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Introducing Children and Young People with Sight Loss to Social Robots: A Preliminary Workshop

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ABSTRACT

Meaningful first-time interactions between humans and robots are important for learning functionality, shaping impressions, and building trust. Additionally, robots should be an inclusive tool, accessible to all, yet typical introductory human-robot interactions rely heavily on the human's visual perceptions. For children and young people with sight loss, this is can be problematic. Therefore, we present a preliminary workshop with four children and young people with sight loss in order to begin investigating how this population learns about social robots for the first time, their overall impressions of social robots, and whether games could assist in creating positive first-time interactions. Our initial findings reveal the importance of promoting tactile exploration, clarifying safety aspects, and careful consideration of the communication of robot emotion.

CCS CONCEPTS

• **Computer systems organization → Robotics**; • **Hardware →** *Haptic devices*; • **Human-centered computing → Accessibility**.

KEYWORDS

social robots, haptics, sight loss, visual impairment, workshop

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1 INTRODUCTION

More than two million people in the UK are living with sight loss (SL)[1], of which an estimated 27,000 are children and young people (C&YP) [18]. Multiple research projects have aimed to use robotics to aid people with SL, mainly with navigation (e.g. [1, 8, 10]). For C&YP, robots have proven beneficial in educational roles [14] and other social settings [5, 11]. Due to the novelty of robots to C&YP, it is vital to consider how users will be introduced to these technologies, as first impressions of robots can persist across repeated interactions [16] and have a strong impact on how the robot is accepted in future [21]. However, C&YP with SL may be excluded from opportunities to interact with robots (e.g., science fairs) due to safety concerns [22], which leaves researchers in the dark about how to introduce this demographic to robots.

Initial interactions with new objects result in impressions of affordances—how the object can be interacted with, what we can do with it, etc. [15]. For sighted people interacting with robots for the first time, affordances are heavily perceived through visual information during demonstrations. For example, an investigation into older adults' acceptance of assistive robots [4] probed participants' opinions about robots before and after seeing three demonstrations of assistive tasks. After these demonstrations, participants reported increased positive opinions about robots. However, demonstrations like these are inaccessible to people with SL.

Thus, the initial interaction must be given more thought by designers who seek to introduce a new robot to a user with SL. For C&YP, it seems important that this initial interaction is fun and engaging [6, 17]. Therefore, the idea of a game has been raised as the initial interaction with a robot since games are a common and enjoyable interaction paradigm for social interactions among C&YP [7] and have been shown to have a positive effect on the perceived anthropomorphism and likeability of a robot [16].

This study is the first stage of an iterative process to understand and develop first interactions with C&YP with SL and robots. As safety is already a concern in human-robot interactions [22], this workshop only introduced participants to robots designed with a focus on human-robot interaction, i.e. social robots. Furthermore, we believe that social robotics is a rapidly developing field that is

[1]Some people who are blind or partially sighted, especially those who have been since birth, may not feel the term "people with sight loss" applies to them. However, we use this term here because it is preferred by the charity that participated in this research.

likely to be applied to assist C&YP with SL in the near future. This preliminary workshop investigated the following aspects:

(1) How C&YP with SL explore social robots during first interactions
(2) Their overarching impressions of social robots
(3) How games could assist in creating a positive first interaction

2 WORKSHOP

2.1 Participants

Four C&YP (three male, one female) aged between 10 and 15 took part in the workshop, and they were accompanied by three supervising adults (a mix of teachers and therapists). Participants had a range of residual vision. Some were blind since birth and some lost their sight during childhood. They were recruited through contact with Sight Scotland, a charity in Scotland that educates and supports young people with vision loss [19]. None had previously been introduced to social robots.

The workshop received ethical approval from Heriot-Watt University, and parental and participant consent forms were signed before the workshop. A health and safety visit was also carried out prior to the workshop by a staff member of their school to assess the building in which the workshop would take place and the robots with which the participants would be interacting.

2.2 Structure

The workshop took place in May 2022 at the university over a single morning (Table 1). Participants interacted with four social robots and the Ultraleap STRATOS Explore (Figure 1), which provides mid-air ultrasonic feedback. Interviews with children and staff at the Royal Blind School revealed that C&YP with SL often add haptic elements to everyday items to facilitate their use, which draws attention to their SL. The ultrasonic feedback device was included to provide another interaction possibility that could be integrated into the introductory game to learn about a robot.

