Thesis Research: Modeling Crowd Behavior Based on Social Comparison Theory

(Extended Abstract)

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ABSTRACT

Modeling crowd behavior is an important challenge for agent-based simulation. My overall goal is to provide a single computational cognitive mechanism that, when executed by individual agents, would give rise to different crowd behaviors, depending on the perceptions and actions available to each individual. I propose a novel model of crowd behavior, based on Social Comparison Theory (SCT), a popular social psychology theory that has been continuously evolving. I am pursuing a concrete algorithmic framework for SCT and evaluating it on different social behaviors. Moreover, I have begun to explore the use of qualitative reasoning techniques to model global (macro-level) social phenomena in demonstrations. I believe that this is the first use of QR techniques for such purposes.

Keywords

Cognitive Modeling, Social Simulation, Modeling Crowd Behavior, Qualitative reasoning

1. THESIS RESEARCH

Modeling crowd behavior is an important challenge for agent-based simulation. Models of crowd behavior facilitate analysis and prediction of the behavior of groups of people, who are in close geographical or logical states, and are affected by each other's presence and actions. Accurate models of crowd behavior are sought in training simulations, safety decision-support systems, traffic management, business and organizational science. Agent-based simulations provide an appropriate framework for such models.

A phenomenon observed in crowds, and discovered early in crowd behavior research, is that people in crowds act similar to one another, often acting in a seemingly coordinated fashion, as if governed by a single mind. However, this coordination is achieved with little or no verbal communication.

Existing models of crowd behavior, in a variety of fields, leave many open challenges. In particular in computer science, models are often simplistic, and typically not tied to a specific cognitive science theory or data. Moreover, existing computer science models often focus only on a specific phenomenon (e.g., flocking, pedestrian movement), and thus must be switched depending on the goals of the simulation.

My overall goal is to provide a single computational cognitive mechanism that, when executed by individual agents, would give rise to different crowd behaviors, depending on the perceptions and actions available to each individual. I propose a novel model of crowd behavior, based on Social Comparison Theory (SCT), a popular social psychology theory that has been continuously evolving since the 1950s. The key idea in this theory is that humans, lacking objective means to evaluate their state, compare themselves to others that are similar. While inspired by SCT, I remain deeply grounded in computer science; I am pursuing and evaluating a concrete algorithmic framework for SCT. I am investigating the scalability of this framework, and generating lessons for the agent-based simulation community [**?**, **?**, **?**, **?**, **?**, **?**].

During my PhD research, I plan to develop the SCT model, to be able to cover crowd behaviors phenomena which are not covered today. We plan to investigate the SCT by simulating complex crowd behaviors such as calm demonstrations which turn violent, etc. Moreover, we also plan to explore the SCT model in small groups' behaviors and cover phenomena like peer pressure. In all of these, the agent-based simulations I build are compared against data from human-studies.

In the first part of my dissertation, now completed, I investigated the use of SCT in pedestrian traffic [**?**, **?**, **?**]. I had shown that the SCT model is more faithful (in comparison with other models) to human pedestrian traffic. I also applied this this architecture to modeling evacuations in large buildings and public places which provided an interesting results. I have also demonstrated that the original SCT model, which called for applying socially-motivated actions only when goal-oriented actions are not feasible, to be incorrect (in that it produces simulations that are not realistic). Instead, I've shown that an architecture in which social considerations are always present works better [**?**, **?**].

In the second part of my dissertation, I have begun to explore the use of qualitative reasoning techniques to model global (macro-level) social phenomena in demonstrations [**?**]. I believe that this is the first use of QR techniques for such purposes. We incrementally present and compare three qualitative models, based on social science theories. The initial results demonstrates the efficacy of qualitative reasoning to

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apply for the development and testing of social sciences theories.

In the remaining time, I am hoping to continue with QR techniques and apply it on additional domains and evaluate it on large datasets. Moreover, I am hoping to extend the use of agent-based models to crowd and group behaviors in two ways. First, I am planning to explore the cultural differences in pedestrian and evacuation behavior and investigate whether the SCT model can account for such differences. Second, I am looking for ways to expand the SCT model by applying it in the context of small social groups. In particular, I am investigating the use of the SCT model in explaining results in game theory and psychology. Here again the application of agent-based modeling and simulation is key to my approach: I am modeling humans in the groups as agents with certain socio-cognitive mechanisms, and am using the simulations to make predictions. These are contrasted against known results.

2. REFERENCES

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