recognised in this role?

Agent-based simulations might be one of the most suitable tools we have at present to mimic social conflicts

- 3.15 The power of agent-based models is based on the creation of many actors interacting qualitatively within a model. It then allows (i) the integration of qualitative variables from socio-anthropological disciplines, and even emotional variables, such as anger or ideological representations; (ii) the interaction between virtual actors that may lead to emergent phenomena, sometimes brutal and even "snowball" ones; (iii) the emphasis on narratives, i.e. the creation of representations and ideologies that may crystallise and reinforce one stakeholder's position (Sluzki 2003), through innovation, diffusion processes and networks (Rogers 1993; Thiriot and Kant 2008). These positive features listed here are necessary and even sufficient conditions for considering that agent-based models, when pushed to their maximum potential, may be the key tool for assessing social conflicts.

Does mimicking social conflicts mean understanding them?

- 3.16** Typically, three objectives are assigned to modelling: description, understanding, and prediction (Bousquet et al. 1998; Edmonds and Moss 2005). These three objectives can be characterised as three stages of one process. Describing a situation by means of a model, a conceptualization, or a map, is the first step in designing a simulation model. This implies to have a coherent overview of the phenomenon. In general, understanding is regarded as the analysis of the dynamics of the interactions. A model allows performing operations that could not be done otherwise (such as what-if analysis, sensitivity analysis, parameter-space searches, etc.). This increases researchers' capacities of both asking and answering relevant questions about the modelled phenomenon. Finally, prediction requires confidence regarding the construction carried out previously, which is used to conceive of scenarios, i.e. changes in conditions beyond the established domain of validity. This last step, prediction, raises harsh ethical issues, as models, just like any scientific theory, cannot actually prove anything, although using models can be a useful asset for stakeholders. However, in the case of conflicts, the stakeholders are conflicting parties. Models can be used strategically, i.e. in support of the interests of parties involved, and not only for conflict settlement.
- 3.17** Two dominant lines of modelling strategies have been identified, which contribute differently to the different stages of the modelling process: (i) a KIDS approach using descriptive models, where numerous variables are combined, while relations and conditions are selected from real cases to illustrate tendencies and trends; (ii) a KISS approach using primarily theoretical models resulting from abstract conflict analyses where theories are tested (Edmonds and Moss 2005). At first sight the KIDS approach is associated more to description and prediction, while the KISS approach is associated more to understanding and explanation. In the latter case the role of simulation models can be described as a tool for testing the robustness of a theory and explicating the mental model of the modeller.
- 3.18** However, the notion of understanding can be extended beyond asking and answering relevant questions about the modelled phenomenon. In line with Max Weber's definition of a socio-scientific analysis (Weber 1984) understanding involves a comprehension of the "inner" motives of an actor ("Verstehen"). Such research is directed at investigating the relation of the individual and society: As pointed out above, the inclusion of non-rational factors requires, among others, examining the process of the social construction and the impact of certain narratives which motivate or guide individual action. Thus, it requires a comprehension of how "external" social processes impact on "internal", mental processes, and *vice versa* — how "internal" cognitive and emotional processes exert influence on inter-personal interactions and social processes. Describing this "two way dynamics" induces one to explicate the mental model of the stakeholders. This cannot be done by abstract theoretical models. From such a perspective, it becomes visible that the KIDS approach, as descriptive mode of modelling, contributes also to the modelling objective of understanding.



Conclusion

- 4.1** These reflections on the challenges involved in modelling conflicts are by no means exhaustive. Nevertheless, we hope to have identified some areas that deserve attention and where it is reasonable to expect that future developments in modelling technologies can provide constructive solutions. In any case, if the issues considered here can at least provide a starting point for a reflection on further problems and possible answers, then some progress has been achieved in the field of modelling conflicts.



Acknowledgements

The workshop of the SIG-SCSS was made possible thanks to generous funding from the ESSA.



Notes

¹ This aspect may seem somewhat new to the field of conflict research, but the fuzzy-logical methodology is already and increasingly in use in the process of agent-based-modelling (Dykstra et al. 2010; Suarez et al. 2010).

² Various authors disagree on whether this "experience" need to be conscious or not. Examples of such "experiences" include a sense of failure to fulfil the needs for gratification/utility, self-confirmation, a sense of sharing a common universe with others, a sense of trust and ontological security, avoidance of anxiety, and affirmation of group membership and social solidarity (Turner 1987).

