

The Effectiveness of Competitive Agent Strategy in Human-Agent Negotiation

ABSTRACT

Human-agent negotiation is a social task that provides a multifaceted proving ground for artificial intelligence systems that aim to interact with humans in a social context. Designing agents that are capable of negotiating with humans provides threefold benefit. First, it allows information regarding human behavior to be gleaned in an efficient and repeatable context through the use of programmable agents, which can serve as perfectly consistent and customizable confederates in empirical studies. Second, these agents are allowed to be tested in a real-world context, and theoretical strategies and behaviors that make the agents more effective are able to be refined directly. Finally, the agents are able to provide feedback for their human partners, directly improving their negotiation abilities and providing personal benefit to the study participants.

This work demonstrates the results of a study conducted on the Interactive Arbitration Guide Online (IAGO) Negotiation platform. The study compares the effectiveness of four different types of automated agents as they negotiate with humans over the course of a 10-minute interaction. The agents differ in a 2x2 design according to agent competitiveness (competitive vs. consensus-building) and agent attitude (nice vs. nasty attitude). These results show that in this multi-issue bargaining task, competitive agents performed far better than consensus-building agents against their human opponents, scoring far more points than the humans did. In contrast to some previous work, there was not a significant effect of agent attitude. These results have impact on agent design for single, one-shot interactions resembling real-world negotiation, although they may not extend to repeated interactions.

Author Keywords

Human-computer interaction; negotiation; empirical studies; IAGO Negotiation platform; emotion

ACM Classification Keywords

• Human-centered computing~Empirical studies in HCI.

ADDITIONAL DESCRIPTION OF STUDY AND RESULTS

This study tested the effect of agent competitiveness and attitude on the negotiation outcomes. Agents were designed to use either a competitive strategy or a consensus-building one. The competitive strategy was characterized by leading with an unfair offer and gradually conceding toward the player. The consensus-building strategy, by contrast, primarily relied on making consistent, fair offers that split the items between the player and the agent, and took into account the user's stated preferences. Agents were also designed to have either a nice or a nasty attitude. Attitude

was expressed as a combination of emotion (nasty agents often expressed anger, versus sadness for nice agents) and dialogue (nasty agents used scripted responses that were more curt and rude than the nice agents). The human players were recruited using Amazon's Mechanical Turk (MTurk) service, and followed basic best practices for that platform. Specifically, they were paid for participation, incentivized for high scores through random lottery ticket payouts, had a 98% user rating, and passed attention checks during a tutorial portion. 290 participants were recruited, and 225 remained after manipulation and attention checks. They faced one of four agents: the nice competitive, nice consensus-building, nasty competitive, or nasty consensus-building agents, assigned randomly. The task was a "multi-issue bargaining task", which consisted of players attempting to divide 20 items between themselves, with each item giving points. Each side knew their own point values, but had to deduce the opponent's point values through a combination of strategy, natural-language discussion, or emotional displays using the in-game animated agent.

We conducted 2 (agent competitiveness: competitive or consensus-building) \times 2 (agent attitude: nice or nasty attitude) ANOVAs on points received by the agent and the user in the negotiation. While agent attitude had no impact ($F_s < 0.54$, $p_s > .46$), the agents' competitiveness had a significant effect on the number of points they earned in the negotiation ($F(1, 225) = 97.67$, $p < .001$) such that competitive agents earned more points ($M = 36.56$, $SE = 0.33$) than consensus-building ones ($M = 32.09$, $SE = 0.31$). Likewise, agents' competitiveness significantly impacted the number of points users earned ($F(1, 225) = 59.83$, $p < .001$) such that users who played competitive agents earned fewer points ($M = 24.73$, $SE = 0.50$) than those who played consensus-building agents ($M = 30.06$, $SE = 0.48$). Again, there was no effect of agent attitude ($F(1, 225) = 0.03$, $p = .86$), and the interaction only approached significance ($F(1, 225) = 2.72$, $p = .10$), where an inspection of the pattern of results revealed that the gap between competitive and consensus-building was, if anything, somewhat stronger for nice agents than nasty ones. This work indicates that competitive strategies are highly effective, but future work should focus on the "cost" of these strategies in repeated interactions.

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