"Who's that?" Identity Self-Perception and Projection in the Use of Telepresence Robots in Hybrid Classrooms

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ABSTRACT

Robotic Telepresence (RT) is a promising medium for students who are unable to attend in-person classes. It enables remote students to be present in the classroom and interact with their classmates and instructors. However, it can be limiting to their identity self-perception and projection, which may have repercussions on the social dynamics and inclusion within the classroom. We present preliminary findings of a qualitative analysis of 12 observations and interviews with RT attendees. We examine RT design and use aspects that either supported identity self-perception and projection or limited it. Finally, we present telepresence robots design and use recommendations for the classroom context.

CCS CONCEPTS

• **Human-centered computing → Collaborative and social computing systems and tools**; **Accessibility technologies**.

KEYWORDS

Robotic telepresence, telerobot, Beam, remote participation, robot-mediated communication, hybrid classroom, identity

ACM Reference Format:
Houda Elmimouni, Amy Kinney, Elizabeth C. Brooks, Hannah Li, and Selma Šabanović. 2023. "Who's that?" Identity Self-Perception and Projection in the Use of Telepresence Robots in Hybrid Classrooms. In *Companion of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI '23 Companion), March 13–16, 2023, Stockholm, Sweden.* ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/3568294.3580090

1 INTRODUCTION

A large number of students do not attend classes because of illnesses, injuries and physical disabilities (temporary or chronic), and more recently, due to COVID illness or quarantine. In some of these cases where the absence from school is extended, the student lags behind instruction, and feels more isolated. This consequently negatively impacts the student's learning, social life, and health. Some schools and instructors have made efforts to provide alternatives to in-person attendance such as online courses, and video conferencing. However, such solutions do not offer the social experience a student needs and gains while interacting with peers in the school environment, as human knowledge depends on being situated in a real-world environment. Robotic Telepresence (RT) is a promising medium as it mimics a face-to-face setting. Thus, many social cues are available when telepresence robots (TR) are involved, such as facial expression, intonation, and accent, as well as physical movement in space. Many studies have explored the support of telepresence for office work [22, 25, 27], attending conferences [8], visiting relatives [19], and eldercare [16], but educational contexts are a less explored frontier for telepresence [9, 10, 20]. Further, most studies focus on the usability and user experience, embodiment, and interaction aspects of RT. In this study we examine identity in the design and use of RT in the context of the classroom. Identity is a crucial human value that is enmeshed in every social interaction. Being able to protect and project your identity in the remote space is the first step to establishing a rapport with other interactants in the remote environment and gaining the sought-after inclusion that TRs promise their users. By following a bottom-up approach and through analyzing screen recordings and interview transcripts with 12 participants, we inductively highlight the affordances of TR that can help participants project their identity and the elements of design that limits the self-perception and projection of identity. We aim to contribute to the literature of RT in the classroom as well as provide design and use recommendations to support users' identity projection as they use TRs.

2 RELATED WORK

2.1 Robotic Telepresence

The concept of Robotic Telepresence (RT) has been defined as a subcategory of telepresence that allows for an individual to be socially and physically present while residing in a remote environment [2, 15]. Mobile forms of telepresence (e.g. beam, double, GoBe) typically consist of video conferencing systems in addition to being physically embodied, granting remote users, *pilots*, the ability to move and navigate a remote space [15]. The perceived importance

HRI '23 Companion, March 13–16, 2023, Stockholm, Sweden

ACM ISBN 978-1-4503-9970-8/23/03…$15.00
https://doi.org/10.1145/3568294.3580090

of TRs particularly increased after the COVID-19 pandemic where social isolation became increasingly problematic among all age and ability groups [5]. Video conferencing devices (e.g. Zoom, Skype, Microsoft Teams,) were used to combat such isolation but these softwares come with issues of their own and are mostly useful when every individual is attending via that platform. Telepresence robots are capable of acting to mediate this issue, as it helps to mimic face-to-face interactions between the pilot and interlocutor [23] (e.g. facial expressions, human-sized embodiment, and mobile control.), and act as physical embodiment of the pilot in order to maintain social interactions with peers [11]. RT was found to contribute to increased conversational engagement between pilots and interlocutors [11, 15, 26] and empowered the operators through embodiment [26]. RT was studied in many contexts: Office work [22, 25, 27], attending conferences [8], and visiting relatives [19], eldercare [16], but few studies considered educational contexts [9, 10, 20].

