THE EFFECT OF AN EMPATHY-ELICITING INTERVENTION ON THE PERCEPTION OF TELEPRESENCE ROBOT USERS

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Abstract— **Telepresence robots can be used in different contexts with different goals; for example, to help remote individuals virtually attend classes and meetings, or to allow healthcare workers and patients in different locations to remain in touch. Although these robots bring about different advantages to mediated communication, telepresence pilots have been found to be perceived less favorably than people who are physically present in a communicative context. Stoll et al. (2018), for example, found that telepresence pilots are more likely to be perceived as less trustworthy and to participate less in collaborative tasks compared to co-situated participants. Thus, in the current work, to mitigate the negative effects of using a telepresence robot, we examine whether an intervention to create empathy can influence the way remote participants are perceived. To this end, in a within-subject design, we asked participants (N=30) to follow text-based instructions to do a language learning activity in groups of three, in which one of the participants used a GoBe telepresence robot to join other co-situated group members. We embedded an intervention designed to create empathy with the telepresence operator in the last section of the activity and used two questionnaires, one before and one after the intervention, to collect participants' subjective evaluations of each other. Findings suggest that after the empathy-eliciting question, participants found the telepresence robot user significantly more trustworthy, reliable, and fascinated by art, music, or literature. Results indicate that the empathy-eliciting intervention has a positive effect on the way collocated participants perceive telepresence users.**

I. INTRODUCTION

Telepresence robots have been increasingly studied from different perspectives over the past few years. For example, their effectiveness has been evaluated with regard to hospitalized children's virtual attendance at school (Johannessen, Rasmussen, & Haldar, 2022), students' social presence and inclusion (Lister, 2020; Wernbacher et al., 2022), social isolation (Cha, Chen & Mataric, 2017), monitoring health-related issues of the elderly (Cortellessa et al., 2018), and so on. Overall, previous research suggests that using telepresence robots to improve the positive effects of mediated communication is promising (see for example Jakonen & Jauni, 2022; Tanaka, Takahashi, Matsuzoe, Tazawa, and Morita, 2014).

However, communication via a telepresence robot can still have disadvantages. According to Stoll et al. (2018), for example, in a multiparty collaboration between two participants who were physically present and one remote user, participants on the telepresence robot were considered less trustworthy. Moreover, in such interactions, chances are that remote users participate less than other participants and experience more task difficulty than their collocated peers (Stoll et al., 2018). In a study by Tsui et al. (2011), telepresence robot participants were found to have a significantly lower sense of belonging and to be less willingness to contribute to group aims in team meetings. Gleason & Greenhow (2017) also report that collaborations between online and co-present participants can become a challenge, especially in noisy environments or due to the limited field of vision of the robot, i.e. factors that can affect the communication between remote and local participants.

The current study aims to address the issue of user perception in mediated communication by using an intervention that is designed to elicit empathy from the co-participants. Since empathy is a construct that has been shown to have positive effects on different types of interaction in various context such as patient-doctor communication (Ozcan et al., 2012), students' topic-based discussions (Alves-Oliveira et al., 2019), simulated interview sessions (Prendinger and Ishizuka, 2005), and even in-group-out-group relations (Finlay & Stephan, 2000), we hypothesize that it might help mitigate the negative effects of using a telepresence robot and improve the way participants perceive each other. Therefore, in this work, we test whether an empathy-eliciting intervention can mitigate possible negative effects of joining multi-party interaction via a telepresence robot. We therefore address whether we can mitigate the negative effects of telepresence in mediated multiparty interaction by making an empathy-eliciting intervention. That is, we ask whether we can positively affect the way participants perceive telepresence users by asking a question designed to create empathy.

II. PREVIOUS WORK

In this section, we will briefly discuss related previous research in the areas of telepresence robots, user perceptions, and empathy.

A. A. Telepresence robot

Telepresence robots can improve remote, mediated communication by providing a rich sense of presence for remote users in different contexts such as telecommuting, medical care, and education (Herring, 2015). Compared to online videoconferencing tools such as Skype or Microsoft Teams, telepresence robots increase mobility (Stoll et al, 2018), level of control and autonomy (Jakonen & Jauni, 2022), and trust level (Rae et al., 2013) of remote participants. Nevertheless, joining interaction through a telepresence robot comes with some shortcomings. In a study, Stoll et al. (2018) investigated to what extent participation, attitude, and perception of participants are affected in a tasked-based group

