

# Arguments in Social Networks

## (Extended Abstract)

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### ABSTRACT

In spite of a substantive claim for the adoption of agent-based models for social simulation, a shared framework to model key reasoning capabilities of social agents has not been developed yet. To fill this gap, we propose a new model, whereby agents belonging to a social network reason and interact argumentatively, and use trust and coherence setting in order to decide whether and how to revise their own beliefs. With this model, we simulate the propagation of arguments and evolution of opinions in a social context.

### Categories and Subject Descriptors

I.2 [Artificial Intelligence]: Distributed Artificial Intelligence

### General Terms

Theory, Experimentation

### Keywords

Agent-based social simulation, social networks, argumentation, agreement, polarization

## 1. AGENT-BASED SOCIAL SIMULATION

This paper aims at assessing how agreement can be reached among a population embedded in a social context. By agreement, we mean the process by which the population: (a) is involved in a process of information exchange in order to produce a common understanding of a problem; (b) achieves a (possibly low) level of polarization, i.e., finally agrees on the subject matter.

Sociologists within the Agent-Based Social Simulations (ABSS) area have attacked the mechanisms that are somewhat related to agreement, under many points of view: in terms of hierarchies, trust evolution, cooperation, opinions polarization and voting attitude, consensus, cultural differentiation, social structure and its effects on cooperation, cultural differentiation, norms and collective beliefs, and finally, in terms of collective behavior.

There are at least two common aspects in all these attempts: (a) the use of social networks to represent social

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embeddedness and (b) a preference for mathematical, game theoretical or artificial intelligence techniques.

This stream of research focuses on agents that do, in fact, interact but where very little explicit reasoning is done - and if it is, it is “compiled” into procedural code. These scholars model agent’s reasoning mainly by (a) threshold models that link the probability of an agent to choose between a set of opportunities; (b) theoretical games, like the Iterated Prisoner’s Dilemma, to assess the emergence of a stable regime of cooperation between bounded rational agents; (c) genetic algorithms, to implement evolving collaborative or competitive strategies in game theoretical settings; (d) neural networks, to explore social meta-reasoning and beliefs.

Among the Social Sciences, this formal approach is competing with a second formal stream, which focuses explicitly on how social agents should reason *socially*, i.e., interdependently with others, by means of formal logics. The relevance of logic in ABSS is an open issue, with both detractors and sustainers [3].

It is interesting to notice that BDI frameworks, like the ones advocated by Hedstrom [7], have not encountered a wide diffusion among sociologists, probably because most agent architectures based on the BDI paradigm are complex to understand and to use by non-computer-scientists, and often not suited for simulation with thousand of agents.

On the other hand, agents are mainly called *social* just because they are linked in network structures, but no social reasoning is actually implemented.

In spite of a substantive claim for the adoption of agent-based models in the Analytical, Generative and Computational fields of Sociology, it looks like a shared framework to model key reasoning capabilities of social agents has not been developed yet (see Carley and Newell [1] for a review of possible models of social agent).

Our work is a first attempt to fill this gap.

To model the problem, we build on well-established theories from social, cognitive, and computer science: the concept of social embeddedness, due to Granovetter [6], Mercier & Sperber’s argumentative theory of reasoning [8] and Dung’s abstract argumentation computational framework [2].

The result is an ABSS model which simulates a population of social agents that interact within a social structure, exchange information by means of simulated discussions and possibly reach an agreement.

## 2. ARGUMENTATIVE REASONING AND INTERACTION

According to Mercier & Sperber [8], the emergence of rea-

soning is best understood within the framework of the evolution of human communication. The function of reasoning is argumentative. Reasoning enables people to exchange arguments that, on the whole, make communication more reliable and hence more advantageous. In particular, for communication to be stable, it has to benefit both senders and receivers. To avoid being victims of misinformation, receivers must exercise some degree of *epistemic vigilance*.

Several psychological mechanisms may contribute to epistemic vigilance. The two most important of these mechanisms are trust calibration and coherence setting.

Some initial coherence checking occurs in the process of comprehension. When it uncovers some incoherence, an epistemically vigilant addressee must choose between two alternatives: either to reject communicated information, thus avoiding the risk of being misled, at the expense of possibly missing an opportunity to correct or update earlier beliefs, or to associate coherence checking and trust, and allow for a fine-grained process of belief revision. In particular, if a highly trusted individual tells us something that is incoherent with our previous beliefs, some revision is unavoidable.

On the other hand, if a communicator wants to communicate a piece of information that the addressee is unlikely to accept on trust, she can produce arguments for her claims, and encourage the addressee to examine, evaluate, and accept these arguments. Reasoning contributes to the effectiveness and reliability of communication by allowing communicators to argue for their claim and by allowing addressees to assess these arguments.

This simple conceptual framework allow us to introduce argumentation as the key reasoning capability of our artificial agents. We identify abstract argumentation [2], as the conceptual and computational framework to model arguments and reason from them automatically.

We propose an agent-based model where agents reason and interact argumentatively. During an exchange with a peer, an agent is constantly assessing whether (a) the new information is coherent with her beliefs, (b) new arguments suffice to accept the new piece of information, and (c) in case of new incoherent information that requires revising beliefs, whether the counterpart is to be trusted or not [5]. In a simulated environment, the argumentative reasoning processes underlying every exchange are automated.

### 3. CONCLUSIONS

To the best of our knowledge, our proposal is original both in the social sciences, and in multi-agent research.

In social sciences there is a plea for the use of logic-related approaches in ABSS [9], but we are not aware of any previous ABSS model that uses argumentation.

On the contrary, in multi-agent research, argumentation-based interaction has been thoroughly investigated, also in the context of dialog and in relation with trust. However, argumentative agents are (typically) rational software agents with objectives to pursue, situated in artificial societies. Dialogues are used, e.g., to persuade fellow agents in order to better achieve some given goals, and the relation with trust is mainly restricted to using argumentation for evaluating trust. If instead we want to propose an agent model for social simulation, the model should be meaningful from a cognitive standpoint, and rationality as intended in the multi-agent literature becomes less relevant here, than coherence with available evidence from behavioural sciences.

We implemented the model [4] and run some initial experiments.<sup>1</sup> Our results confirm that our logic approach can be profitably used in ABSS in order to obtain meaningful results, with an artificial population of argumentative agents. Among other results, we found that our hypotheses on the dialogue procedure are, in principle, sufficient to reproduce two macro-behaviors embedded in Granovetter's theory, i.e., the tendency of inclusion of weak ties and a competitive advantage for non-isolated caves.

Our work finds useful applications not only in theoretical research, but also in the domains of interest of policy-makers, like sustainable energy, political discussions and e-participation. By simulating with argumentative agents, we could help policy-makers understand how a topic is being discussed, what positions (arguments) are involved in a debate, and how they relate with one another. Ultimately, by simulation, we could forecast a range of possible conclusions that may emerge from such debates.

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<sup>1</sup>[http://youtu.be/\\_YfhKpYAsf0](http://youtu.be/_YfhKpYAsf0)