"Why can't we be friends?" An empathic game companion for long-term interaction

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Abstract. The ability of artificial companions (virtual agents or robots) to establish meaningful relationships with users is still limited. In humans, a key aspect of such ability is empathy, often seen as the basis of social cooperation and pro-social behaviour. In this paper, we present a study where a social robot with empathic capabilities interacts with two users playing a chess game against each other. During the game, the agent behaves in an empathic manner towards one of the players and in a neutral way towards the other. In an experiment conducted with 40 participants, results showed that users to whom the robot was empathic provided higher ratings in terms of companionship.

Key words: affective interaction, companionship, empathy, friendship.

1 Introduction

To develop artificial agents capable of building long-term social relationships with users, we need to model the complex social dynamics present in human behaviour. We argue that one of such social requirements is empathy. Previous research has shown that empathic agents are perceived as more caring, likeable and trustworthy than agents without empathic capabilities [3, 11]. Empathy involves perspective taking, the understanding of nonverbal cues, sensitivity to the other's affective state and communication of a feeling of care [7]. As such, empathy is often related to helping behaviour and friendship: people tend to feel more empathy for friends than for strangers.

The main objective of this paper is to investigate people's perceptions of a companion agent with empathic behaviour, more specifically in terms of the possible relation of companionship established between them. To do so, we developed a scenario where a social robot observes a chess match played between two humans and reacts empathetically by commenting the game and disclosing its affective state. The results of a study conducted in this scenario indicate that subjects interacting with the empathic version of the robot considered it more as a "companion" than subjects interacting with a neutral version of the agent.

2 Related Work

The idea of using empathy as a way to establish and maintain social relations between users and agents was first addressed by Bickmore and Picard [2]. They developed Laura, a relational virtual agent that plays the role of an exercise advisor. Among other relational strategies, Laura uses empathic dialogue. After four weeks of daily interaction with the agent, the relational behaviours increased user's perceptions of the quality of the working alliance on measures such as liking, trust and respect.

Some researchers have also been studying the effect of empathic agents in game scenarios. Brave *et al.* [3] concluded that empathic agents in a blackjack game were perceived as more caring, likeable and trustworthy than agents without empathic capabilities, and that people feel more supported in the presence of such agents. More recently, other researchers extended these results [10], arguing that empathic agents can improve user's attention and willingness to interact with a system. Moreover, human-like agents without empathic capabilities can lead to a negative user experience due to the expectations that users may create while interacting with such agents.

In the field of social robotics, significant research has been pursued in one particular aspect of empathy - emotional contagion - where the user's affective state is mimicked [12]. One of the plausible reasons for this is that only recently the first working prototypes of automatic affect recognition using speech and vision started to appear [8], while in the field of virtual agents these problems have been surpassed, for example, by predicting the user's affective state using task related features or predefined dialogues [5].

3 Modelling an Empathic Game Companion

Although no precise definition of the internal processes of empathy exists so far, most researchers agree that empathy can be divided in two stages: (1) inferring the state of others and (2) responding emotionally to those states. These stages are also the basis of our empathy model, implemented in the Philip's iCat robot. The robot acts as an empathic game companion during a chess match played on an electronic chessboard between two human players (see Fig. 1) and treats the two players differently: empathises with one of them - the *companion*, and behaves in a neutral way towards the other player - the *opponent*. This scenario is a follow-up work from the scenario described in [9], where the iCat plays chess against a human opponent.

3.1 Inferring the user's affective state

The iCat uses role-taking to perceive the companion's affective state. This means that when a new move is played on the chessboard by one of the players, the iCat evaluates the new board position using a chess heuristic function in the

perspective of its companion. This function returns positive scores if the companion is in advantage (higher values indicate more advantage), and negative scores if the companion is in disadvantage. The evaluation is then used by the iCat's own emotional system, based on the *emotivector* anticipatory mechanism, which associates one of nine possible affective states to the move played on the chessboard. For more details on the *emotivector* system and its implementation in the iCat please consult [9].

