Artificial Intelligence for Human-Robot Interaction
Papers from the AAAI 2015 Fall Symposium

Promoting Social Collaboration between Children with a Social Robot

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Abstract

We are interested in the development of an autonomous social robot whose goal is to promote collaborative behaviors in children while playing an interactive game.

Introduction

In our increasingly interactive world, collaboration is becoming more essential to many parts of life, including learning, work, and everyday social interactions. Collaboration, here defined as "a process wherein two or more parties, communicating verbally and nonverbally, build on shared knowledge to create a joint action plan in order to achieve a shared goal", is a useful and often necessary tool for many professions and occupational fields including nursing (Henneman, Lee, and Cohen 1995; Leonard, Graham, and Bonacum 2004), education (Briscoe and Peters 1997; Dettmer, Dyck, and Thurston 2005), software design and engineering (Whitehead 2007; Lingard and Berry 2002), and business (Goltz et al. 2008). Effective collaboration also enhances creativity (MacDonald, Miell, and Morgan 2000; Kahn Jr et al. 2014), improves problem-solving ability (Azmitia and Montgomery 1993), and increases learning gains (Johnson and Johnson 1989). Dettmer, Dyck, and Thurston claim that "collaborative work groups have sustained and improved the quality of life from early ages to modern times with ever-escalating significance and consequence"(Dettmer, Dyck, and Thurston 2005).

Due to the high value placed on collaborative and teamwork skills, the development of these skills in primary, secondary, and post-secondary settings is highly important. However, most teachers in today's education systems do not explicitly focus on their students' growth in this area. They may put students together for group projects, but provide minimal support within each team to promote good collaboration between team members. Even with new teaching approaches that incorporate more group work and team activities, students are not taught collaborative skills, but are expected to 'pick them up' as they go. Murphy and Faulkner have shown that children defined as less likable and have lower peer group status according to established evaluation methods (Denham et al. 1990; Newcomb and Bukowski 1983), are less successful and had more disputes in a collaborative scenario than 'popular' children. This suggests that at least some children do not naturally have sufficient collaboration skills and would benefit from practice and training in collaboration.

We are interested in developing a social robot that not only serves as a contributor to a collaborative task, but promotes collaboration among its colleagues. We are motivated to promote collaboration because teamwork skills are highly important, as mentioned previously, and also because part of being a good collaborator is fostering better teamwork within the group.

Components of Collaboration

It is important to examine the components of good collaboration for two reasons: 1) so we know more precisely which behaviors the robot should promote in the children and 2) so that we can measure how 'collaborative' the children are during the interaction. From the literature, we have identified six categories of collaborative behavior relevant to a robot interacting with children (Cortez et al. 2009; Baker and Salas 1992; Marks, Mathieu, and Zaccaro 2001):

1. Team Orientation - actions that benefit either the team as a whole or benefit an individual at the cost of harming the team
2. Feedback - giving, asking for, and receiving feedback
3. Coordination - establishing goals, planning actions, or discussing strategy
4. Monitoring - recognition of others' needs, progress, or the system
5. Helping - giving, asking for, or receiving help
6. Communication - providing relevant information and asking for clarification

It is important to note that we are not measuring collaborative success through the outcome of a given task. There are many factors that contribute to the outcome of a task in addition to collaborative quality, such as each individual's level of general cognitive ability, personality traits, commitment to the task, and ownership of the task (McDonough 2000; Kichuk and Wiesner 1997). Since there are many other factors that influence task outcome, we chose to measure collaborative behavior expression as a more direct indicator of collaboration.

Promoting Collaboration

In order to provide a robot with the ability to promote collaboration, we turn to literature to see what factors influence the expression of collaborative behaviors, as discussed in detail in the previous section.

Expressions of gratitude lead to more prosocial or helping behavior. Grant and Gino found that participants were much more likely to help provide feedback on a cover letter if they received gratitude from the feedback they had given on another cover letter they had completed before.

Preexisting friendships can also help facilitate open dialogue of what a participant knows and what they can gain from their partner, which would increase the use of coordination, monitoring, feedback, and communication behaviors. Children working together on a musical composition have a harder time talking to one another freely if they are not friends (Miell and MacDonald 2000).

Both interpersonal cohesiveness, a state where team orientation behaviors are expressed, and task cohesiveness have different effects on both collaborative behavior expression and the outcome of a task. Craig and Kelly conducted a study with adults where groups of three were instructed to draw a technical drawing. Each group was assigned to either low or high task cohesiveness and low or high interpersonal cohesiveness. In experimental groups assigned to high task cohesiveness, subjects were given written rationale that emphasized the importance of group work in the workplace. In groups assigned to high interpersonal cohesiveness, they were given about 15 minutes to get to know each other and could come up with a team name. Groups with high task cohesiveness had drawings of higher technical quality and groups with high interpersonal cohesiveness had drawings of higher creativity, which they attribute to less inhibited communication between members.

From the current research, it seems that a social robot can best promote collaborative behavior by expressing gratitude and strengthening the friendship/interpersonal cohesiveness between participants.

Our Approach

We would like to investigate the following two hypotheses:

1. If a robot asks questions to increase collaboration between participants during pauses in a team-oriented game, collaborative behavior expression will increase in the two participants.
2. Relational questions made by the robot will show a greater increase in collaborative behavior than task-focused questions.

In our second hypothesis we make the distinction between relational and task-focused questions. By relational questions, we are describing questions that are targeted at developing and reinforcing the relationship between the participants. One example of a relational question is, "[Participant 1], is there a way for you to help [Participant 2] better next time?" And by task-focused questions, we are describing questions that aim to better focus the participants on the task they are working on. An example of a task-focused question is, "[Participant 2], which pieces do you want to change for next time?"

We expect to see that a social robot asking either relational or task-focused questions will show an improvement in collaborative behavior expression, compared to the robot not saying anything during the pauses in the interaction. Additionally, we expect to see the robot asking the relational questions to establish more interpersonal cohesiveness between the participants, which will lead to more collaborative behavior expression than the robot that asks task focused questions. However, we would not be surprised if participants interacting with the robot asking the task focused questions perform better on the task.

We are also interested in gathering age, gender, friendship, and personality data for each individual in the interaction to see what effect each of those factors has on both the expression of collaborative behavior and performance on the task.

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