³ The aspect that emotions do play a role in the actions of individuals was already mentioned by Theodore Kemper (1978), Arlie Hochschild (1990), Helena Flam (1990a, 1990b) and Uwe Schimank (2010), who emphasised the effect of emotions on action—constructing another actor model, the so called "emotional man", additional to the concepts of *homo oeconomicus* and *homo sociologicus* (cf. Schimank 2010: 135). One can also find various attempts in AI literature to develop a computational architecture for "emotional agents" (see e.g. Egges et al. 2004; El-Nasr et al. 2000; Ventura and Pinto-Ferreira 2009).

⁴ It has to be emphasised that the notion of successfulness is not used in a moral sense. Successful means only that a narrative factually reaches an audience. It also includes successful stimulation of negative or aggressive emotions.



References

- AMBLARD, F, Geller, A, Neumann, M, Srbljinovic, A and Wijermans, N (2010) Analyzing social conflict via computational social simulation: A review of approaches. In Martínás K, Matika D, and Srbljinovic A (Eds.) *Complex Societal Dynamics - Security Challenges and Opportunities*. Amsterdam: IOS Press. pp. 126-141.
- BAR-TAL D and Halperin E (2011) Socio-psychological barriers to conflict resolution. In Bar-Tal D (Ed.) *Intergroup conflicts and their resolution: Social psychological perspective*. New-York: Psychology Press. pp. 217-240.
- BOUSQUET, F, Bakam, I., Protonand, H. and Le Page C (1998) Cormas: Common-Pool Resources and Multi-Agent Systems. In *IEA/AIE '98 Proceedings of the 11th International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems: Tasks and Methods in Applied Artificial Intelligence*. Berlin: Springer. pp. 826-837.
- COBB S (2006) A developmental approach to *turning points*: 'Irony' as an ethics for negotiation pragmatics. *Harvard Negotiation Law Review* 11 (2). pp. 147-197.
- CROZIER M and Friedberg E (1977) *L'acteur et le système. Dynamiques de l'action collective*. Seuil, Paris, France.
- DEFFUANT, G, Amblard, F, Weisbuch, G and Faure, T (2002) How can extremism prevail? A study based on the relative agreement model. *Journal of Artificial Societies and Social Simulation* 5 (4) 1, <http://jasss.soc.surrey.ac.uk/5/4/1.html>.
- DYKSTRA, P, Elsenbroich, C, Jager, W, de Lavalette, G and Verbrugge, R (2010) A logic-based architecture for opinion dynamics. In Ernst A and Kuhn S (Eds.) *Proceedings of the 3rd World Congress on Social Simulation WCSS2010* (CD-ROM). Kassel, Germany: Center for Environmental Systems Research, University of Kassel.
- EDMONDS B and Moss S (2005) From KISS to KIDS: an 'anti-simplistic' modelling approach. *Lecture Notes in Artificial Intelligence* 34 (15). pp. 130-144.
- EGGES, A, Kshirsagar, S and Magnenat-Thalmann, N (2004) Generic personality and emotion simulation for conversational agents. *Computer Animation and Virtual Worlds* 15 (1). pp. 1-13. [doi:10.1002/cav.3]
- EL-NASR, M S, Yen, J and Loerger, T (2000) FLAME - A Fuzzy Logic Adaptive Model of Emotions, *Autonomous Agents and Multi-agent Systems* 3 (3). pp. 219-257. [doi:10.1023/A:1010030809960]
- FINK C F (1968) Some conceptual difficulties in the theory of social conflict. *Journal of Conflict Resolution* 12 (4). pp. 412-460. [doi:10.1177/002200276801200402]
- FLAM H (1990a) The Emotional Man I: The Emotional Man and the Problem of Collective Action. *International Sociology* 5. pp. 39-56. [doi:10.1177/026858090005001004]
- FLAM H (1990b) The Emotional Man II: Corporate Actors as Emotion-Motivated Emotion Managers. *International Sociology* 5. pp. 225-234. [doi:10.1177/026858090005002007]
- GRIMM, V. et al. (2006) A standard protocol for describing individual and agent-based models. *Ecological Modelling* 198 (1-2). pp. 115-126. [doi:10.1016/j.ecolmodel.2006.04.023]
- GODARD O (2005) Les trois courants complémentaires du champ de l'économie de l'environnement: une lecture systémique. *Cahiers d'épistémologie*, 335.
- HAGMANN T (2005) Confronting the concept of environmentally-induced conflict. *Peace, Conflict & Development*, 6. pp. 1-22.
- HAMILL L (2010) Agent-based modelling: The next 15 years. *Journal of Artificial Societies and Social Simulation* 13 (4) 7, <http://jasss.soc.surrey.ac.uk/13/4/7.html>.
- HEDSTRÖM P (2008) *Anatomie des Sozialen. Prinzipien der Analytischen Soziologie*. Wiesbaden: VS Verlag.
- HEGSELMANN R and Krause U (2002) Opinion dynamics and bounded confidence: Models, analysis and simulation. *Journal of Artificial Societies and Social Simulation* 5 (3) 2, <http://jasss.soc.surrey.ac.uk/5/3/2.html>.
- HOCHSCHILD A (1990) Ideology an Emotion Management: A Perspective and Path for Future Research. In Kemper T (ed): *Research Agendas in the Sociology of Emotions*. Albany: State University of New York Press. pp 117-142.
- KEMPER T (1978) *A Social Interactional Theory of Emotions*. New York et al.: John Wiley & Sons.
- KIRAT T and Torre A. (2004) *Modalités d'émergence et procédures de résolution des conflits d'usage autour de l'espace et des ressources naturelles. Analyse dans les espaces ruraux*. Programme Environnement, Vie, Sociétés: Territoires,