Table 1: Workshop Structure. Phases 2 and 3, colored in blue, were repeated for each of the 5 technologies shown in Fig. 1.

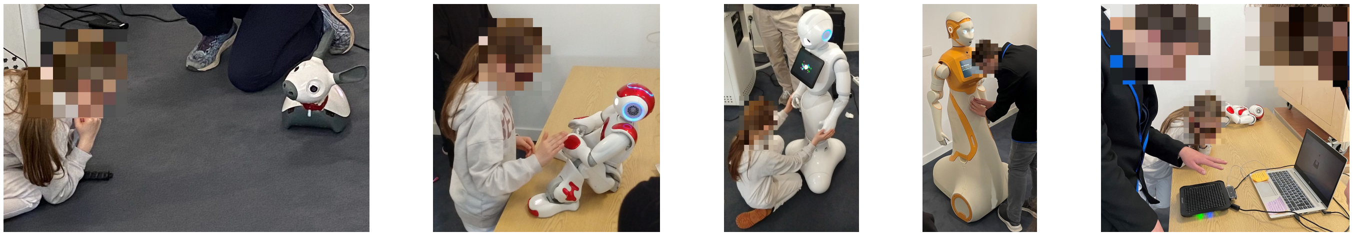
Phase	Duration (Total: 2 hours)
1. Welcome	5 minutes
2. Demonstrations (x5)	10 minutes per demonstration
3. Questionnaires (x5)	5 minutes per demonstration
4. Lunch	15 minutes
5. Semi-Structured Interviews	30 minutes

2.2.1 Demonstrations. The objective of this phase was to perform observations to understand how the participants interacted with the robots upon first-time introduction. A researcher experienced in participatory design led these demonstrations, firstly providing a short description of the robot, which included information such as the name, type (e.g., "humanoid"), features (e.g., speech), sensors (e.g., touch sensors), and applications (e.g. "used in hospitals"). Descriptions regarding its size and form were kept to a minimum to provide them the maximum opportunity for discovery through exploration. This occurred while the researcher answered questions and referenced interesting features, such as Pepper's lifelike hands and MiRo's tail. Secondly, the researcher introduced a short demonstration which would be performed by each robot. The exceptions to this procedure were the MiRo and the ultrasonic feedback device, which were explained while the demonstrations were running since the demonstrations were continuous. The content of the demonstrations, shown in the list below, was chosen to expose participants to the wide range of interaction modalities and feed into the games discussion outlined in §3.3.2.

- **MiRo:** Freeform interaction. The robot autonomously moved around the floor, turning its head and making noises. It wagged its tail when the children stroked its head or back.
- **Nao:** Memory game as in [12]—the participant is given a sequence of body parts on the robot and must touch the body parts in the given order. Auditory feedback (a beep) confirms the touch input was registered.
- **Pepper:** Same memory game as with the Nao robot.
- **ARI:** Oral quiz on COVID-19 with multiple choice options (topical during the time of the workshop).
- **Ultrasonic Feedback Device:** Variety of tactile effects including buttons and sliders, sensations like bubbles popping, and feeling different shapes in 3D (e.g., teapot and pyramid).

2.2.2 Questionnaires. A child-friendly version of the **GODSPEED** questionnaire [2] was administered after each demonstration to provide insight into the perceptions of robots with varying embodiments. Participants chose a position on a semantic differential scale from 1 (lowest level of social attribute) to 5 (highest level of social attribute). The **Social Acceptance Questionnaire** was administered before and after all the demonstrations to indicate how the participants' views on robots changed and provide insight into their overall acceptance of social robots. The questionnaire is based on [9] and has been used before in a study with children and social robots [20]. The first three items on the questionnaire related to liking and wanting to interact with a robot socially. The remaining four items gathered participants' attitudes towards interacting socially with a robot that has reduced functionality in various areas. Namely, a robot that is not able to speak well, hear well, see well, or needs extra help to execute tasks.

