



NEGOTIATION GOES HIGH TECH: CAN YOU NEGOTIATE WITH A MACHINE?

Gordana Dobrijević, Jelena Đorđević Boljanović

Singidunum University, Belgrade

Abstract:

Negotiation is one of the basic forms of interpersonal communication. Because of negotiating parties' cognitive biases and limited capacity for information processing, the negotiation outcomes are sometimes far from optimal. This led to the development of various negotiation support systems and automated agents, which help human negotiators reach better outcomes. In this article, we review some of the most common systems used for electronic negotiations.

Key words:

negotiation,
electronic negotiation,
negotiation support system,
automated negotiating agent,
negotiation subprocesses.

INTRODUCTION

Negotiation is a process by which two or more parties (individuals or groups) try to resolve their conflicting interests. It happens for several reasons: 1) to distribute or share some limited resource, such as money or time; 2) to make something new that neither party would be able to do on their own; and 3) to solve a problem or a conflict between the parties [1]. Negotiation is one of the basic forms of interpersonal communication, and we sometimes engage in it even if we are not aware of it. It is an interactive communication process that takes place whenever we want something from others, or other people want something from us. Apart from communication, decision-making is another major aspect of every negotiation process. The parties have to collect and process information to decide on offers and alternatives.

During the negotiation process itself, some other psychological and sociological subprocesses take place, which we do not always recognize as such. They influence the behaviour of the negotiators, their choice of negotiation strategies and tactics, the negotiation outcome and negotiators' satisfaction with it, as well as mutual relationship during this particular negotiation and all future interactions. Those subprocesses are perception, cognition, power, influence, emotion, ethics, and communication [1]. We shall briefly point out their most important adverse effects on negotiation.

All our social interactions depend on our perception of the world around us. In any negotiation, negotiator's personal experiences can create biases and errors in perception, e.g. stereotyping, halo effect, and selective perception. Framing is another critical issue – it means that two or more people involved in the same situation can see it in different ways. In every negotiation, frames create what the parties establish as the most important issues and how they talk and feel about them.

There are also various cognitive biases that can decrease negotiator's performance: irrational escalation of commitment, anchoring, self-serving bias, reactive devaluation, the availability of information, the winner's curse, to mention just some of them. These biases lead to systematic errors in decision making.

Negotiation process can generate both positive and negative emotions and moods due to various reasons. Sometimes, even emotions created by some random events, which have nothing to do with the actual negotiation can influence the whole process.

All negotiators want to have power and influence. They can help us get what we want from the other party. While power is the capacity to change others' attitudes and behaviours, influence includes actual tactics and actions we undertake in order to modify their behaviours or attitudes [2]. Sometimes this want for power and the wish to get what we want from negotiations leads negotiators towards ethically ambiguous tactics, although, in the



long run, they result in ruined reputation and decreased negotiator performance.

Last but not least, there are three important problems in communication: 1) negotiators may not be talking to each other; instead, they are trying to impress third parties or their own constituencies; 2) negotiators sometimes don't pay enough attention to what the other side is saying; instead, they are thinking about what they are going to say; 3) negotiators may misunderstand each other due to different languages, dialects or nonverbal communication [3].

Because of this human factor (especially cognitive biases and limited capacity for information processing), the negotiation outcomes are sometimes far from optimal. This led to the development of various negotiation support systems (NSS) and negotiating agents, which help human negotiators reach better outcomes.

ELECTRONIC NEGOTIATION

Electronic negotiation is a process of conflict management administered on the Internet and supported with software. It can support simple everyday communication between the parties using e-mail or chat, or implement tools for complex multimedia interactions, such as e-markets. Today's software is made to support e-negotiations and online dispute resolution, using many of the methods and models dating from the seventies [4]. Internet's potential for supporting some or all negotiation activities has considerably enabled the manufacturing partners to reduce production costs and time [5].

We shall analyse several ways of using information technology in negotiation, starting with the simplest one – using e-mail to conduct negotiation.

NEGOTIATING VIA E-MAIL

E-mail is increasingly used as a communication tool in negotiations, being a cost-effective way of reaching people from other parts of the world. It is the simplest form of e-negotiations, used for exchanging offers and counteroffers. There are considerable differences between e-mails and other communication media if used in negotiation, and some serious drawbacks of this form of communication. For the majority of people, Internet is still perceived as an informal communication medium, so that even in a formal business communication they use informal discourse, without paying enough attention to grammar and orthography. Internet also provides a sense of anonymity, so that people often say things they would never say during a direct face-to-face communication. For example, they become more hostile, give ultimatums, start conflicts, etc. [1]. One piece of research has shown that people normally cooperate more and reach better outcomes if they establish some more personal contact before e-mail negotiations by phone or face-to-face [6].

The results of one recent study show similar effects of online negotiation teaching. New technologies have enabled teachers to have their courses online. This piece of

research compares the traditional and virtual courses, and it shows that online students lack interaction with their teacher and classmates [7].