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activity with two physically and one virtually present participant. They designed a puzzle and instructed the groups to solve it while (a) all members had access to the translation key, (b) the collocated members had access to the translation key, or (c) only the remote member had access to the translation key. The results suggest that participants who used a telepresence robot were considered less trustworthy, participated less, and experienced more task difficulty compared to collocated participants. Gleason & Greenhow (2017) also carried out a study to examine the role of physical embodiment and social presence for doctoral students in a hybrid class. Although they reported positive results regarding facilitated interaction and physical presence, collaborations between online and co-present participants were challenging due to the limited field of vision of the robot and incomprehensibility of communication in noisy contexts (Gleason & Greenhow, 2017). In another study, Tsui et al. (2011) found that telepresence robot participants experienced a significantly lower sense of belonging and willingness to contribute to group aims in team meetings.

B. *Perception of mediated users*

There are various factors that can affect the way people are perceived in mediated interaction. According to the Media Equation Hypothesis, the type or physical features of technology can affect people's perception of its content (Reeves and Nass, 1996). In a study by Kurtzberg et al. (2018), it was found that in communications via a laptop or mobile phone, larger screen size positively affects negotiations and higher joint outcome compared to a small screen. Reeves, Lombard, & Melwani (1999) also suggested that screen size directly affects viewers' evaluation of the people shown on the screen. That is, the feeling of liking or disliking a person increased and became stronger when they were projected on a bigger screen. Cores-Sarría et al. (2022) examined the role of camera distance and angle in emotional response, and found that closer framing and high/low angles – as opposed to straight angles – can increase affective responses. Overall, there all various attributes influencing the way the content of technology is perceived, such as distance to camera, camera angel, and screen size. In case of a mediated communication via a telepresence robot, these elements have the potential to negatively impact the interaction and the perception of the person on the robot.

C. *Empathy*

Empathy has been defined differently by different scholars. According to Hoffman (2001), it is the ability to share and experience feelings and emotions of someone else. Davis (2018) defines empathy as a set of constructs created in response to the feelings and experiences of other people. Empathy is created when a person feels, experiences, and shares the emotions and perspectives of another person and understands why those feelings occur (Preston and De Waal, 2002). It plays a major role in interactions and can boost relationships and collaboration (Paiva et al., 2017).

Empathy is regarded as a construct with two dimensions: (a) cognitive empathy, that is the understanding and acknowledgment of the feelings of someone else, and (b) affective empathy, which is the ability to understand the emotions of others and to share and experience those feelings (Hoffman, 2001; Liu & Sundar, 2018, Stephan, 2015). In this work, we use an intervention that is designed to elicit empathy toward the participant on the telepresence robot in an attempt to improve the way they are perceived by collocated group members.

III. METHODS

In this section, we will give an overview of the sample of the study, the experimental setup, the measurements for data collection, and the procedure of the experiment.

A. A. *Participants*

In total, 30 participants were recruited for the study through convenience sampling, i.e. by inviting students and staff to the lab in return for a bar of chocolate. The sample included 20 males (aged 18-31, M= 22.1, SD=3.40) and 10 females (aged 18-23, M= 20.8, SD=1.81). As soon as participants were recruited, they were put into groups of three, two of whom were sent to the human-robot interaction laboratory, and one was taken to a nearby room to use a desktop computer to operate the telepresence robot. The experiment was run at the University of Southern Denmark, and all participants were students or employees of the university.

B. *Experiment set-up*

The telepresence robot used in the experiment is a GoBe Robot (Fig. 1); a mobile robot that is 161 centimeters tall, weighs nearly 40 kilograms, and has a 21.5-inch touchscreen display with a high-definition webcam and high-quality speakers. The GoBe Robot can be controlled by connecting to the company's web-based interface[1]. The interface allows users to navigate, communicate with others, and to control the speed and volume of the robot. In our study, participants who operated the GoBe Robot used a Linux-based computer to control the robot, read and sign consent forms, complete their questionnaires, and communicate with their peers. The other participants were given iPads for consent forms and questionnaires. Fig. 2 shows the set-up of the study. Participants were free to move around during the tasks of the experiment.