2.2 Telepresence for education

The research on Robotic Telepresece for education is sparse. The early research related to RT in education reveal that the use of RT provides numerous benefits to homebound students who cannot attend class in person, especially in comparison to videoconferencing [9, 21]. Recent studies in educational contexts rarely focused on students. Cha et al. [6] study involved interaction designers who participated in K-12 classrooms. Zhang et al. [28] involved remote teachers as telepresence users. A few recent studies focused on students[10, 17, 24]. Schouten et al. [24] examined how the use of TR attributes to some of the robot-like characteristics on an interaction partner and how this can hinder communication. Fitter et al. [10] work examined how 9- to 13-year-old participants personalized their TRs and how that affected their self-presence. Finally, Liao and Lu [17] deployed telepresence robots on college campus tours so students could learn second language skills. The design recommendations concerned communication quality, inclusion, embodiment, interaction, and interface design. This work contributes the gap in the literature pertaining to the use of TRs within the classroom.

2.3 Identity

Identity refers to people's understanding of who they are over time, embracing both continuity and discontinuity [12]. From a sociological stand point, Goffman et al. [13] defined identity as the mental model one has of themself. Such identity, according to Goffman, is composed of many elements including appearance, attitudes towards others, beliefs, emotions and so on and manifest to others through their interactions and actions. A few RT studies touched upon identity features as they examine embodiment and social interactions [7, 18]. Neustaedter et al. [18] discussed how remote conference attendees presented themselves and how they were identified by others in the conference venue. Choi and Kwak [7] conducted an experiment about the effect of identity levels on presence. Some studies in the context of the classroom also tackled identity aspects[1, 17, 24]. However, no study endeavored to examine the identity features that are enmeshed in the design and use through an inductive qualitative and non-experimental approach.

3 METHOD

In this study, we used a qualitative approach to collect behavioral and attitudinal data about the use of TR in the classroom. We conducted participatory observations, surveys, and interviews with students who attended one class session via Beam Pro by Suitable Technologies. While we collected data about the whole experience of the student pilots, in this paper we focus on the identity aspect of such use and experience. Instead of operationalizing the concept of identity, we used a bottom-up approach to deduct the identity aspects from the data as we analyze it. This study was approved by the IRB at Indiana University Bloomington where all authors were affiliated at the time of data collection.

- **Research Questions:** There are two overarching questions for this study:

(1) How is identity as a value enmeshed in the design and use of TRs in the classroom context? The goal is to capture and understand the identity aspects that emerge as a result of the TR design and use.
(2) How can the answers to the former research question inform the design and use of TR for the classroom context? The goal is to provide guidelines for educators who consider using TR to support their students' classroom attendance, as well as design recommendations that consider the classroom context. Data was collected during Fall 2022 Semester and it is still ongoing.

We respond to these questions through a social sciences qualitative lens that captures identity aspects inductively.

- **Setting:** We used two locations for this study: our lab and the classroom. The lab is located in the same building as the classroom. It was equipped with a desk and a computer that students can use to access the classroom materials and the Beam app. The classrooms are of medium size. We used two classes that meet twice weekly for 80 min. The classes were set up in rows with multiple screens in the the front and the back. One class run for 16 weeks and another for 13 weeks.

- **Participants:** In this study, we are reporting from 12 participants (F=5, M=7). The students belong to undergraduate and graduate levels and major in data science, computer science, engineering, and human-computer interaction. Participants were offered 2 extra credits to thank them for their time.

- **Recruitment and procedure:** This study was advertised to students through their instructors. Interested students were requested to arrive at our lab for a 30 min training prior to using the TR. We instructed the remote students to participate in their class the same way that they would in person; move around the classroom and interact with their classmates and instructor. Two research team members assisted in every session. One was located in the lab and one in the classroom. The assistant in the lab trained the remote student and recorded their beam screen and the assistant in the classroom took notes of the interactions with the student. After the session, the students were surveyed about their use and invited for an interview that was planned within the same week.

- **Protocols:** The after-use survey was a 2 min structured protocol hosted on Qualtrics. Its aim was to collect general user experience information. The interview was semi-structured with open-ended questions. The questions were informed by the video recording

and observation notes. This allowed us to get in-depth information about the TR pilots' experiences, impressions, attitudes, challenges, and feelings about their participation. While most of the questions were not related to identity, a few questions concerned the perceptibility of their identity and what they could do to make it more apparent. The observation protocol was open-ended as the assistants were instructed to take notes of what they found interesting, surprising, weird, or unusual.