NEGOTIATION SUPPORT SYSTEMS

Internet enabled the use of decision and negotiation support systems (DSS and NSS). They were developed to give support to individual negotiators, or to assist situations involving two or more negotiators [8]. Negotiation support systems are designed to help human negotiators during various phases of the negotiation process, e.g. understanding the issue(s) of negotiation, assigning preferences for negotiable issues and alternatives, and setting the reservation price before the actual negotiation takes place [9]. Although they are supported by the NSSs, human negotiators still direct the whole negotiation process [10].

There are some online NSSs, open for public use, for example INSPIRE, Smartsettle and ExpertNegotiator.

- ◆ INSPIRE [11] was developed for teaching and research at Carleton University, Canada. It can be used for determination of preferences, evaluation of offers, communication management, graphical demonstration of the negotiation's progress, post-agreement analysis, etc. It can be used as a game, as a decision support system, a negotiation simulator, a negotiation support system, and a research and training tool. It is also a valuable tool during all three phases of negotiation: preparation, the actual negotiation (exchange of offers and counteroffers, including concessions), and the post-settlement period.
- ◆ Smartsettle [12] is used for conflict management and prevention within family and small business, helping the parties reach a settlement out of court. It can be used online or in combination with face-to-face meetings. If negotiators are not able to meet, they can negotiate asynchronously. In the process of blind bidding, parties keep their preferences private. If there is an overlap, the agreement is pronounced, so that the endless bargaining can be eliminated from the process.
- ◆ ExpertNegotiator [13] is based on the collective experience and best practices of many famous negotiators. It includes five tools:
 - a strategic planning tool, with templates that allow negotiators to make a negotiation plan in ten minutes,
 - the Five golden rules method (a strategic approach developed by Marty Latz, a famous negotiation expert) which includes gaining information, maximizing leverage, fair criteria, choosing the most effective offer, and controlling the agenda,
 - a counterpart intelligence bank, where users keep all information about the other party's reputation and strategies;
 - the ExpertAdvice centre, where users can find professional negotiation guidance and research; and



- a negotiation best practice management system, where users create deal-specific templates for different types of negotiations.

NSSs develop all possible alternatives based on the inputs of all parties, thus fixing the impulse to end negotiations prematurely, with the first satisfactory solution. They also eliminate irrational behaviour of human negotiators [14]. Research has shown that NSSs increase preferred negotiation outcomes, bring about higher joint gains and more balanced agreements, and reduce negotiation time [15].

AUTOMATED NEGOTIATION AGENTS

With the growth of global e-business, there are growing possibilities for the use of software agents in negotiation with humans. Fully automated agents can conduct negotiations on behalf of human decision makers. They give some benefits to the e-market, such as better outcomes, fewer problems connected to social and emotional conflicts, and reduced costs due to less required work performed by humans [10].

During negotiation, each party has their desires and preferences (many times not telling about them to the other party). Those preferences are often in conflict, so that negotiators need to make concessions and to cooperate in order to reach an agreement. That is where automated negotiation agents come in handy, with some important benefits: 1) they can relieve the effort of the negotiators during the process; 2) they can help less experienced negotiators with the negotiation process, which can sometimes be complicated, 3) they can completely replace human negotiators, and 4) they can serve as a training instrument before the actual process takes place [16].

The designers of negotiation agents have to take into consideration the negotiation environment, *i.e.* how many parties there are (two or more), the time frame (only once or repeatedly), and the issues (how many attributes for each issue). The information model dictates what is known to each agent, whether they have complete information and know each other's preferences or not [16]. In an experiment of human-agent negotiation conducted by Vahidov and Kersten [17], in most cases human negotiators were not able to guess whether they were negotiating with a human or a machine. That was because agents were able to use a complex concession pattern – first they competed, then collaborated.

Lin and Kraus [16] give a thorough review of the current state-of-the-art automated agents for negotiating with humans, beginning with the simple ones:

