# Motivation-based selection of negotiation partners.

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## Abstract

*Negotiation is key to resolving conflicts, allocating resources and establishing cooperation in systems of self-interested agents. Often, an agent may have to select between different potential negotiation partners, and identifying which offers the best chance of a successful negotiation is a challenging task. However, poor selection of partners can result in failure or in inefficient outcomes. To that end, this paper describes a motivation-based mechanism to evaluate and select between negotiation candidates. This is achieved by a twofold process: first, acceptable candidates are identified using motivation-based* thresholds *on objective scoring measures; second, the importance of issues is considered, and expected performance measures are evaluated accordingly. The mechanism is described and empirically evaluated.*

## 1. Introduction

When entering a negotiation, the kinds of deals possible are affected by four main criteria: the negotiation protocol used; the strategies used by the participants; the available resources; and, the valuations placed on the resources by the participants. Much existing work examines the influences that protocols and strategies can have on negotiation outcomes (e.g. [2, 3]), but there is less work that details the effects of resource availability and valuation on the selection of negotiation partners and, as a consequence, the kinds of negotiation deals that are possible.

### 1.1. Partner Selection for Negotiation

Selecting a negotiation partner involves the consideration of several *issues* against which *candidates* may be measured, comparing their relative performance and selecting the best performing candidate. Exactly which issues are considered depends largely on the particular negotiation and the participants, with some common possibilities being *price*, *quality*, and the *speed of delivery* of the negotiation object by the candidate.

When evaluating the performance of agents on particular issues, it is common to use scoring functions, which offer a way to relate the performance of different agents over different issues. However, agents must typically cope with environments that impose dynamic constraints on the satisfaction of goals, which must be taken into account by the scoring function. For example, an agent with a large amount of money should score performance over an issue of price, say, differently from an agent with little money. Such considerations need a subjective approach in which the agent is able to rate the performance of another agent based on its current needs and constraints.

### 1.2. Motivation and Dynamic Constraints

One way to model the influence of agent attitudes and dynamically changing constraints on selection criteria (typically triggered by environmental circumstances) is through the use of *motivation*, which affects the choices and actions of agents [6, 4, 1]. Motivations have an associated *intensity* level, which is modified by the perception of motivationally important features of the environment, called *motivational cues* [5]. Motivations with higher intensities have greater influence over an agent's actions than those with lower intensities.

## 2. Identification of Candidates

Negotiation issues can typically be associated with a set of possible values which, during the course of a negotiation, may be assigned to the issue. Scoring the the expected performance of candidate negotiation partners involves forming expectations of the values a candidate will accept for a given issue, and then evaluating that value. However, this assumes that the issue will have a fixed importance to the agent so that the evaluation by the scoring function yields the same score for the same expected performance at different times. However, this is unrealistic in many agent applications, where changing resource constraints may mean that an issue may take on a greater or lesser level of importance over time.


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### 2.1. The Importance of Issues and Goals

In order to incorporate this issue of importance into the evaluation of performance, we link motivations to issues so that, as a motivation increases in intensity, then so does the issue in importance. In turn, an issue's importance determines an *acceptability threshold*, which limits those values the issue might take to those that are seen as acceptable to an agent.

Once we have the acceptability threshold set by the importance of the issue, we then incorporate the importance of the goal for which the negotiation has been set. Like issues, goals are associated with motivations in the model presented in [6], so that as a motivation's intensity increases, so does the importance of any goal that is associated with it. The importance of the goal thus modifies the acceptability threshold, so that if the goal is highly important to the agent the acceptability threshold is altered so that more values from the set of possible values the issue might take can be considered acceptable.

## 3. Evaluation of Candidates

Once an agent has updated the acceptability thresholds for each issue in the forthcoming negotiation, it can consider the expected performance on those issues for each of the possible negotiation candidates. In our work, we use an historical approach in which past performance of candidates on these issues is used to extrapolate future performance. At this stage, the agent can discard those candidates whose expected performance does not pass the acceptability thresholds. However, of the remaining set of candidates, the scores of each are weighted using associated motivational intensities to determine which candidate has the best overall performance given each issue's relative importance to the agent at that time.

## 4. Evaluating the Model

In order to evaluate the model we ran experiments to check that the buyer was able to use information about potential negotiation partners gained through past interactions. We tested this by calculating which agent, out of a set of available seller agents, offered the optimal deal given the buyer's current motivational state, and then comparing this with the actual deal found by the buyer. Each run of the experiment lasted for 200 negotiation rounds and we performed 20 such runs with 100 candidate negotiation agents and one buyer agent. Figure 1 shows the average variation between the buyer-agent's deal values and the optimal deal values over the 20 experimental runs. It can be seen that over time the buyer-agent eventually learns to exploit the best seller-agents given its current motivational state, shown by the variation line falling to 0 after negotiation number 150.

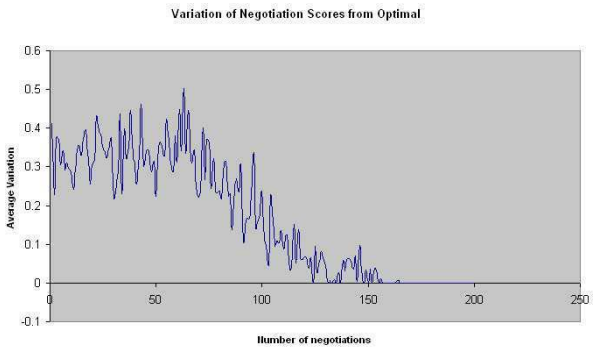


**Figure 1. Performance of Motivated Partner Selection**

Though this analysis suggests that the model is effective, much more work is needed to explore the full range of concerns. Indeed, work is ongoing to examine the difference in efficiency gains made by using motivational selection over other selection processes.

## 5. Conclusion

By linking negotiation issues to motivations, agents are able to evaluate prospective negotiation partner performance over those issues in terms of current motivational needs, so that compatible partners can be identified. As an agent's circumstances change, the issues involved also change in importance, and this must be considered when attempting to choose which agents to negotiate with. We expect future work to address the development of methods for negotiation partner selection where protocols and strategies are important decision factors.

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