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Study of Telerobot Personalization for Children:

Exploring Qualitative Coding of Artwork

Veronica Ahumada-Newhart,
School of Medicine, University of California Davis, Sacramento, CA USA

Taffeta S. Wood,
School of Medicine, University of California, Davis, Sacramento, CA USA

Erin R. Taylor,
School of Engineering, University of California Los, Angeles Los Angeles, CA USA

Francesca O. Johnson,
College of Biological Sciences, University of California Davis, Davis, CA USA

Siena Saltzen,
College of Engineering, University of California Davis, Davis, CA USA

Sanjay S. Joshi
Department of Mechanical & Aerospace Engineering, University of California Davis, Davis, CA USA

Abstract

Social telepresence robots (i.e., telerobots) are used for social and learning experiences by children. However, most (if not all) commercially available telerobot bodies were designed for adults in corporate or healthcare settings. Due to an adult-focused market, telerobot design has typically not considered important factors such as age and physical aspect in the design of robot bodies. To better understand how peer interactants can facilitate the identities of remote children through personalization of robot bodies, we conducted an exploratory study to evaluate collaborative robot personalization. In this study, child participants (N=28) attended an interactive lesson on robots in our society. After the lesson, participants interacted with two telerobots for personalization activities and a robot fashion show. Finally, participants completed an artwork activity on robot design. Initial findings from this study will inform our continued work on telepresence robots for virtual inclusion and improved educational experiences of remote children and their peers.

Keywords

Telepresence; Robotics; Personalization; Robot design; Identity; Education

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vahumada@ucdavis.edu .

1 INTRODUCTION

The ways in which social telepresence robot (telerobot) design should be informed by child behavioral and developmental needs remain an unmet challenge. Age and physical aspect are considered two of the primary social identities that determine how we are perceived, how we are ordered socially, and how we are accepted by others [1, 2]. As such, how children dress themselves and their robots represents crucial components of identity for remote children and their peers [3]. The small body of research literature on telerobots in educational settings has documented remote students' increased sense of agency and autonomy [4, 5] but studies on how to promote positive development through robot-mediated experiences with peers is largely unexplored. Given the paucity of research, we know very little about child interactant experiences, expectations, and reactions. However, these are important factors in building a positive experience for both the remote child and peer interactants.

Additionally, in the context of social telerobots, interactant awareness of robot occupancy may be increased with robot clothing and accessories, as this physical personalization is more easily recognized from a distance than simple face screen images [6]. In this study, we instantiate personalization as the ways in which robot bodies can be dressed and/or accessorized to convey identity and presence of the remote user. Such personalization goes beyond mere decoration as it signals to interactants "who" is occupying the robot—relaying occupancy awareness [7].

2. METHODOLOGY

For this exploratory study on robot personalization, we conducted an informative lesson on robot bodies and allowed children to touch and explore the robots while asking questions about robot materials and capabilities. Children then collaboratively personalized the robots and conducted a robot fashion show. The fashion show was followed by a qualitative drawing activity where each child designed a robot that they felt would represent their identity and presence at school.

2.1 Participants

A total of 28 children (11 male, 17 female) were recruited and participated in this study. At the time of the study, participants were in grades 3–4 and ranged from 8 to 9 years of age (M=8.5, SD=0.5).

The research study was approved by our university Institutional Review Board (IRB) and no compensation was provided to participants.

Ethical considerations for recruitment were met by following all relevant IRB protocols including guidelines for ensuring both voluntary participation and anonymization of data. This age group was selected for this study as it is considered to be in the concrete operational period of cognitive development where children are able to display organized and rational thinking [8].

2.2 Materials and Procedure

Consent: Prior to the learning session, parent notices were sent home providing information on the learning activity that would take place in the classroom with a remote child using a robot. Parents were given the option to have their child opt out of the activity. Children who opted out of the activity or who did not wish to participate in the activity did not attend the activity. At the start of the study, the lead researcher obtained verbal assent from participants.

Instruction: After obtaining assent, the lead researcher instructed participants on human-robot social guidelines for interacting with the robot and introduced a learning activity for co-designing robot bodies. A short instructional session was provided on the materials of robot bodies and safety features needed for robots in educational settings. After completing the learning activity on robot bodies, participants were asked to imagine what robot bodies should look like in the future for children, adolescents, adults, and older adults. Participants were then given a short break where they had the opportunity to touch the robots, explore, and ask questions.

Personalization: Participants were guided through various personalization options for both telerobot models. Personalization options were presented in a maker space format where the options were laid out on tables: each table had various forms of shirts, skirts, shorts, and pants as clothing options. Clothing options were typical for this age group (per retail sizing standards) but also included younger options such as fairy wings and a Star Wars stormtrooper robe. Clothing options were purchased at local consignment stores to reflect regional clothing styles. Participants were divided into two groups to create personalization options for their remote peers. A mirror was available for each remote child to view themselves.

