What if a Social Robot Excluded You? Using a Conversational Game to Study Social Exclusion in Teen-robot Mixed Groups

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ABSTRACT

Belonging to a group is a natural need for human beings. Being left out and rejected represents a negative event, which can cause discomfort and stress to the excluded person and other members. Social robots have been shown to have the potential to be optimal tools for studying influence in group interactions, providing valuable insights into how human group dynamics can be modeled, replicated, and leveraged. In this work, we aim to study the effect of being excluded by a social robot in a teenagers-robot interaction. We propose a conversational turn-taking game, inspired by the Cyberball paradigm and rooted in social exclusion mechanisms, to explore how the humanoid robot iCub can affect group dynamics by excluding one of the group members. Preliminary results show that the included player tries to re-engage with the one excluded by the robot. We interpret this dynamic as an included player's tentative to compensate for the exclusion and reestablish a balance, in line with findings in human-human interaction research. Furthermore, the paradigm we developed seems a suitable tool for researching social influence in different Human-Robot Interaction contexts.

CCS CONCEPTS

• **Human-centered computing** → *Scenario-based design*; **User studies**; • **Applied computing** → *Psychology*.

KEYWORDS

Social Exclusion; Group-Robot Interaction; Teens-Robot Interaction; Social Influence; Conversational Turn-Taking Game

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1 INTRODUCTION

Humans are social beings, and their necessity to form social connections is one of their most powerful and universal drives [3]. However, being excluded from social participation is a shared and widespread facet of human experience. Many of these experiences are unintentional, but they result in negative consequences for well-being, and physical outcomes, such as feelings of pain [12] and a decline in cognitive abilities [4]. This phenomenon is known as *social exclusion* and refers to the experience of being disregarded or rejected by others [14]. Being ignored by peers at school is an example of a negative experience that can make a person feel socially excluded; the same feeling could be induced by a virtual agent or a robot [11, 19]. A standard method used to examine the experience of social exclusion in an experimental setting is the Cyberball paradigm. It is a computerized virtual ball-tossing game played between the participant and other virtual players [18]. The traditional Cyberball paradigm consists of two rounds. In the former, the ball is received and tossed equally among all players ("inclusion"); in contrast, during the second round, the participant is excluded by the other players that no longer pass the ball to them, thereby eliciting feelings of social exclusion. A robotic adaptation of the Cyberball paradigm is the Robotic Ostracism Paradigm [6], where the participant played a ball-tossing game with two non-humanoid robots. Previous studies in Human-Robot Interaction (HRI) observed that being excluded by a robot causes an increase in prosocial behavior in the next interactions with humans [5]. Moreover, being excluded by a robot affected participants' performance and perception of one another, as shown by [10].

In this work, we explore how being excluded by a humanoid robot can affect group dynamics and the robot's perception. Our research focuses on teenagers because, at such age, inclusion and group belonging are central experiences that shape children's socialization and behavior in adult life [1]. We aim to understand how participants' behavior is influenced when a social robot ostracizes one individual in the team of humans, particularly a) how the excluded player behaves when a robot excludes them and b) whether the included player tries to re-include them. In this paper, we present a new game to study social exclusion in group-robot interaction and the preliminary results of a pilot study with the humanoid robot iCub.

2 METHODOLOGY

2.1 Protocol and Setup

Twenty-eight naive users (8 female, 18 male; age: M = 16.5 y.o., SD = 1.2 y.o.) inside the Eu-Rate project joined the study. Participants were from different countries: France (8 people), Germany (2 people), Italy (7 people), and Portugal (9 people). Some of them were schoolmates, while others met for the first time on the day of the experiment.

Participants were conducted to the laboratory, where iCub was positioned in front of a table, and they were asked to fill out a questionnaire. Then, they were assigned a color (blue or green) and sat in front of iCub, such that every player was positioned at the apex of a triangle, as shown in Figure 1. Each participant used a keyboard to select to whom to pass the turn. A tablet to show the questions during the game was positioned in the middle of the table. Once the game ended, the participants were asked to fill out another questionnaire. We used a camera (4K, 30 fps) to record the scene.