An important motivation for using this form of emotion recognition comes from a previous study [4], where it was showed that, in the particular context of a chess game, the game state is relevant to discriminate the valence (positive or negative) of the user's affective state. We are aware that the agent may have a different perspective of the game from the user which may lead to wrong interpretations. Yet, the same can also happen with humans.

3.2 Behaving in an empathic manner

To define how the agent would act in an empathic manner towards its companion and in a neutral way towards the opponent, the agent's behaviour was based in characteristics of empathic teachers described in [6], such as body-language, voice, attitudes, facial characteristics or verbal responses. Given the limitations of the scenario, only differences in the facial characteristics and verbal responses were modelled.

Facial Characteristics One important behaviour of empathic teachers is that they constantly reflect the student's emotions in their facial expressions. Similarly, our empathic agent always expresses its affective state using a proper facial expression that reflects the companion's situation in the game. As an example, if the opponent plays a good move and captures one of the companion's pieces, the iCat expresses a sad expression as a result of its empathy towards the companion who has lost advantage.

Aside from constantly expressing their emotional states, another facial characteristic of empathic teachers is that they tend to use lots of eye-contact. This characteristic was also modelled in our agent: while players are thinking on their next moves, the iCat looks two times more to the companion than it does to the opponent.

Verbal Responses After exhibiting a facial expression, the iCat makes a comment on the move just played. The comments not only depend on the iCat's empathic state, but also if the user who just played is the iCat's companion or the opponent. Inspired on the characteristics of empathic teachers, two sets of utterances for each affective state of the iCat were defined: "empathic" utterances, to be used when the iCat is commenting the companion's moves, and "neutral" utterances, to be used when the robot is commenting on the opponent's moves. While neutral utterances merely indicate the quality of the move in a very direct way (e.g., "bad move", "well done", ...), empathic utterances often contain references to possible companion's emotions (e.g., "don't be sad, you

didn't had better options"), and try to encourage and motivate the companion (e.g., "you're doing great, carry on!").

Furthermore, the iCat also congratulates the companion when she/he captures a piece and also encourages the companion in critical moments of the game, whether he/she is gaining a large advantage or disadvantage (for example, when the chances of winning become evident).

4 Experiment

The hypothesis of this experiment is that subjects to whom the iCat behaved in an empathic manner perceive the robot more as a "friend" than subjects to whom the iCat behaved in a neutral way.

Fig. 1. Users interacting with the iCat.

4.1 Procedure

Forty subjects, 36 male and 4 female, with ages ranging from 18 and 28 years old, took part in the experiment. All of them were undergraduate or graduated students and were recruited via email. The selected participants obeyed two requirements: they knew the basic rules of chess and had never interacted with the iCat before.

During the experiment, participants sat in front of each other in a table that held both the electronic chessboard and the iCat as depicted in Fig. 1. They were instructed to play an entire chess game against each other, and while doing so to pay attention to the iCat's behaviour, as they were going to be questioned about it at the end of the game. On average, each game took one hour.

At the end of the game, participants were guided to another room where they filled a questionnaire. After filling the questionnaire, they were rewarded with a movie ticket and the experiment was over.

4.2 Manipulation

There were two different conditions regarding the iCat's behaviour, *empathic* and *neutral*, according to the behaviours described in the previous section. The iCat behaved in an *empathic* way towards subjects playing with the black pieces, and in a *neutral* way towards subjects playing with the white pieces, which means that we have 20 subjects in each condition. There was no criteria for assigning the participants to the different conditions. At the beginning of the game, participants could chose the side of the board where they prefer to sit down and they were not aware that the iCat's behaviour was going to be different.

4.3 Measures

To evaluate the different attitudes of the subjects towards the iCat, we employed McGill Friendship Questionnaire (MFQ) [1], which measures the degree to which a friend fulfils the following six functions: (1) *stimulating companionship* - doing enjoyable or exciting things together; (2) *help* - providing guidance and other forms of aid; (3) *intimacy* - being sensitive to the other's needs and states and being open to honest expressions of thoughts, feelings and personal information; (4) *reliable alliance* - remaining available and loyal; (5) *self-validation* - reassuring, encouraging, and otherwise helping the other maintain a positive self- image; (6) *emotional security* - providing comfort and confidence in novel or threatening situations. The questionnaire contains a set of assertions for each one of the six functions, and participants express their agreement or disagreement about each assertion using a five-point Likert scale.