Activities: Volunteer remote robot drivers were asked to login to iPads to gain access to the telerobots while their peers were in an adjoining room. The children driving the robots were separate from the other children and communicated with their peers via the telerobot's audio and visual functions.

Peer interactants were divided into two groups of 10 where one group interacted via a Double and the other group interacted via a VGo. Peer interactants were responsible for communicating with the remote driver to pick personalization artifacts (clothing, badges, stickers) for each robot.

Two researchers were available to support in the driving of the robots to the maker spaces and two researchers were available in the maker spaces to oversee the personalization activities. Aside from occasional connectivity issues, both remote child participants were able to drive their respective telerobots after receiving brief guidance on the control features in the user interface.

After selecting their final personalization options, researchers and child participants chose music for the fashion show. Once the final outfits and music were selected, peer interactants conducted a fashion show for their remote peers to reveal the personalized robots.

Following the fashion show, participants were given art supplies to draw on a coloring sheet that had an outline of the Double robot. They were asked to draw how a robot could be personalized to represent themselves as an individual. After the coloring and drawing session, coloring sheets were scanned by the research team and stored securely for future coding. As a child-centered study, researchers did not keep original drawings. This allowed for traditional learning practices where children take their artwork home to share with their families.

Robots: We used two robots in the study, the Double 3 and the VGo (Figure 1). Both models are mobile telerobots that can move forward, backward, and turn. The Double can “sit” or “stand” using adjustable height control. The Double weighs approximately 16 pounds, the VGo weighs 26 pounds, and as such, both pose minimal risk of injury to participants. Both robots were modified with hangers and pool noodles to facilitate personalization. Shown on the Double 3 is the addition of a lower hanger that allowed for addition of skirts, shorts, or pants (Figure 1).

2.3 Environment

The study took place in a large building with internet access. We were given access to a prearranged area consisting of two large adjoining rooms. Room 1 had a space for the initial 28 children to sit on the floor comfortably while the research team introduced themselves and gave a brief lesson on robots in our society. In this area, the telerobots were also introduced to the children to view and ask questions. In Room 2, the maker space tables were set up parallel to one another with the personalization items. The robots were driven by remote child volunteers (n=2) in Room 1. The peer interactants personalizing the robots were located in Room 2 (n=26). The pathway for the robots from Room 1 to Room 2 was approximately 10 feet long (Figure 2).

2.4 Initial Analysis

The qualitative coding of children’s drawings remains largely unexplored. Coding children’s drawings/coloring sheets as data has been used to triangulate anxiety scales [9]. However, this practice is rare in studies about children’s views on technology. For our analysis, a codebook was developed by the research team using inductive coding to capture first impressions of categories that emerged in the drawings to be present in the coloring sheet data. The lead researcher created the codebook and made slight alterations before the lead and secondary researcher coded the data in discussion with one another. This process was iterative and led to the expansion of codes. This qualitative coding recorded impressions within and between cases, where each “case” was a child who completed the entire study (n=9).

3. RESULTS AND FUTURE WORK

In this exploratory study we found that the group maker space activity of personalizing the robots allowed for strong collaborative efforts between the remote user and peer interactants to select personalization artifacts that represented the identity of the remote user. Additionally, we found that the artwork provided unique insights into children's perceptions of robot design, social identities, and creativity. Our coding scheme and analysis are in process with planned follow up studies to validate our measures. Below, we detail our preliminary findings:

Preliminary Finding 1:

Robot Redesign. Some children illustrated the base image of the Double 3 in ways that recommended modifications at the structural level (the addition of arms, hands, legs, and feet for example). This denotes thinking "outside of the lines" and imagines personalization that is embodied beyond the base robot body model. Additionally, children consistently drew articles of clothing for the lower body of their robots (skirts, shorts, leggings). Child drawings that went outside the confines of the drawn robot body represented a desire to have body parts (e.g., limbs, feet, hands) that support their personal identities in ways that are familiar to the remote child and peers.

Preliminary Finding 2:

Social Identities. Social identities were revealed in children's drawing through the expressed desire to have their faces on the screens, to be seen alongside their best friend, or to be called by certain names. The ways in which children imagined and illustrated embodiment in the telerobot varied on the robot face screen. Some children illustrated themselves on the screen, some drew a smiley face, and some included their friend in the drawing. These representations revealed that children wanted to be seen in their interactions with their peers.

Preliminary Finding 3:

Playfulness/Creativity. In addition to drawing traditional clothing and social elements, children also engaged in creative drawings that were developmentally representative for their age. Some children added creative costumes to their robot bodies. In particular, three children drew their robot in a pickle costume and/or referred to their robot as "Dr. Pickle" or "Joe Pickle." Children dressing the Double insisted on having their friend's robot wear the Star Wars robe to school and the remote driver of the VGo insisted on her robot wearing fairy wings (Figure 3). Another aspect of creativity was seen in the coloring sheets that had artistic elements to denote movement and speech. Some drawings had squiggles to show movement for the robot and others had lines around the face to represent sound coming out of the robot.