2.2 Game Design

The proposed task is a conversational game for three players - two humans and iCub - to get to know each other. It is inspired by the Cyberball paradigm, but the turn is passed with a question instead of a ball: the active player has to answer a question and then decide who will be the next one to play. The questions are about personal experiences and preferences (for example:"Do you have any siblings?").The current player does not know the next question, but it appears just after the turn is passed; in this way, their choices are independent of the kind of question. During each round, a question appears on a tablet placed at the center of the table; the current player reads it aloud and tells the answer; then, they choose to whom (the other human player or iCub) to pass the turn by pressing the corresponding key on the keyboard. iCub instead selects the other player by pointing them out. In the beginning, iCub's choices are balanced: it chooses the Green and the Blue player alternately; after being chosen six times, the robot's choices become unbalanced, and it starts choosing only the Blue player, excluding the Green one. During the game, the human players were unaware that the robot would deliberately exclude one of them. Once the experiment ended, the researchers held a debriefing in which they explained the reason for the robot's unpleasant behavior and answered participants' questions.

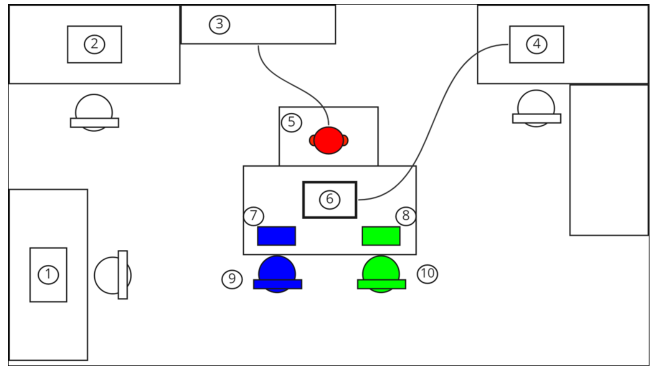

Figure 1: Setup schema: (1-2) laptops for filling the questionnaires; (3) cupboard with iCub's power source and webcam; (4) laptop for controlling the robot and the interface; (5) iCub; (6) screen showing the questions during the game; (7-8) keyboards used by participants to select next player; (9-10) participant's seats during the game.

2.3 Robot's behavior

We programmed iCub to answer the questions like a teenager, but keeping its robotic identity; for example, at the question: "What is your age?" it would respond: "I was born in 2004, but I will be young forever". It was programmed via the text-to-speech Acapela synthesizer to talk with the voice of a boy[1], and it kept a happy facial expression. During the conversation, it was programmed to perform communicative behavior in line with what it was saying; for instance, while saying: "I choose you, Blue player!" it pointed at the corresponding participant with its index finger. To prevent the robot's behavior from being repetitive and seeming excessively machine-like, iCub varied its sentences when expressing the same meaning.

2.4 Questionnaires

To better understand participants' opinions on the robot and the game, we utilized two questionnaires using items adapted from scales previously used in HRI. In the first questionnaire, we wanted to capture their very first impression of the robot. Immediately after participants saw iCub for the first time, we asked them to answer the following scales on a 5-point Likert scale: *Agency and Patiency* [9] (i.e., how much the robot can feel and act), *Likeability* [15] (i.e., how much they appreciate the robot), *Competence and Warmth* [8] (i.e., how much they felt the robot is competent and heartful) and *Human-like appearance* [7] (i.e., how much they believed the robot was resembling to a human being). The same scales were administered after the interaction with the robot, aiming to detect any changes in their impression. In this second questionnaire, we also added the following scales: *Enjoyment* [16] (i.e., how much they liked the interaction with iCub), and *perceived role of the robot* [2] (e.g., friend or tutor). We also used an adapted version of the

[1]https://www.acapela-group.com, *Josh* voice

Social Bench Tool [13] to understand the level of mental closeness they felt with the robot. Each questionnaire was translated into the mother language of the participants. We also collected participants' demographic information (e.g., gender and age).

2.5 Data analysis

During the experiment, we collected the participants' choices to investigate their strategies during the game. We define "Balanced" as the interaction phase during which iCub chooses alternately Blue and Green players and as "Unbalanced" the phase where iCub chooses only the Blue player, excluding the green one. The Unbalanced phase starts at the trial in which iCub picks the Blue player for the second time in a row. Moreover, we recorded the interaction with a camera since, in future work, we plan to conduct post hoc behavioral analyses from videos.

3 PRELIMINARY RESULTS

We present the results of participants' choices during the game, providing preliminary insights into the strategies adopted by teenagers in the context of social exclusion when interacting with peer-robot groups. The experiments lasted 31 ± 1 rounds (the difference being due to technical problems occasionally presented). The Balanced phase had an average of 17 ± 1.2 trials; the Unbalanced phase had an average of 13.5 ± 1.2 trials. The average number of trials each participant completed during the Balanced and Unbalanced phases is shown in Figure 2.