2.2.3 Semi-Structured Interviews. Each participant took part in a one-to-one semi-structured interview where they were queried regarding their experience with the interactions, including overall satisfaction and preferences for interaction modalities. The supervising adults clarified questions when needed. Participants were additionally presented with three robot-related games. Our goal here was not to gather design ideas, but rather to stimulate discussion and understand the participant's interests in using games during first-time interactions with robots. For this reason, the games were based on simple concepts but included aspects of the interactions seen in the previous robot demonstrations so the participants could recall what they most liked and relate them to the proposed games. They were asked to rate each game on a 5-point Likert scale and select their favorite. Each proposed game used the robot's tactile sensors as inputs, the robot's speech to facilitate the game, and



(a) MiRo (b) Nao (c) Pepper (d) ARI (e) STRATOS Explore

Figure 1: Technologies demonstrated to participants. Left to right gives order of presentation.

included various gamification elements (e.g., score). Descriptions of the games are as follows:

- **Memory Game** The robot verbalizes two lists of words. The player touches the robot's left hand if the word was in the original list or right hand if not. A performance score is given upon completion.
- **Unlock the Robot Game** The robot's movement is frozen and requires the player to memorize a password to unfreeze it. The robot verbalizes a list of body parts to touch in order. The player must touch each body part to unlock the robot and the game ends if the player fails to touch the correct part. The robot also encourages the players by guessing which part they touched (e.g. "Hmm I can feel that, did you touch my left hand?").
- **Sound Game** The robot plays an animal sound and gives options for what animal it was, plus the associated sensors. The player would touch a sensor to submit their guess. The game would end with a fist-bump or high-five.

3 RESULTS

3.1 Facilitator's Observations from the Demonstrations

3.1.1 Physical Explorations. Observations highlighted the importance of physical exploration when interacting with these technologies. During the robot introductions a pattern was observed of the participants using tactile exploration, starting at the top of the robot and moving to the bottom, pausing at areas of interest. Participants frequently used both hands, patting down the left and right sides of the robot, but a participant who used a cane as a mobility aid tended to only use one hand to explore the robots. As seen in Figure 1a, participants got down on the floor with MiRo to engage in tactile interaction. Areas of interest were similar across participants. Observations revealed high interest in complex, realistic aspects of the robots such as Pepper's hands and MiRo's tail.

The ultrasonic feedback device requires the user to hover their hand over the haptic board to feel the ultrasonic feedback. One participant enjoyed the interaction so much they brought the adult who picked them up over to show them the device. However, some had difficulty keeping their hand positioned properly. Other participants stabilized themselves by leaning on table with their other hand or arm, but this did not completely prevent drift.

3.1.2 Robot Emotion. Participants frequently questioned the robots' emotions. One participant described MiRo as being affectionate towards another participant and asked how to tell if MiRo was angry. A different participant liked ARI's "sense of humor" and another described the robots as "friendly".

3.1.3 Safety. Participants expressed various safety-related questions, such as how the robots avoid colliding with people and obstacles or falling down stairs. They highlighted a further safety concern specific to users with SL. The robot might move to a new location without the awareness of the user, which could become hazardous. One supervising adult raised the matter that safety considerations for users with SL are different to sighted users.

3.2 Questionnaires

3.2.1 GODSPEED. While statistical testing was not feasible here due to the small sample size, results were generally close to the ceiling, which indicated high degrees of perceived social attributes. There was consensus among participants on a few items: ARI was interactive, likeable and intelligent; MiRo was interactive; and Nao was calm.

3.2.2 Social Acceptance. Participants agreed or strongly agreed with the statements on liking and wanting to interact with robots, both before and after the demonstrations. Also, following the demonstrations, five of the "agree" responses shifted to "strongly agree", so the proportion of responses that were "strongly agree" doubled. The acceptance of reduced functionality varied across participants and across the duration of the workshop. For example, one participant was initially accepting of a robot that could not hear or speak well but following the demonstrations they decided that a robot needed to hear and speak well for them to interact with it smoothly, while also increasing in their tolerance of robots that needed extra help to do things. Overall, participants were broadly prepared to accept a robot with some limitations to its functionality where this was not in conflict with safety, see §3.1.3, though the specific areas were personal to each participant.

3.3 Semi-Structured Interviews

3.3.1 Interaction Experience. All participants were highly satisfied with the experience of interacting with the robots (all rated their satisfaction as 10 out of 10). They frequently commented on how "interesting" the interactions and robots were. Participants also described the robots as "cool" and "useful," and the interactions were described as "good" and "fun".