3.1 Future Work

Challenges were posed due to connectivity issues at the study site. Attrition was also a challenge. The original group of child participants numbered 28 and by the end of two-hour study session, the group numbered 9 children. Some participants left to play other activities (billiards, outdoor sports) and others left with parents/guardians (pick up times varied by family schedules). After speaking with the administrator of the study site, other scheduled activities and family pick-up times were determined to be the main factors that contributed to attrition in the study.

This study indicates that peers can enthusiastically contribute valuable insights to personalization of telerobots for remote children. To be virtually included via robot in a physical space requires not just access to a robot but also social acceptance [10]. Future studies will measure the effectiveness of collaborative personalization on levels of social presence.

Additionally, this work makes a unique contribution through an innovative approach that uses qualitative coding of children's artwork to inform future robot design. This is a fundamental step to expand our on-going and future studies with K-12 community partners to co-create and design improved robots and best practices for telerobots in educational and learning experiences. This novel, age-appropriate, method of data collection may provide insights not previously captured in traditional HRI studies.

Given the importance of representing child identities for meaningful learning and social interactions, robot personalization is an important factor of telerobot use in K-12 schools. Personalization of a telerobot that is informed by both the remote user and peer interactants holds great promise for improving educational and social experiences for remote children.

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CCS CONCEPTS

•Computer systems organization ~ Embedded and cyber-physical systems ~ **Robotics** • Human-centered computing ~ Collaborative and social computing ~ **Collaborative and social computing theory, concepts and paradigms** • Human-centered computing ~ Interaction design ~ **Interaction design theory, concepts and paradigms**

Figure 1:
Double 3 and VGo robots modified with clothes hangers and pool noodles

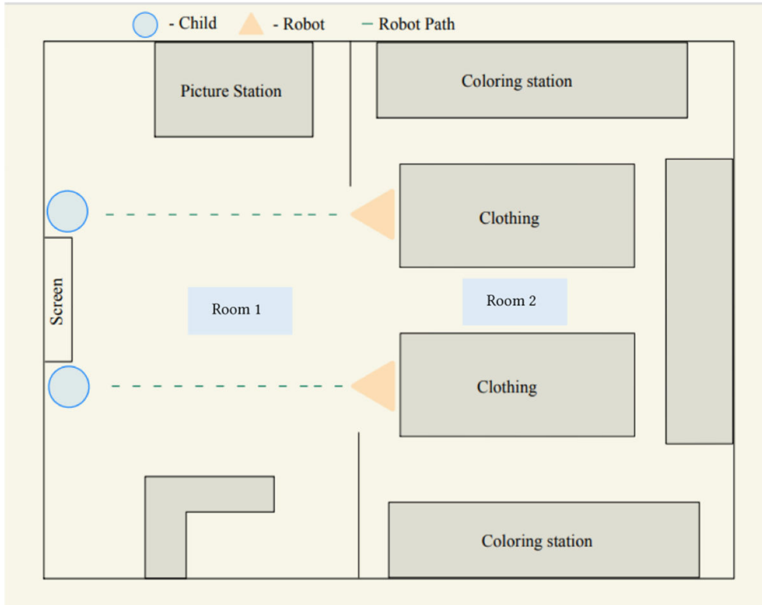

Figure 2:
Activity environment

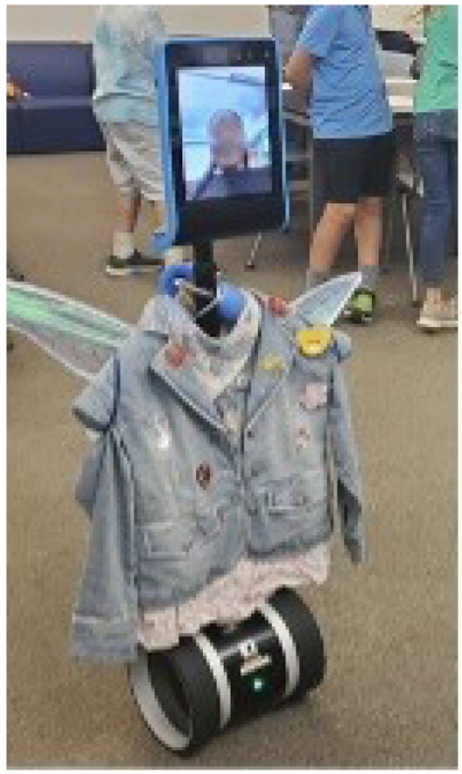

Figure 3:
Double 3 with fairy wings