# Realistic Agents with Social Practices

Doctoral Consortium

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## ABSTRACT

This project investigates to what extent an agent framework centered around the concept of social practices can provide realistic agent-based simulations. The concept of social practices stems from sociology and depicts our 'doings and saying', such as dining, commuting and greeting, in an elegant way. We investigate if a computational version of social practices allows agents to closer resemble (empirical data on) humans in social settings.

## KEYWORDS

Agent-based simulation; Social practices; Architectures for social reasoning; Cognitive models; Agent-based analysis of human interactions

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Over the past years, an important new tool has arisen to understand social systems: agent-based models [7]. In an agent-based model a system is represented as a collection of interacting entities, called agents. Agents represent humans (and sometimes, companies, governments, etc.) as a collection of well-defined functions and variables. This mechanistic representation of humans allows one to simulate how humans interact with each other and their environment. Agent-based simulations have some advantages to more classical sociological tools. One advantage is that it allows modelers to check, by computational inference, the (interactive) consequences of their assumptions on human behavior. As such, one can check the realism of the model both on the individual (micro) as on the (inferred) group (macro) level. One can check the realism, for example, by comparing the simulated behavior of the agent to empirical data on human behavior. The resulting realism, defined as the resemblance of the model to the real world, provides insight in complex social systems.

To our knowledge, most agent frameworks are not evaluated on realism. Boero and Squazzoni [1] argued for the importance of embedding agent frameworks in empirical analysis for them to have any real analytical value. Edmonds [6] agreed and claimed that (despite the importance) there are a lot of published 'floating models': models that are not constrained by empirical evidence of observed social phenomena. Other authors have tried to pinpoint on which aspects current frameworks lack realism: e.g. trust and reputation [12], fast- and slow-thinking [5], non-rationality [17] or regret minimization [2]. Although it is a long and difficult road towards a realistic model of human behavior all these papers underline the importance of realism for agent-based simulations.

In this project, we investigate to what extent an agent framework centered around the concept of social practices can provide realism. The concept social practices stems from sociology, and aims to depict our 'doings and sayings' [14, p. 86], such as dining, commuting and greeting. As the name suggests, social practices aim to capture the social aspects of our actions. Sociality is defined as, the similarity of our cognitive world and the consequent ability to form expectations of the actions of others.[1] In recent years, several authors have proposed sociality as a leading principle in agent design [4, 10, 12], arguing that it is paramount for the design of realistic agents. At this moment, the social practice agent framework [5], is in the early conceptual stages. One aim in this project is to extend the framework into a precise and computationally implemented version, such that the realism can be properly checked.

Within the time limit of this PhD we check the realism of our framework for two scenarios: the ultimatum game [9] and travel mode choice [3]. The ultimatum game is a psychological experiment: tangible, extensively studied, but artificial. Travel mode choice is a real-life situation: complex, but representing real problems. For now we want to emphasize that social intelligence plays a large role in both scenarios. Our focus thus lies on showing the realism of our framework in these social scenarios. A realistic social practice agent framework has been envisioned to be relevant to many policies and social problems [5]. Furthermore, it could be relevant to other scientific fields such as virtual agents or human computer-interaction. This project can contribute to this, and moreover, help establish the true potential and scope of this theory by making the theory more precise and checking the realism of it within a specific domain.

In conclusion, there is the challenge to construct a realistic agent framework, a theory of social practice agents (in the making) that might provide this realism, and a domain to test our theory that is centered around social intelligence.

The main research question in this PhD is the following:

*To what extent does enabling software agents to act according to social practices improve the realism of simulations within social scenarios?*

We identify the following instrumental sub research questions:

(1) How do we measure and evaluate the realism of agent-based simulations?

[1] This definition is based partly on the work of [15].

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Our main criteria of evaluation is realism: the resemblance of the simulation, and in particular the behavior of the agent, to the real world. One approach to realism, we have taken in our initial three studies, is to compare the simulated behavior to quantitative data on human behavior from psychological meta-studies. However, a continuous critical investigation on how to measure realism will result in a more robust analysis of the added value of our social practice agent.

