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A heuristic personality-based bilateral multi-issue bargaining model in electronic commerce

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Abstract

Our everyday lives and specially our commercial transactions involve complex negotiations that incorporate decision-making in a multi-issue setting under utility constraints. Negotiation as a key stage in all commercial transactions has been proliferated by applying decision support facilities that AI techniques provide. Recently, Distributed Artificial Intelligence techniques have been evolved towards multi-agent systems (MASs) where each agent is an intelligent system that solves a specific problem. Incorporating MAS into e-commerce negotiation and bargaining has brought even more potential improvement in efficiency and effectiveness of business systems by automating several of the most time consuming and repetitive stages of the buying process. In bargaining, participants with opposing interests communicate and try to find mutually beneficial agreements by exchanging compromising proposals. However, recent studies on commercial bargaining and negotiation in MASs lack a personality model. Indeed, adding personality to intelligent agents makes them more human-like and increases their flexibility.

We investigate the role of personality behaviors of participants in multi-criteria bilateral bargaining in a single-good e-marketplace, where both parties are OCEAN agents based on the five-factor (Openness, Conscientiousness, Extraversion, Agreeableness, and Negative emotions) model of personality. We do not aim to determine strategies that humans should use in negotiation, but to present a more human-like model to enhance the realism of rational bargaining behavior in MASs. First, this study presents a computational approach based on a heuristic bargaining protocol and a personality model, and second, considers the issue of what personality traits and behaviors should be investigated in relation to automated negotiations. We show the results obtained via the simulation on artificial stereotypes. The results suggest and model compound personality style behaviors appropriate to gain the best overall utility in the role of buyer and seller agents and with regard to social welfare and market activeness. This personality-based approach can be used as a predictive or descriptive model of human behavior to adopt in appropriate situations in many areas involving negotiation and bargaining (e.g., commerce, business, politics, military, etc.) for conflict prevention and resolution. This model can be applied as a testbed for comparing personality models against each other based on human data in different negotiation domains.

Keywords: Conflict prevention; Decision-making; E-commerce; Five-factor model of personality; Fuzzy inference; Intelligent agents; Multi-criteria two-person bargaining

1. Introduction

At present, e-commerce is a relatively new interdisciplinary field. The most common form of e-commerce systems are essentially electronic shop fronts to allow business to sell goods and services to customers via the Internet. A human buyer does still collect and interpret information on merchants and products, make decisions

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about which merchants and products to investigate, negotiate the terms of transactions with these merchants, and finally place orders and make payments automatically. Fortunately, agent-based technology is a rapidly developing area of research in AI which is incorporated into e-commerce systems and has brought even more potential improvement in efficiency and effectiveness of business systems. An agent is an atomic software entity operating through autonomous actions on behalf of the user without intervention. Mobile intelligent, software agents are the key technology that gives both buyer and seller the mobility feature for better exploiting the e-commerce environment facilities to maximize their own profits in purchasing/selling the good. These software autonomous agents travel across the network and pass synchronous and asynchronous messages to communicate with each other.

Recently, Distributed Artificial Intelligence techniques have been evolved towards multi-agent systems (MASs) where each agent is an intelligent system that solves a specific problem. E-commerce even has been more proliferated by applying MAS in automating negotiation and bargaining, the most time consuming and repetitive stage of the buying process. Negotiation is a key stage in all commercial transactions where participants with opposing interests communicate and try to find mutual beneficial agreements by exchanging compromising proposals. Negotiation and bargaining can be described as a distributed search through a space of potential agreements. Participants raise/reduce their offers until an agreement is hopefully reached (Nash, 1950; Kraus, 1997; Faratin et al., 1998; Weiss, 1999; Deschner et al., 2001; Jennings et al., 2001; Fatima et al., 2005). Bargaining is a challenging area that has been well explored in both MASs and economics. Elegant studies have been recently done on MAS-based negotiation and bargaining. These studies often deal with strategies in bilateral negotiations to find an equilibrium outcome or to model the opponent (Faratin et al., 1998; Talman, 2004; Fatima et al., 2005; Gal and Pfeffer, 2006, 2007; Lin et al., 2008). The result of bargaining is strongly related to the behaviors of participants. However, the important issue that has not been considered in these studies on bargaining and negotiation in electronic commerce is a computational model on personality of participants. Adding personality and behaviors to intelligent agents in a negotiation makes them more human-like and realistic. When participants represent compound behaviors and personalities, reaching an agreement turns into a complex, challenging but worthwhile phenomenon (Howard and Howard, 2004; Hudlicka, 2006; Lewicki et al., 2006; Lin et al., 2008).

Meanwhile, in recent years, many researchers have fruitfully utilized the MASs to design and implement models for personality, behavior, and emotion among agents in several contexts, and more possibilities exist (Reilly and Bates, 1992; Sloman, 1993; Bates, 1994; Barber et al., 1998; André et al., 2000; Gratch and Marsella, 2001, 2004; Hudlicka, 2003, 2006; Ghasem-Aghaee and Ören, 2004; Martínez-Miranda and Aldea, 2005). Behaviors are influenced by personalities and personality refers to the sets of predictable behaviors by which people are recognized and identified (Ghasem-Aghaee and Ören, 2004). According to the OCEAN model, *Openness*, *Conscientiousness*, *Extraversion*, *Agreeableness*, and *Negative emotions* (including a total of 30 facets) make up a big five-factor model (FFM) of personality. Since the 80's, a plethora of personality researchers has established the FFM. FFM is the most widely accepted set of descriptive personality traits and its capability in accounting for a wide variety of behaviors has been demonstrated (Norman, 1963; McCrae and Costa, 1985, 1987, 1999; Liebert and Speigler, 1990; McAdams, 1992; Costa and McCrae, 1992a–c, 1995; Barrett and Pietromonaco, 1997; Heinström, 2003; Howard and Howard, 2004; Landers and Lounsbury, 2006).

However, to the best of our knowledge, the use of FFM in the context of electronic commerce, specially automated commercial negotiation and bargaining, is a research area still unexplored. In this study, we aim to present a computational use of the FFM of personality to enhance the realism of rational bargaining behavior and show how measurable personality traits can be incorporated into MASs. We model human bargaining behavior by introducing a personality-based bargaining approach which considers different types of behaviors related to the personalities of participants in multi-criteria bilateral bargaining in a single-good e-marketplace, where both parties are simulated by OCEAN agents. The study provides simulation data, based on a new mathematical model to gain insight into exploring and illustrating patterns of behavior and negotiation outcomes. The simulation results suggest and model compound personality style behaviors appropriate to gain the best overall utility in the role of buyer and seller and with regard to social welfare and market activeness. This personality-based approach can be used as a predictive or descriptive model of human behavior to adopt in appropriate situations in many areas involving negotiation and bargaining (e.g., commerce, business, politics, the military, etc.). However, this study has also limitations with respect to limitations of FFM and the lack of empirical data as well as lack of psychological studies on personality behaviors in negotiation domains that required us to use highly stereotypical personality types in our case study simulation. In this computational model, instead of FFM other personality models can be exploited that may have more or fewer personality traits. What is important in this model is that it shows how personality traits can be mapped into autonomous decision-making. In addition, competitive or cooperative decision-making are two types of different behaviors that a personality model encompasses. Therefore, by feeding human data into the model, it can be applied as a testbed for comparing personality models against each other in different competitive and cooperative negotiation domains.