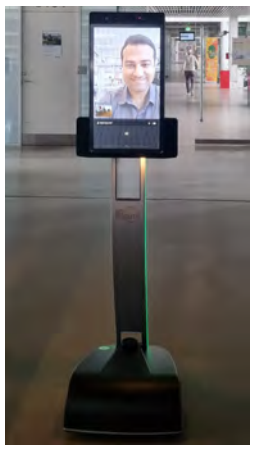

Figure 1. GoBe Robot

[1] https://app.gobe-robots.com/

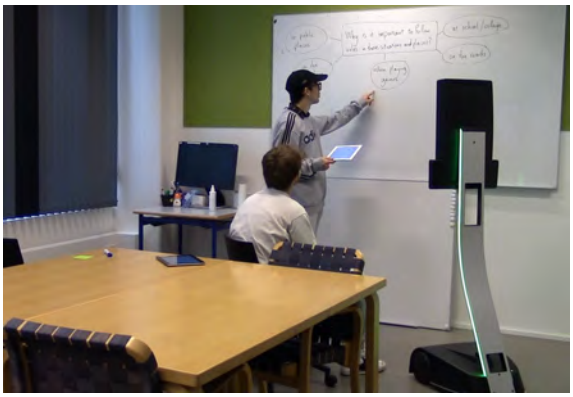

Figure 2. Experiment set-up

C. Measurements

In order to assess participants' perceptions of the personality and trustworthiness of their group members before and after the empathy-raising intervention, we had participants fill out two questionnaires, one before and one after the intervention. In the first part of the first questionnaire, we collected information about participants' age and gender, and enquired to what extent, on a 7-point semantic differential scale, they know each other. Then, in line with the findings by Stoll et al (2018), which found the trustworthiness of telepresence robot operators to be rated generally lower than that of co-present participants, we used the trustworthiness questionnaire items from McCroskey and Teven (1999). The 7-point semantic differential items include: honest vs. dishonest, untrustworthy vs. trustworthy, honorable vs. dishonorable, moral vs. immoral, unethical vs. ethical, and phoney vs. genuine. In addition, in order to identify possible other effects on the rating of the telepresence robot operator, we added the 15-item extra-short form of the Big Five Inventory proposed by Soto & John (2017). This 5-point Likert scale questionnaire consists of five major domains, each of which contains three facets. The traits and facets in this questionnaire include: (a) extraversion: quiet, dominant, energetic (b) agreeableness: compassionate, rude, assumes the best about people (c) conscientiousness: disorganized, has difficulty starting a task, reliable (d) emotional stability or neuroticism: worries a lot, depressed, emotionally stable and (e) openness: fascinated by art, music, or literature, little interest in abstract ideas, original. The extra-short personality test is a reliable and valid measurement that reduces respondent fatigue and shortens assessment time (Soto & John, 2017). We also added the neuroticism facets from John and Srivastava (1999) to the questionnaire to measure the emotional stability of participants. These 5-point Likert scale items include: tense, irritable, not contented, shy, moody, and not self-confident. To minimize the impact of order effect, we randomized the order of questionnaire items. The second questionnaire was the same as the first questionnaire with the exception that we did not ask about participants' demographics or how well they know each other again.

B. D.Experiment task

The task was a speaking activity taken from the C1 Advance Exam by Cambridge Assessment English, specifically designed for groups of two or three participants. We adopted the following interactive activity and two follow-up questions, which we asked the participants to discuss

Q.1: Why is it important to follow rules in these situations and places? (a) In public places, (b) In the workplace, (c) When playing games, (d) At school / college, and (e) On the roads.

Q.2: Are there occasions when we should question the rules and not simply obey? Why or why not?

Q.3: Do you think we have to follow too many rules in our lives?

The fourth question of the study was the empathy-raising intervention, in which we asked "How does it feel to be on the telepresence robot?"

C. E. Procedure

After recruiting three participants at a time and welcoming them to the laboratory, the main author briefed them on the main aims of the experiment. Then, we asked for a volunteer to operate the telepresence robot, who was then taken to a nearby room where they could operate the robot. The GoBe Robot users were given a brief training on how to control and navigate the robot. Participants were informed that they were expected to follow the text-based instructions on their iPads/computers, independently of the experimenter. However, they were told that in case of a technical issue, they could inform him. After that, the experimenter asked participants to read and sign a consent form on their iPads/computers. When they started discussing the questions given, the experimenter moved to the other end of the laboratory, orienting toward his computer that faced 90 degrees away from the participants.

As the experiment began, participants read a brief introduction of the experiment on their iPads/computers and were instructed to discuss the first and second questions of the task. We had written in the instructions that they had about three minutes to discuss each question, although if the participants took longer, we did not interrupt them until they decided that they were done and were ready to move on. Next, participants were led to the first questionnaire and were asked to complete it.