- **Data Analysis:** Our bottom-up approach started with weekly meetings where 5 researchers on the study gathered to make sense of the interview data. As a group, we deducted insights from 6 interview transcripts. The insights were written on post-it notes and then organized on a board in groups. The insights helped us create a preliminary code-book with categories and subcategories. Next, we used thematic analysis [4] where we identified more recurrent themes in the raw data line-by-line prior to interpretation [3]. Thematic analysis goes beyond identifying and counting occurrences of words or phrases to identify implicit ideas [14] and affinities between them; this involves iteratively looking for consistencies and differences in the data.

Figure 1: Making sense of the data

While this study is in progress, we are reporting here from the interview transcripts.

4 PRELIMINARY FINDINGS

Our inductive analysis revealed design affordances and user strategies that helped the participants self-perceive and project their identity but also design aspects that limited such perception and projection. Namely, our participants reported being able to project some aspects of their identity, but also expressed skepticism about how they looked and sounded, and reported the dominance of the robot identity. In some instances, their embodiment in the robot identity made participants inherit the limitations of the robot body and feel as though they were a differently-abled person.

4.1 Affordances and use strategies supporting identity projection

Here we illustrate some elements that allowed the remote students to project some aspects of their identity. The main design element that helped the remote students project their identity was the screen. P3 mentioned that he faced students when he wanted them to see who he was: *"When I want to talk to someone, I move in front of them so they can see my face and know who I am. If I am not facing them, I don't think they can tell."* P3 quoted illustrates a design element that can be used as an affordance, only if used in a particular way. Similarly, P2 thinks of his voice and movements as a way to project his identity since people sitting in the back cannot see his screen. Therefore, he tried to move around and talk so his classmates knew that he his is attending remotely via RT. While the beam app allows you to write your name and display it on the beam screen, four participants made use of it to post funny expressions, like: *"Happy robot"*, *"I am not a robot."* P1 explains how he did not need that label for others to know him, rather, he used it to tell jokes: *"So I think at one point, I put something like downloading software, it was more just like, oh, they could find funny. So I feel like I didn't have to do much to establish identity because, you know, my face is already there."*

4.2 Skepticism about identity self-perception

Some participants conveyed uncertainty about the size of the Beam and how much space it was taking up in their place in the physical world. P4 expressed that she had concern in a moment of another student trying to pass by her while she was piloting the Beam, asking, *"how wide am I for [someone] to squeeze by me?"* There seems to be a lack of clarity as to how big the robot is to users operating it, also including P7 who stated *"I wasn't sure if I was gonna run into it or not"* when trying to pass by a water fountain in a hallway. Students' experiences indicated that the two static cameras on the robot created confusion as to their 'own' size while using it because these viewpoints cannot indicate everything similarly to people's own scope of vision while walking.

Many participants mentioned that they found it difficult to discern how loud their audio was to those in the classroom listening to it. P3 mentioned that he *"never figured out what's better, and how [he] could... make them hear [him] better"*, along with other participants expressing that they *"don't know how the audio was because [they] didn't listen to [themself]."* Some mentioned that they recalled hearing the TR's volume when it was used by other students in their classroom and that it was louder than they expected, but others took note that they could not remember or gauge how it was that the robot sounded on their behalf. Some of the participants mentioned fluctuating their volume in an attempt to find a good spot for their output sound to be at, worried of causing a disruption. This includes P1, who expressed that *"people are leaned in because they can't hear it. But when I turned it up, people were like, wow, that's really loud."* This indicates an uncertainty in understanding the way that one is being presented, an issue shared by most students that were asked about their experiences with the robot's volume. Unless a user is able to hear the audio for themself before the robot is put to use, this becomes a limitation of their projection of self.

4.3 Student identity loss and robot identity and ability dominance

4.3.1 Feeling and acting like a robot. Some participants reported an increased feeling of identity loss, and that they felt as though they were being perceived as a robot, rather than as a human. P2

expressed a desire to be able to turn the head of the robot instead of the whole body in order to become more human-like. He continues, *"It would be good, instead of the whole body of the robot or the head turning will be like a human body, that's the difference between the robot and the physical person... It's not P2, its robot."* Similarly, P1 described robot movement, and also felt as though people interacted with him more just because he was perceived as a robot. P1 described this scenario, *"to a degree, what I found was the people move a lot faster than the robot. So usually, like they already have gone into groups by the time we're coming over there."* He continues, *"But also, like, they're very interested in the robot. So it's very easy to just like, push yourself into a coop and be like, hey, because suddenly everyone's wants to talk to the robot."* P1 also noted a conversational shift towards the robot once he became present.

