

Chapter 7

Negotiation Behaviors in Agent-Based Negotiation Support Systems

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ABSTRACT

Prior research on negotiation support systems (NSS) has paid limited attention to the information content in the observed bid sequences of negotiators as well as on the cognitive limitations of individual negotiators and their impacts on negotiation performance. In this paper, we assess the performance of human subjects in the context of agent-based NSS, and the accuracy of an exponential functional form in representing observed human bid sequences. We then predict the reservation values of negotiators based on their observed bids. Finally, we study the impact of negotiation support systems in helping users realize superior negotiation outcomes. Results indicate that an exponential function is a good model for observed bids.

INTRODUCTION

Negotiation is a form of decision-making where two or more agents who cannot make decisions independently, must make concessions to achieve a compromise (Kersten, Michalowski, Szpakowicz and Koperczak 1991). As observed by Raiffa

(1982, pg 358), negotiators often fail to reach an agreement when in fact agreement was possible based on the preferences of the negotiators. Much remains to be done in creating effective negotiation aids to automate the bidding process and to facilitate the development of agent-based environments where agents can act as surrogates for human negotiators.

This article addresses the emerging environment where agents act as surrogates for human principals in a fully automated agent-based environment. For example, in emerging electronic markets for perishable goods and services, where transient market opportunities may require buyers and sellers to reach agreement quickly (Kambil and Heck 1998), or in emerging e-procurement systems where buyer agents could negotiate with supplier agents. In some of these environments, there are no alternate channels for communicating justifications of bids that could be expected in traditional negotiations involving human negotiators. The only inter-agent communication is a sequence of bids for all issues being negotiated. We use experiments with human subjects to test the applicability of an exponential function to model observed negotiation bids. We then examine the impact of a software-agent-based NSS platform in helping users overcome their limitations in realizing superior negotiation outcomes. A distinguishing feature of the NSS is that it can estimate opponent characteristics.

We make the following contributions in this article: (1) model human negotiation bid sequences, (2) investigate the impact of NSS in assisting users to overcome their limitations in achieving superior negotiation outcomes, and (3) predict reservation values of negotiators based on the observed bids. The results in this article can help in the development of next generation NSS.

This article is organized as follows. Section 2 provides an overview of the agent-based NSS and relevant literature. The various research hypotheses are presented in Section 3. The experimental setup to test the various hypotheses is described in Section 4. Results from the experimental study are presented in Section 5. The article concludes with a discussion of the results in Section 6. An appendix contains a brief description of the Hybrid agent used in the experiments.

AGENT-BASED NSS

Empirical research suggests that a NSS can improve outcomes, particularly when there are opportunities for integrative solutions, i.e., when the two negotiating parties have different priorities for the various issues under negotiations, and therefore there are opportunities for expanding the pie (Raiffa 1982). For example, Rangaswamy and Shell (1997) have reported that in an integrative situation, a simple NSS that provides a structured negotiation process and enables negotiators to analyze their own preferences improves the likelihood of agreement from 11% in case of face-to-face negotiations to 43% using the NSS.

Many agent systems have been developed for automated/semi-automated negotiations. The Kasbah agent system uses simple negotiation heuristics based on pre-defined price decay or increment functions (Chavez and Maes 1996). Kasbah agents do not learn and therefore cannot adapt to the negotiation environment. Faratin et al. (1998), use families of polynomial and exponential functions to model opponent concession behaviors during negotiations. The three canonical behaviors modeled are Boulware, conceiver and imitative behaviors. These behaviors are then combined using weights via human intervention to create a composite negotiation strategy. The Inspire project provides negotiators with a communication platform and analytical tools to analyze the negotiation scenario (Vetschera, Kersten and Koeszegi 2006). Agents developed in the Bazaar project (Zeng and Sycara 1998) use Bayesian update rules from historical data to learn and form beliefs about the opponent's reservation values. However, as pointed out before, estimating multitude of probabilities accurately is not always practical in many situations.

To summarize the above research, we find that the various prior NSS are generally incapable of learning and estimating opponent characteristics based on the observed bid sequence in an automated fashion. In prior research (Chari and

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