Participants emphasized the importance of speech and touch as ways to interact with the robot while providing variety in the feedback (e.g., different sounds rather than all the same beeps). Speech was one of the features mentioned frequently when discussing why they liked ARI. They also found the mid-air haptic feedback novel and interesting, and some wanted it to be incorporated into the robot or robot game. Participants wanted longer interactions with the robots and variation within the interaction. Participants liked the combination of verbal description and tactile exploration used to introduce the robots. One participant wanted the two methods to be used concurrently to associate the description with the tactile feedback "so that you don't miss anything."

3.3.2 Game Preferences. Participants wanted to be able to succeed at the game through the robot prompting if they were stuck or providing a second chance if they made a mistake. For instance, a participant made a mistake early on during one trial of the Nao memory game, resulting in the game ending. The participant was disappointed, which may explain discrepancies between Nao and Pepper, e.g. in their interactivity rating, despite the participants engaging with the same game. The sound game had the highest overall rating and was the favorite of two participants. The unlock the robot game received the second highest rating and was the favorite of one participant. The memory game received the lowest overall ratings but was still the favorite of one participant, showing the broad range of preferences, even within a small group.

4 DISCUSSION

This preliminary workshop provided initial insight into the following three key areas:

How C&YP with SL explore social robots during first-time interactions. The participants' strong reliance on tactile exploration, particularly on realistic areas of the embodiment such as robot hands, emphasizes the importance of considering alternate ways to introduce C&YP with SL to social robots. Encouragement of tactile exploration during these first-time introductions may be beneficial. Although this is something that is not typical in existing human-robot interaction, positive social acceptance ratings from the questionnaires suggest such an approach may merit further investigation. The interactions with the ultrasonic feedback device were positive, but revealed that maintaining the correct hand positioning was a key difficulty. This has been observed in other first-time interactions with this device [13]. Moving forward, an armrest could be incorporated to stabilize the user's arm.

Difficulty in understanding the robots' emotions during the demonstrations suggests that visual cues play a large role here. Emotion is an important component of interaction, which can drive better outcomes [3]. For C&YP with SL being introduced to robots for the first time, it is important such emotions are communicated effectively by focusing on non-visual modalities, such as adapting the intonation of the robot's voice to convey different emotions.

The popularity of speech during the demonstrations and interviews suggests that C&YP with SL may benefit from verbal commands or two-way conversation during first-time introductions, possibly to facilitate tactile exploration or communicate emotion.

Finally, our observations reveal safety may be a key worry for C&YP with SL when interacting with robots, as they can struggle to perceive their location and intended actions. Further, if we actively promote tactile interaction, we must consider potentially dangerous regions of the robot, such as pinch points. This raises new questions regarding the robot's movement during the interaction and how it communicates its safety features to increase users' acceptance.

Their overarching impressions of social robots. This preliminary workshop shows that the participant group initially held positive views about robots. Additionally, the group enjoyed the overall experience with each robot, with no preferences toward any robot in particular. Their high acceptance of social robots provides encouraging insight for future first-time introductions between C&YP with SL and social robots.

How games could assist in creating a positive first interaction. This workshop revealed interest from participants to incorporate interaction-rich games into robots as learning and exploration mediums for C&YP with SL. Feedback suggests that an important consideration will be to include games that promote exploration of the robot in an accessible and fun way, without being too challenging, to avoid C&YP with SL losing interest or becoming frustrated.

5 FUTURE WORK

This preliminary workshop was the first step in an iterative process towards understanding and developing effective and educational first-time interactions between C&YP with SL and robots. Moving forward, we plan to use the insights gained to plan a participatory design workshop with a larger group of participants. Outcomes will then be used to develop and evaluate a robot-led self-introduction. Social robots will continue to be the focus of our interactions due to their highly interactive and safe nature, yet the findings from future work may shed light on effective ways to introduce all kinds of robots to C&YP with SL.

6 CONCLUSION

We ran a preliminary workshop to observe how four children and young people with sight loss interacted with four social robots and an ultrasonic feedback device for the first time. Participants provided feedback through questionnaires and discussions on their opinions regarding embodiment, interaction modalities, and game design. Findings revealed the participants had a strong dependence on tactile interactions to explore body parts and sensors on the robot. They were also interested to learn about the robots' emotions and about movements from a safety perspective. Findings also revealed interest in a variety of interaction modalities such as touch and haptics. This workshop further supports the use of multimodal games as a potential means to engage C&YP with SL in initial interactions with robots. In future work, we plan to continue the iterative design and development process towards a gamified self-led introduction to social robots.

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