P6 felt uncomfortable with being referred to as a robot and reported a different reaction to the increased attention from P1. P6 stated, *"I would say as the robot, a lot of people refer to me as like the robot...And people like would make jokes about the robot. "* P6 told an anecdote about a classmate threatening that they will turn off her beam. P6 found this threat to be hurtful but theorized that the classmate did not recognize her as herself, just as a robot.

4.3.2 Inheriting robot's body ability limitations. Another common finding was that some participants felt as though they were being put into a differently-abled body. P2 expressed discomfort in being carried up the stairs as he was navigating from the classroom to the beam docking station. Similarly, P5 found it awkward to be carried, *"I don't want people to carry me. Because just like a human, I don't want people to carry me right."* She continued, *"It's weird, we cannot act normal like walking on the stairs. So I would appreciate if there is a slope."*. P7 compared her treatment as an embedded individual to her experience of being a wheelchair user, especially as she was crossing the narrow hallway, *"I felt like they wanted to ask me politely to move out of the way, now that I am thinking about this, this is all exactly how it feels like to be in a wheelchair."* The combined experiences of P2, P5, and P7 stipulate that not only do pilots feel embedded in the robot but that it also impacts the treatment they get from their peers, leading to a diminished sense of normalcy and increased discomfort.

5 PRELIMINARY IMPLICATIONS

Our findings describe technology affordances that either helped project remote students' identity or limited / suppressed their projection or self-perception of who they are. In light of our findings, we describe both implications for use and design that can help remote students better self-perceive and project their identity.

5.1 Use recommendations

Since an increasing number of higher education institutions are incorporating RT technology, we suggest the following guidelines to help remote students self-perceive and project their identity.

- **Identity perception:** It would be helpful to demo TR in the classroom before students use it, so that students know how tall and loud it is, as well as how much space it can take as it is walking in the hallways and in between the tables. This can help build a certain confidence in what the TR can or can't do.
- **Identity projection:** Since students felt very limited by the TR technology. Students could be instructed about the possibility of embellishing the TR (e.g., by using a t-shirt, a tutu or a hat) or adding a label to the TR back. Students usually hesitate in decorating the robots as they think they do not own them. Such changes on the exterior of the robot can give the robot a more humanoid appearance and hopefully will be referred to less as a robot.

Another use recommendation that would help both identity perception and projection is the accessibility of the setting. The location of the classroom should not have stairs or obstacles in the way of the TR as they make the remote attendee perceive themselves as having body limitations and project the limited identity to the people around them.

5.2 Design recommendations

Similar to use recommendations, we present design recommendations in two categories.

- **Identity perception:** Technology could be developed with better mechanisms that would allow the users to gauge how loud they are in the remote space. As for how tall they are or how much space their robot would take, we suggest the integration of VR to improve such perception.
- **Identity projection:** We learned from our participants that they made use of their screen label field to add funny expressions but they did not think it can help project their identity. The label as well as the video are located in the front of the TR with no other cues on the back, we suggest having the label project the name/nickname of the students on a back screen. In addition, the TR robot movement could be re-designed to be more human-like in terms of speed and ability to turn the head without turning the whole robot body. Finally, a TR ramp that can be part of the robot body and help it get through stairs would be a very appreciated design by TR users.

6 CONCLUSION AND FUTURE STEPS

In this study, we examined how 12 students who used TRs self-perceived and projected their identity. The findings of our qualitative inductive study highlighted affordances and limitations to such perception and projection. We described such affordances and limitations and illustrated them with quotes from the data. Finally, we suggested design and use recommendations that can support remote students in the context of the classroom. Since this paper is based on preliminary data, in our next steps, we will interview more participants and include the classmates of the TR students. We will further analyze data from the classmates' surveys and conduct participatory design sessions with interested participants.

ACKNOWLEDGMENTS

We thank Prof. Katie Siek for supporting data collection, IU undergrad students who helped with data collection and coding, and all the students who participated in the study. This material is based upon work supported by the National Science Foundation under Grant # 2030859 to the Computing Research Association for the CIFellows Project

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