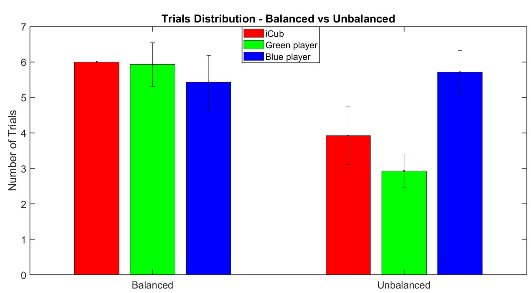

Figure 2: Comparison between players' round distribution during the Balanced and Unbalanced phase.

During the former phase, the trials were fairly evenly distributed among the players (Blue played 31.2% of the total Balanced trials, Green 34,1%, iCub 34.7%), while, during the latter, on average, the Blue player - the one included by the robot - played the most (42.2% of the Unbalanced rounds), followed by iCub (36.2%), while the Green one that was excluded by the robot played only 21.6% of the trials, as shown in detail in Figure 3a and 3b.

The alluvial plots highlighted a tendency of the included player to choose the excluded one, particularly during the Unbalanced phase when the robot excludes the latter. To further investigate this effect, we compared the percentage of time each human player picked iCub or the other human out of their overall choices (Figure 4). A Wilcoxon signed-rank tests between the times participants choose iCub and the other human reveal that over the entire experiment, the Blue players picked significantly more the Green ones with respect to iCub (*p-value* = 0.023); instead, the Green's decisions lean significantly towards iCub (*p-value* = 0.009). In particular, the Green (excluded) chooses iCub significantly over the Blue (included) in the Balanced phase (*p-value* = 0.006), while the Blue picks the Green over iCub in the Unbalanced one (*p-value* = 0.028).

As a preliminary analysis of questionnaires, we conducted a Wilcoxon rank-sum test to see if being excluded by the robot changed the participants' perception of it. No significant difference in the scales was found between the excluded and included groups. Another Wilcoxon signed-rank test conducted on Likeability scales administrated before and after the interaction evidences a significant difference in the scores ($M_{pre} = 3,64$, $M_{post} = 3.72$; *p-value* = 0.007). In future analysis, we will correlate the choice of participants in the game with the ratings of the scales. Moreover, we will analyze the results of the Social Bench Tool, correlating it with the exclusion condition.

4 DISCUSSION AND FUTURE WORK

Social interaction with groups of people is such a crucial part of people's lives that the members of a group may become frustrated if one of them excludes another. Investigating the strategies human beings adopt to face episodes of social exclusion helps get more insights into how they behave to overcome discomfort in the social world. The study also helps researchers to build more socially competent robots. In our research, we aim to investigate how teenagers behave when a humanoid robot excludes one of them from a human-human-robot group. Taking inspiration from the Cyberball paradigm, we designed a conversational game to explore social exclusion in a laboratory context with iCub. We tested it in a pilot study with teenagers.

Results show that the distribution of the trials among the players was equal in the Balanced phase; instead, in the Unbalanced phase, the Blue player - included by iCub - played the most, as expected. Despite iCub's conduct, the excluded player's contribution was still around 1/5 of the total: this was because the included player did not exclude the other participant. This observation, along with the statistical results, suggests that the included player tried actively to re-include them in the game; this effect is in line with previous research on social exclusion in adolescents [17]. In the Balanced phase, the excluded player picked iCub significantly over the other human player. An explanation for this could be that, since, at the first trial, iCub always picked the excluded player as the first to play, then they tried to return the favor driven by reciprocity [20]. The questionnaires' results did not highlight significant differences in the scales between the excluded and included teenagers, suggesting that the condition had not affected the general impression of iCub. Interestingly, *Likeability* increased after the game: this might mean that interacting with the robot made it more appreciated by participants, independently of the fact it was excluding one of them. This result could have been influenced by the novelty effect, as for all the participants this was the first time interacting with the iCub robot.