- ♦ The Diplomat Agent, developed over twenty years ago by Kraus and Lehmann. The agent plays the Diplomacy game with the goal to win. The game includes several sessions of multi-issue negotiations, where players may exchange misleading information. Commitments can be broken, so that the issue of trust is also important. It has five different modules, where different personality traits can be implemented. The agent tries to estimate the other party's personality, thus predicting whether or not the other party will keep their promises.
- ♦ The OutONA Agent, developed by Byde. It can be used for multiple negotiators between buyers and sellers over the quantity and price of some product. Each offer is directed at only one player on the other side and is kept private. In each round, players can make / accept new offers or end the negotiations. This agent allows commitments to be made without keeping them, as in negotiations between humans.
- ♦ The Cliff-Edge Agent was developed by Katz and Kraus. It uses the reinforcement learning algorithm that combines virtual learning with reinforcement learning. The results of the earlier encounters are kept in the database for future reference. If an offer is rejected during a present encounter, then the following time the proposer will make a higher offer. The automated agents generally have higher payoff than humans.
- ♦ The Colored-Trails Agent, developed by Ficici and Pfeffer, used in playing the Colored Trails game. Agents negotiate with each other in order to obtain chips. They are given the results from the earlier human-human interactions, and later they perform similarly to humans.
- ♦ The Guessing Heuristic Agent, developed by Jonker, Robu and Treur. It can be used in bilateral multi-issue and multi-attribute negotiation, where the parties have incomplete information. It uses a guessing heuristic, which tries to predict the other party's preferences based on their offers' history. This agent is used as a substitute for the human negotiator, who only sets the preferences parameters in the beginning.
- ♦ The QOAgent can negotiate with humans in bilateral negotiations with incomplete information. Costs are given to each negotiator, so that they can gain or lose credit over time. Negotiators don't disclose their preferences, but the opponents can predict them based on their previous offers.
- ♦ The Virtual Human Agent can be used not only in negotiation, but also in developing interpersonal skills, such as leadership and cultural awareness. It is based on Soar Cognitive Architecture. Agent chooses *e.g.* when to act aggressively or how much to trust the opponent.

There are many changes in open commerce environments, so that automated negotiation systems should be designed as adaptable to those changes. According to Resinas, Fernandez, and Corchuleo [18], the automated systems should be able to support multiple negotiation protocols, negotiate the negotiation protocol, support multiple decision-making algorithms, multiple agreement models, and multiple preferences models, as well as allow for user preferences about negotiation processes. Due to limited information about the parties with which they negotiate, they should be able to manage different types of knowledge about the other party, gather information from different sources, and build analysis-based models of parties.



Negotiating agents are normally built from scratch, which obviously limits their potential in practical applications. There have been different methodologies for agent-oriented software engineering, e.g. Gaia [19], MESSAGE [20], and Aspects [21]. A recently developed model for the design of negotiating agents is KEMNAD (A Knowledge Engineering Methodology for Negotiating Agent Development) [22]. It consists of a generic knowledge model of the main task and various standardized templates that are reusable models of the main task model. Combining different templates can create different negotiation models.

According to Rahwan, Sonenberg, Jennings, and McBurney [23], one of the major problems in making negotiating agents is the design of negotiation strategy, which determines the behaviour of the negotiation agent. Researchers initially used the classical game theory to design strategies used by negotiation agents. The practical experience has shown that the results of the game theory are only valid if we assume that both parties are perfectly rational. In practical applications, agents can be malicious, whimsical, or just badly coded, so that their behaviour has not shown perfect economic rationality. That is why agent designers started using heuristic methods. They are rules of thumb based on empirical testing and evaluation, which produce satisfactory outcomes (not the best ones).

One of the solutions for automated electronic negotiation is STRATUM [23], a methodology for designing strategies for negotiating agents. It acts as a link between theoretical studies and software engineering of applications used in negotiation, enabling the analysis of the negotiation environment. It designs strategies based on agent capabilities, sufficiently general to be used in different negotiation situations. Apart from heuristic models, there are some other models for the design of negotiation strategies: generic algorithms, Bayesian models, and estimation algorithms for multi-issue trade-offs [10].

CHALLENGES OF ELECTRONIC NEGOTIATION

There are several important challenges of electronic negotiation. Firstly, automated agents that negotiate with humans must be able to negotiate in an environment where both parties have limited information and bounded rationality. It is necessary for automated agents to have two independent mechanisms. The first one is a decision-making mechanism, which is in charge of creating and accepting/rejecting offers. The problem is not making decisions *per se*, but taking into consideration environmental and social factors that make human behaviour. Another challenge for an agent is to generalize its behaviour, so that it can be used in any setting, to be a “general” negotiator. Building trust is another possible problem. It is well known that successful negotiations are based on trust, which in turn is based on mutual relationship. This is why some of the agents allow cheap-talk and unenforceable agreements [16].

When conducting electronic negotiations, there is a risk of disclosing more data than we want. If we send files to the other party, some confidential information in the form of metadata can also be sent inadvertently. Negotiators have to be very careful and to eliminate all the meta-

data from the documents before sending them to other parties [24].

And finally, non-existing nonverbal communication sometimes makes it hard for negotiators to discern the tone that the sender wanted to convey. We have already mentioned that due to the lack of human contact and the sense of anonymity negotiators tend to become more aggressive and give ultimatums more often in electronic negotiations.

CONCLUSION

Although the basis of every negotiation is interpersonal communication between people, negotiation is increasingly becoming supported by high technology. Among some other factors, cognitive biases and limited capacity of negotiators often bring about less than optimal outcomes. There are various negotiation support systems and automated negotiating agents that can help human negotiators achieve better results and spend less time and effort on the negotiation process. In this article we presented some of those systems and agents, briefly analysing some of their characteristics, strengths and weaknesses.

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