environnement et nouveaux modes de gestion : la "gouvernance" en question, Rapport de Recherche CNRS-IRIS-INRA.

KOSKO, B (1993) *Fuzzy Thinking. The New Science of Fuzzy Logic*. New York: Hyperion.

MORGENTHAU H (1948) *Politics among Nations. The Struggle for Power and Peace*. New York: McGraw-Hill.

NEDELMANN B (1997) Gewaltsoziologie am Scheideweg. Die Auseinandersetzung in der gegenwärtigen und Wege der künftigen Sozialforschung. In von Trotha T (Ed.) *Soziologie der Gewalt. Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft 37*. Wiesbaden: Westdeutscher Verlag. pp. 59-85.

OLSON M (1965) *The Logic of Collective Action. Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.

OSTROM E (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge U.K.

POLHILL J G (2010) ODD Updated. *Journal of Artificial Societies and Social Simulation* 13 (4) 9, <http://jasss.soc.surrey.ac.uk/13/4/9.html>.

RAGIN C (1989) *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*. Berkeley/Los Angeles/London: University of Chicago Press.

RAGIN C (2000) *Fuzzy-Set Social Science*. Chicago/London: University of Chicago Press.

RICHIARDI, M, Leombruni, R, Saam, N and Sonnessa, M (2006) A common protocol for describing agent-based models. *Journal of Artificial Societies and Social Simulation* 9 (1) 15, <http://jasss.soc.surrey.ac.uk/9/1/15.html>.

ROGERS P (1993) *Model to Generate Pareto-Admissible Outcomes for International River Basin Negotiations*. Nota di Lavoro, Fondazione Eni Enrico Mattei, Roma, Italy.

SAWYER R K (2005) *Social Emergence: Societies as Complex Systems*. New York, NY: Cambridge University Press. [doi:10.1017/CBO9780511734892]

SCHIMANK U (2010). *Handeln und Struktur*. Weinheim/München: Juventa.

SCHMIDT-LAINE C. and Pavé A (2002) Environnement : modélisation et modèles pour comprendre, agir ou décider dans un contexte interdisciplinaire. *Natures Sciences Sociétés*, 10. pp. 5-25.

SLUZKI C (2003) The process toward reconciliation. In Chayes A and Minow M (Eds.) *Imagine Coexistence: Restoring Humanity after Violent Ethnic Conflict*. San Francisco: Jossey-Bass. pp. 22-31.

SUAREZ, E, Puga, M, Flores, D, Díaz, A, Castro, J and Fuentes, M (2010) A multi-layered agency analysis of voting models. In Ernst A and Kuhn S (Eds.) *Proceedings of the 3rd World Congress on Social Simulation WCSS2010* (CD-ROM). Kassel, Germany: Center for Environmental Systems Research, University of Kassel.

THIRIOT S and Kant J-D (2008) Using associative networks to represent adopters' beliefs in a multi-agent model of innovation diffusion. *Advances in Complex Systems*, 11 (2). pp. 261-272. [doi:10.1142/S0219525908001611]

TURNER J H (1987) Toward a sociological theory of motivation. *American Sociological Review* 52 (1). pp. 15-27. [doi:10.2307/2095389]

VENTURA R and Pinto-Ferreira, C (2009) Responding efficiently to relevant stimuli using an emotion-based agent architecture. *Neurocomputing* 72 (13-15). pp. 2923-2930. [doi:10.1016/j.neucom.2008.09.019]

VON TROTHA T (1997) Zur Soziologie der Gewalt. In von Trotha T (Ed.) *Soziologie der Gewalt. Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft 37*. Wiesbaden: Westdeutscher Verlag. pp. 9-56.

WALTZ K (1965) *Man, the State and War - A Theoretical Analysis*. New York: Columbia University Press.

WEBER M (1984) *Soziologische Grundbegriffe*. Tübingen: Mohr.