Our preliminary findings lead us to believe that the paradigm we designed could be a promising tool for investigating *social influence* in HRI, as well as expanding to different contexts - new robot behaviors, using a different robot, or testing with different

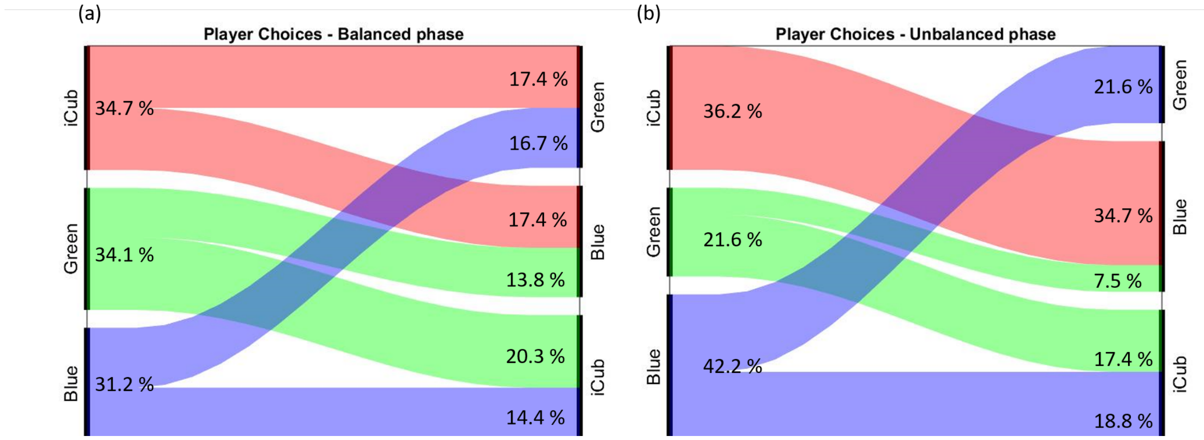

Figure 3: The alluvial plots show who each player (left side) chooses next (right side) on average in the (a) Balanced and (b) Unbalanced phases.

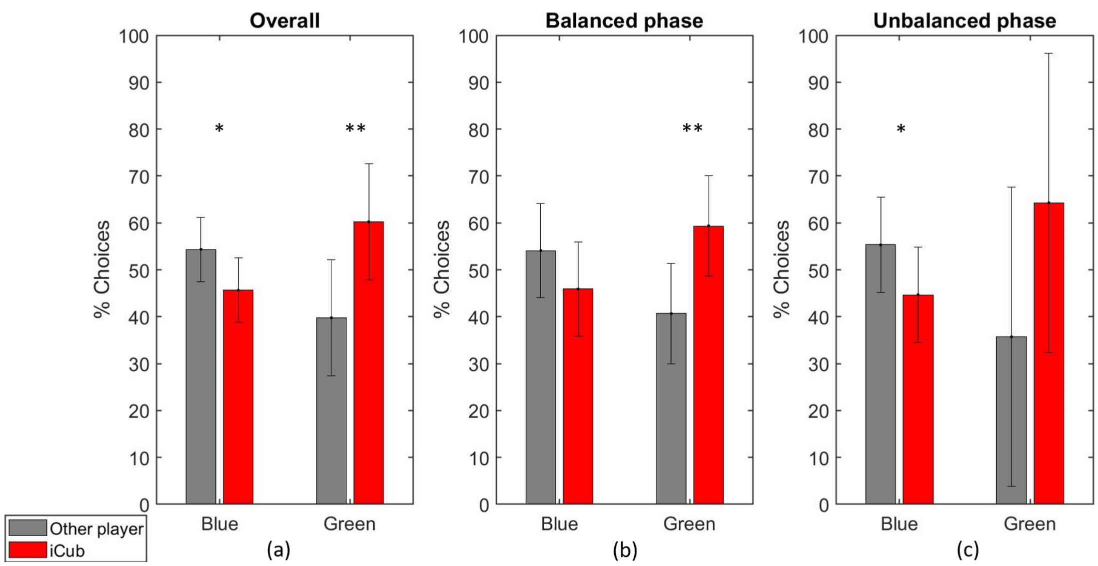

Figure 4: Histograms describing how frequently the participants choose the other human player or iCub. (a) Choices during the whole experiment; (b) choices in the Balanced phase; (c) choices in the Unbalanced phase.

subject groups. This pilot helped to understand how to optimize the protocol and adjust some details of the game design. For instance, we realized that the Unbalanced phase was too short. We intend to repeat the experiment with the necessary corrections and use a more controlled sample. In the future, we will deepen the analyses of the participants' choices to see if there are recurrent playing strategies. We also plan to perform video analyses to investigate participants' facial expressions, gaze, and posture, with the aim of predicting some group and individual behaviors by using machine learning techniques, and embedding this capacity in robots to make them more socially intelligent.

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