After that, participants were given a third question, followed by the empathy-raising intervention. Next, participants were asked to fill out the second questionnaire of the study. By the end of the experiment, we thanked the participants and rewarded them with a bar of chocolate. The duration of each session varied depending on how fast or thorough participants were in discussing the questions or answering the questionnaire.

IV. Results

Here we report the analysis of the data collected by means of our two questionnaires. In order to answer the research question, which enquired whether we can positively affect the way participants perceive telepresence users by using an empathy-raising intervention, we ran paired samples t-tests to determine whether there are any significant differences between the mean scores of the participants before and after the intervention. Regarding the trustworthiness questionnaire, we

found a significant increase in the means scores for the *trustworthy* item ($t(19) = 2.29$, $p = 0.033$) before (M=5.30; SD=1.97) and after (M=6.30; SD=1.08) the intervention. The effect size ($d = 0.62$) of this item was calculated using Cohen's *d* formula (Cohen, 1969), which is the mean difference divided by the standard deviation of the difference. As for the rest of the items of the trustworthiness questionnaire, with the exception of phoney-genuine item which remained stable, there was a non-significant increase in all of participants' scores in the second questionnaire compared to the one that was completed before the intervention. In the Big Five section of the questionnaire, the facets *reliable* ($t(19) = 3.19$, $p = 0.005$) and *fascinated by art, music, or literature* ($t(19) = 2.17$, $p = 0.042$) increased significantly in the second questionnaire (reliable: M=3.95; SD=0.82; fascinated by art, music, or literature: M=3.20; SD=0.69) compared to the first one (reliable: M=3.60; SD=0.88; fascinated by art, music, or literature: M=2.80; SD=0.89). The effect size for these items were d=0.41 and d=0.50, respectively. Similar to the first questionnaire, there was a positive effect in the ratings of participants after the intervention, although the differences did not produce any significant results. Moreover, no significant difference emerged concerning how telepresence users perceive collocated participants. In sum, after the empathy-raising intervention, collocated participants found telepresence users to be significantly more *trustworthy*, *reliable*, and *fascinated by art, music, or literature*.

V. Discussion

We investigated the effects of an emphathy-raising intervention on the perception of telepresence robot user. The analysis of the data suggests that eliciting empathy by means of a simple question about the experience of participating on a telepresence robot can lead to a positive influence on the way telepresent participants were rated, as they were considered significantly more trustworthy, reliable, and fascinated by art, music, or literature in this study. Following the empathy-eliciting intervention, we could also see a positive trend regarding user perception in favor of the telepresence participants. However, these differences were not significant. We infer from the results that raising empathy in group members leads to some degrees of change, but there may be a need for more interventions to help the telepresence robot pilot have a more positive experience. As shown in previous research, group work and collaboration can be influenced by the level of trust among participants (Dirks, 1999; Tschannen-Moran, 2001). Therefore, a less trustworthy classmate on a telepresence robot may encounter some difficulty maintaining interactions with others. This is especially important in cases where the remote user is from a vulnerable group – such as a hospitalized child – who hopes to integrate with their desired communities, which in this case would be to attend school and be socially included with their classmates. The results of the study suggest that drawing attention to the possible difficulties the telepresence operator may face may lead to higher trust ratings of the robot operators, and thus the empathy-raising strategy employed is likely to be effective.

However, the sample of the study was rather small. A post hoc power analysis shows that 26 participants would have been sufficient to demonstrate the effect of the empathy-raising intervention on perceived trustworthiness of the robot operator, but that for the other effects, between 42 and 63 subjects would have been useful to exclude that no potentially significant effect was overlooked. Hence, it would be helpful to collect more data from more participants in a mediated communication context. Moreover, the selection of the participants was limited to university students and staff and hence to a certain subset of adults; a more diverse sample that includes people from different age groups, social statuses, and educational backgrounds can result in a richer dataset and perhaps more significant and generalizable results. Furthermore, using different types of telepresence robots with different specifications would most likely lead to differences in user perceptions. For example, past research has found that screen size is a factor that can impact participants' judgements and perceptions (Reeves et al.,1992) or height of the telepresence robot can influence interaction balance (Rae et al., 2013). Accordingly, a robot with a bigger or smaller screen or shorter or taller height can also have an effect in this respect.

Nevertheless, given the medium-size effect sizes we have determined on the 30 participants in this study gives reason to assume that asking the telepresence robot operator about their experience may mitigate some of the negative effects caused by the lack of co-presence of the telepresence robot operator, compared to collocated participants, and may be suited to raise empathy towards the remote participant.

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