Modeling Culture in Intelligent Virtual Agents - From Theory to Implementation

(JAAMAS Extended Abstract)

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1. INTRODUCTION

This work addresses the representation of general cultural biases of social conduct in a cognitive model for virtual agents. The resulting model was applied in a serious game named Traveller [1], which is centered around human-agent interaction in everyday situations with agents that have their own cultural values. A cross-cultural study was conducted using one scene of Traveller with participants from two different countries, Portugal and the Netherlands. The aim was to investigate whether individuals from these two countries perceive and interact more favorably with agents that have a similar culture profile. The results showed that this was the case for the collectivistic agents who were indeed perceived significantly more favorably by the Portuguese participants than the Dutch. However, the general opinion about individualistic agents was similarly positive in both countries, possibly due to limitations in the scenario design.

2. MODELING CULTURE

According to Kemper [4], the extent to which we are willing to act in the interest of others, both in the performance of instrumental or ritualistic actions, is determined by how we perceive each other in relational terms. This perception is a subjective process that is heavily influenced by cultural biases. For instance, in cultures that score high on collectivism, the importance of in-group members is higher than it is in more individualistic cultures [3].

Our proposed SID model [6] is centered around the notion of Social Importance (SI). This is a relational variable that agents have towards others. It quantifies the extent that an agent is willing to act voluntarily in the interest of another, similar to the notion of status in Kemper's theory [4]. SI is determined by the sum of all *SI Attribution Rules* whose

activation conditions are verified in the agent's beliefs. Each rule represents a specific relational factor that is associated in human culture to a gain or a loss of SI. For instance, in the case of the in-group bias of collectivism, our proposed model includes two *SI Attribution Rules*, one that increases the SI of other agents that belong to the in-group and another that decreases the SI of others that are perceived as outsiders. In both rules, the amount that is increased or decreased is augmented by a factor that is linearly proportional to the collectivism score (COL) of the agent's culture.

The *SI Attribution Rules* are one of the three components of the SID model that are shared by a group of agents. The other two elements are *SI Claims* and *SI Conferrals*. An *SI Claim* associates a specific SI requirement to a given action, like joining a group to strike a conversation. Whenever an agent witnesses another agent performing an action, if the SI they attribute to the performer is lower than the SI score of the action's *SI Claim* then the act is perceived as inappropriate and the SI attributed to the performer is lowered. Consequentially, to avoid being inappropriate, agents infer how much SI they have and abstain from choosing actions whose claims exceed it. Claims can also be influenced by cultural biases and in our model, there is a claim associated to the action of joining a group having a conversation. More precisely, the SI requirement of this claim is linearly increased by the COL score of the agent's culture.

Concerning *SI Conferrals*, they represent a behavior that confers a certain amount of SI and is socially expected to be performed in a given context. In our model, the context is dictated by a set of logical conditions. Whenever such conditions are verified in the agent's beliefs, the agent will have a desire to perform the conferral to another agent as long as the amount of SI of the conferral does not exceed that other agent's SI. If more than one conferral meets the SI requirement, the agent will choose the one with the highest SI among the alternatives.

3. EVALUATION

The proposed SID model [6] has been implemented into

an existing BDI agent architecture, named FAtiMA Modular [2] and the resulting architecture was used to develop an intercultural training application named Traveller [1]. Traveller is a serious game where users are encouraged to raise their intercultural awareness by interacting with intelligent virtual agents whose cultural biases can be adapted with our model. The experience consists of an interactive narrative that takes place in a fictitious world and is divided in several scenes, named critical incidents. Each of the scenes is designed to evoke mismatches between the cultural biases of users and the cultural biases of agents.

The first critical incident of Traveller takes place in a bar located on a beach where the user arrives late at night after failing to find the way to his or her hotel. At the start of the scene, there are only two characters sitting in the bar and they are talking to each other. The barman is absent (although he later appears). The goal of the user is simply to find directions to his or her hotel. Because the user plays the role of a foreigner, agents will believe the user is an outsider and the higher the collectivism score of the agents the more they will lower the SI they attribute to the user. The user will also lose some SI when he or she performs an action that is perceived as an inappropriate claim in the culture of the agents. Consequentially, agents will choose to perform conferrals with a lower SI score in response.

We conducted a cross-cultural study to determine how users perceived and responded to two cultural configurations in the beach bar scenario. The aim was to compare users from both a collectivistic country, Portugal, and an individualistic country, the Netherlands, concerning how they perceived the behaviour of the agents in this particular scenario. For reference, Portugal is the most collectivistic country in Europe (scoring 27 on that dimension), and the Netherlands is one of the most individualistic countries in Europe (scoring 80 on that dimension) [3].

The experiment consisted of a 2x2 between-subjects design in which the independent variables were the participant's nationality (Dutch or Portuguese) and the cultural parameterization of the agents (Individualistic or Collectivistic). The main hypotheses we wanted to verify within this study were the following: H1 - Portuguese participants have a more positive opinion of the collectivistic agents' behavior than the Dutch and H2 - Dutch participants have a more positive opinion of the individualistic agents' behavior than the Portuguese.

After the participants completed the beach bar episode, they were asked to fill in an online questionnaire about their experience. The questionnaire contained both open-ended questions as well Likert statements about the participants' impressions of the characters' social behavior. In total, we had 72 participants of which 37 were Dutch and 35 were Portuguese, with an average age of 23.

The obtained results of the two-way factorial ANOVA statistical test, as detailed in [5], show that a significant interaction effect between the agents' culture and the participants' nationality was found for the statement "My general impression about the behavior of these characters is positive" ($F(1,68) = 6.441$, $p = 0.013$) and for the statement "The characters behaved appropriately toward me" ($F(1,68) = 4.922$, $p = 0.03$). For these two statements, the participants' opinions about the two cultural versions of the agents was affected differently by their nationalities. A simple effects analysis revealed that the score of the collectivistic agents

was significantly higher in Portugal than in the Netherlands for the first statement ($F(1,68) = 6.685$ $p = 0.012$) and for the second statement ($F(1,68) = 4.678$, $p = 0.034$). Both results support hypothesis H1. In contrast, hypothesis H2 was not supported as the score given to the individualistic agents by the Dutch was not significantly higher than the score given by the Portuguese, neither for the first statement ($F = 1.052$, $p = 0.309$) nor for the second one ($F(1,68) = 0.982$, $p = 0.325$).

These results constitute evidence of the proposed model's capability in adapting the agents' cultural behavior toward one extreme of the Individualism vs. Collectivism dimension. However, the adaptation of the model to make agents more individualistic did not cause a negative impression in the Portuguese participants. Still, in their qualitative answers, some Portuguese participants wrote negative remarks about the appropriateness of the individualistic agents. For instance, they found it strange that these agents invited the user to sit with them immediately. However, it is plausible that for many Portuguese participants, this strangeness was interpreted as unexpected friendliness rather than unwarranted intrusiveness.

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