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Representing decision-makers using styles of behavior: An approach designed for group decision support systems

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Abstract

Supporting decision-making processes when the elements of a group are geographically dispersed and on a tight schedule is a complex task. Aiming to support decision-makers anytime and anywhere, Web-based group decision support systems have been studied. However, the limitations in the decision-makers' interactions associated to this scenario bring new challenges. In this work, we propose a set of behavioral styles from which decision-makers' intentions can be modelled into agents. The goal is that, besides having agents represent typical preferences of the decision-makers (towards alternatives and criteria), they can also represent their intentions. To do so, we conducted a survey with 64 participants in order to find homogeneous operating values so as to numerically define the proposed behavioral styles in four dimensions. In addition, we also propose a communication model that simulates the dialogues made by decision-makers in face-to-face meetings. We developed a prototype to simulate decision scenarios and found that agents are capable of acting according to the decision-makers' intentions and fundamentally benefit from different possible behavioral styles, just as a face-to-face meeting benefits from the heterogeneity of its participants.

Keywords: Group decision support systems; Styles of behavior; Cognitive agents; Affective computing

1. Introduction

It is a given that in organizations most decisions are group decisions (Lunenburg, 2011). There are 2 main reasons: on the one hand, most of the current organizations organigrams involve several decision-makers (Luthans, 2010), both at the strategic (Eisenhardt & Zbaracki, 1992) and at the technical level (Montoya-Weiss, Massey, & Song, 2001), and on the other hand, deciding as a group can potentiate the decision quality (Dennis, 1996; Hill, 1982; Huber, 1984). Group Decision Support Systems (GDSS) have been widely studied throughout the last decades (DeSanctis & Gallupe, 1984, 1987; Gray, 1987; Marakas, 2003) to support this type of decisions. However, in the last ten/twenty years, we have seen a remarkable change in the context where the decision-making process happens, particularly in large organizations (Chen, Liou, Wang, Fan, & Chi, 2007; Grudin, 2002). With the

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emergence of global markets, the growth of multinational organizations and a globalist view of the planet, we can easily have decision-makers (chief executive officers, managers and other members of global virtual teams) spreading around the world, across countries with different time zones (Shum, Cannavacciuolo, De Liddo, Iandoli, & Quinto, 2013). Moreover, to support the group decision-making process in this context is particularly complex, due to the decision-makers being geographically dispersed. This can lead to additional problems: failure to communicate and retain contextual information, unevenly distributed information, difficulty to communicate and to understand the salience of information, differences in the speed of access to information, and difficulty to interpret the meaning of silence (Bjørn, Esbensen, Jensen, & Matthiesen, 2014); and to deal with temporal issues, which can originate: ambiguity, conflicting temporal interests and requirements, and scarcity of temporal resources (McGrath, 1991). To provide an answer and operate correctly in this type of scenarios, the traditional GDSS have evolved to what we identify today as Web-based GDSS (Alonso, Herrera-Viedma, Chiclana, & Herrera, 2010; Kwon, Yoo, & Suh, 2005; Marreiros, Santos, Ramos, & Neves, 2010). The idea behind the Web-based GDSS is to support the decision-making process "anytime" and "anywhere" (Santos, Marreiros, Ramos, Neves, & Bulas-Cruz, 2006; Shim et al., 2002), and to help deal with some of the referred problems. Two main approaches have been implemented in GDSS to help with group decision-making processes. The classical approaches, based on preferences' aggregation, and the consensus-based approaches. The former consists in an aggregation phase, that combines the experts' preferences, followed by the selection of one alternative (Herrera, Martınez, & Sánchez, 2005; Saaty, 1988). The latter extends the former through an iterative process in order to achieve consensus (Fedrizzi & Kacprzyk, 1988; Iván Palomares & Martínez, 2014b).

When developing a Web-based GDSS it is necessary to be aware of the benefits inherent to group decision-making. A typical face-to-face meeting allows the decision-makers' interaction, exchange of ideas, work on new knowledge and intelligence generation (Dennis, 1996; Hill, 1982; Huber, 1984). In an ideal scenario, we can achieve some of these benefits using automatic negotiation models (for instance: argumentation-based negotiation models). However, there is much more besides the "messages" exchanged by decision-makers. It is necessary to work in the representation of those decision-makers. The representation can range from criteria's evaluation (for instance in a multi-criteria problem (Carneiro, Martinho, Marreiros, & Novais, 2015)) to a complete representation of the individual (personality, emotions, mood, etc. (Gmytrasiewicz & Lisetti, 2002; Raja & Srivatsa, 2006; Santos, Marreiros, Ramos, Neves, & Bulas-Cruz, 2009b)). The face-to-face meetings benefit from the decision-makers' heterogeneity (Hambrick, Cho, & Chen, 1996). This heterogeneity is related with the decision-makers' temperament but also with the decision-makers' intentions. Let us consider a scenario in which a medical team intends to choose a particular course of treatment for a patient whose condition calls for different areas of expertise. As in any other multi-criteria problem, each of the specialists, depending on their own background could have their own preferences over a number of possible alternatives, considering for instance, the order/timing of certain required interventions. However, each team member's opinion may be subject to a different appreciation, being judged for instance in terms of importance, rank, expert level or even based on implicit rules regarding their overall credibility. It is also conceivable that in some authoritative contexts the opinions of the highest graduated specialist may be taken as the rule of law, limiting any further suggestions once they are stated.

To model agents with human-like aspects is not new. At the start of the new millennium, some projects dealing with agents' humanization began to appear (André, Klesen, Gebhard, Allen, & Rist, 2000). Nowadays, there are many proposals that intend to model human characteristics in agents, such as: personality (Dimuro, da Rocha Costa, Gonçalves, & Hübner, 2007; Padgham & Taylor, 1997), emotions (Ball & Breese, 2000; Gmytrasiewicz & Lisetti, 2002), cognitive styles (Frank, Bittner, & Raubal, 2001), etc. There are also some few proposals under the topic of GDSS (Palomares, Martinez, & Herrera, 2014; Palomares, Rodríguez, & Martínez, 2013; Recio-García, Quijano, & Díaz-Agudo, 2013; Santos et al., 2009b). All of them share the idea that the inclusion of cognitive/affective aspects helps in some way the decision-making process. However, (to the best of our knowledge) most of them are oriented to be used in simulated environments. The usage of such techniques in real systems can bring some disadvantages. "A real me" can be a bad approach if my persona is less persuasive/intelligent/capable than others. An application that mimics one's limitation will be of lesser interest. Moreover, the inclusion of aspects such as personality, do not permit to reflect other aspects such as intentions and objectives. For each decision-maker the objectives and intentions can vary even for the same problem.

In this article, we propose a set of behavioral styles (Dominating, Integrating, Compromising, Obliging and Avoiding) to model agents that represent decision-makers in a group decision-making process. An agent modelled with each of these behavior styles is able to act following the intentions of the decision-maker it represents; The intentions may be for instance "preferring to please a group of other decision-makers", "preferring to dominate the course of the decision", "let people better positioned to lead the decision process", etc. The proposed behavioral styles act according to four dimensions deemed relevant in the context of group decision-making (Concern for self, Concern for others, Resistance to change and Activity level). Moreover, we introduce a communication model that allows agents to have dialogues that mimic the logic of communication existing in face-to-face meetings. Our