A version of the MFQ questionnaire validated to Portuguese was used [13]. Given that some of the assertions of MFQ were not applicable to the interaction experience that users had with the iCat, we replaced those by assertions obtained in an online survey. Sixteen subjects participated in this survey, and there was no overlap between these subjects and the ones who participated in the experiment. In this paper, the results of the Stimulating Companionship function of this questionnaire will be presented and discussed.

4.4 Results and Discussion

As we used a modified version of MFQ, we first performed a Cronbach alpha test to evaluate the internal consistency of the Stimulating Companionship function (reliable, α=.79). Outliers in our data were removed according to the following criteria: 1.5**stdev*. Four outliers were identified in the *empathic* condition and five in the *neutral* condition.

After eliminating the outliers, we ran Mann-Whitney U test to compare the overall result of the Stimulating Companionship function. The overall result was calculated by the sum of the ratings for the corresponding assertions in the questionnaire. Subjects in the empathic condition significantly gave higher ratings in this function than subjects in the neutral condition ($U = 72.5$, $p < 0.05$, $z = -1.893$). Figure 2 contains the mean values of each one of the assertions of the

questionnaire that belong to this function. The chart shows that participants in the empathic condition rated each assertion higher than subjects in the neutral condition. However, this was only significant for the third question, "iCat behaved as my companion during the game" ($U = 69$, $p < 0.05$, $z = -2.239$). Given that this function is about spending time doing things together, these results suggest that subjects prefer to interact with empathic agents. As they consider the interaction more enjoyable, they may eventually spend more time interacting with the agents, which is important if we aim to build artificial companions capable of engaging users in the long term.

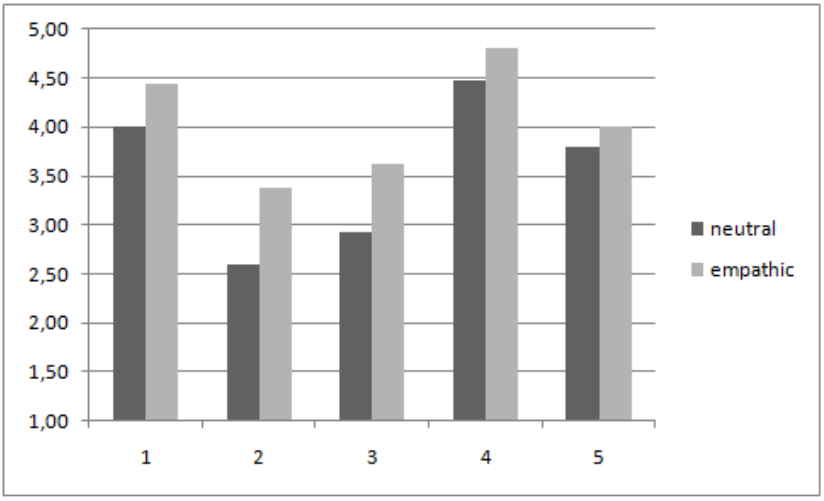

Fig. 2. Mean values for each assertion of the Stimulating Companionship function: (1) I had fun playing with iCat by my side; (2) I enjoyed talking to iCat; (3) iCat behaved as my companion during the game; (4) iCat made me laugh; (5) It was nice being with iCat.

5 Conclusions

This paper explored users' perceived companionship towards a social robot that displays empathic behaviours. We argued that if an agent behaves in an empathic manner, users could more easily establish a relationship with it. An experiment involving forty subjects was conducted to evaluate this hypothesis. Participants interacting with the empathic version of the robot gave significant higher ratings in terms of stimulating companionship. In the future, we intend to analyse the results of the other functions of the friendship questionnaire, in the attempt to understand which functions are more determinant for the robot to establish a friendship relationship with the user.

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