(2) What realistic behavioral principles are lacking in current agent-based simulations within social scenarios?

To make an informed choices in the design of social practice agents, we need to know on what aspects current agent-based models lack realism. In a initial literature survey we found that possibilities for such aspects will be numerous. An important task is thus to filter these possibilities on their empirical support in the literature and relevance for social scenarios. Moreover, we would like to find commonalities in these anomalies; certain behavioral principles that describe reality, but are not yet captured in current models. It should be noted that an extensive list of central behavioral principles in social scenarios falls outside the scope of this thesis, but that in our view a partial list will nonetheless help in the design of social practices agents. In our three initial studies, one such behavioral principle is how humans care about more than their own welfare [16].

(3) How do we use these behavioral principles to refine current theory on social practice agents?

At this moment the design of social practices agents is in the early conceptual stages [5]. To make a claim on reality we first need to make the theory more precise. By using the behavioral principles current simulations lack we can make a more informed choice in how to further develop the theory. For some principles there will be no obvious way to connect them to social practices. In such cases we can decide to narrow the scope of the theory, so that it excludes cases where these behavioral principles play a leading role. Another option is to change the theory to encompass these behavioral principles. In both cases, the decision will play a central role in the realism of our social practice agent.

(4) How do we make a formal model and computational implementation of a social practice agent?

Translating a (refined) theory into a formal model and computational implementation has at least two advantages. First, it allows modelers to simulate the (interactive) consequences of their assumptions on human behavior. As such, one can check the realism of the model both on the individual (micro) as group (macro) level [11]. Second, it makes the theory less ambiguous, due to that programming forces the modeler to make certain assumptions explicit. Unambiguity play an important role in ensuring the realism of the social practice agent.

(5) How realistic is our framework on social practice agents compared to state-of-the-art agent frameworks?

In line with Popper [13] we take an evolutionary approach to science. This means that we do not see it so much as our task to make a *completely* realistic framework, but to show that we have made a step in the right direction. In our initial three studies, we found that it is easier to make a comparative analysis, than to give absolute standards for how realistic a framework should be. Having said that, a comparative analysis brings the problem of what the object of comparison should be. Gilbert and Balke [8] described and categorized 14 state-of-the-art agent frameworks that have attracted attention in agent-based modeling. One possibility is to compare our agent framework to frameworks that, according to Gilbert and Balke [8], excel in their category. In addition to their excellence, it is important if the framework is relevant for social scenarios, if there is a practical implementation at hand and if the scope of the framework overlaps with ours. We will need further work to determine to what frameworks will fit these criteria.

We approach our main research question by going through multiple cycles of our sub research questions. The main results of this PhD for now are as follows:

**The Use of Values for Modelling Social Agents** This paper compares an agent using human values (e.g., fairness, wealth) to a homo economicus agent in the ultimatum game. Showing how the first provides more realism than the latter.

**Using Values and Norms to Model Realistic Social Agents** This paper extends the previous paper by showing that an agent with values and norms further improves the realism. This value-norm model provides a base-line for the social practice model we aim to construct. Furthermore, it gives insight into the role values and norms can play in the social practice model.

**A Meta-Model for Agents with Social Practices** This paper provides an overview of the literature on social practices that is relevant for making an agent architecture. Furthermore, it provides a UML-diagram based on this literature that can be used as a meta-model for further implementations.

**Modelling the Social Practices of an Emergency Room** This paper grounds the UML into description logic and shows how the resulting ontology can be used to make social queries in the context of a hospital.

We are currently working on the following two papers:

- A Dynamic Extension of the Meta-Model UML.
- A Comparison of Social Practice Agents to Consumat Agents for Travel Mode Choices

We hope the resulting social practice meta-model can provide a basis for realistic social agents such that we get more insight and can improve social systems

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