Designing for Perceived Robot Empathy for Children in Long-Term Care

Alexandra Bejarano, Olivia Lomax, Peyton Scherschel, and Tom Williams

Colorado School of Mines
Department of Computer Science
Golden, CO 80401
{abejarano, olomax, peytonscherschel, twilliams}@mines.edu

Abstract. We describe a mixed-methods approach toward the design and evaluation of social robots that can offer emotional support for children in long-term care environments. Based on the results of a needfinding interview with a local expert, our specific aim was to design a robot that would be perceived as empathetic. An online human-subject study (n=26) provided preliminary support for a hypothesis that this design goal could be achieved by designing robots to maintain the flow of conversation and ask related followup questions to further understand interlocutors' feelings.

Keywords: Social Robot Design. Child-Robot Interaction. Empathy.

1 INTRODUCTION

Researchers have argued that social robots designed for hospitalized children must appear to be empathetic [9]. For a robot to be emotionally supportive it must address users' feelings in a sensitive and effective way [2]. For robots to be comforting and address those feelings in emotionally supportive roles, they must be perceived as empathetic. Researchers have described empathy as the feeling of sharing someone or something's emotional state [1]. Moreover, previous research has found that people communicate better with robots that display empathy [6], and that robots recognizing children's affective states and responding with encouraging or positive followups are perceived as more positive and supporting in long-term child-robot interactions [8, 7, 9].

We build on this work to explore how best to design robots to be perceived as empathetic in children's long-term hospitalization contexts. We begin by presenting the results of a qualitatively analyzed needfinding experiment with a local domain expert, and then discuss how we used storyboarding and improvisation to design a robot interaction designed to meet identified needs by asking followup questions and remaining on topic to appear empathetic and fulfill emotional support roles. We then present the results of a human-subject evaluation of this designed interaction. Our results provide preliminary support that our interaction technique achieves our design goals.

2 Needfinding Interview

To begin our research process, we conducted a semi-structured needfinding interview [10] with a doctor at a local children's hospital, asking questions regarding (1) our interviewee's role and duties at the children's hospital, and (2) the patients they work with and their daily routines. The interview was then analyzed using Empathy Mapping [5], wherein an interviewee's utterances were associated with six key thematic categories (*Think, Feel, Say, Do, Pain, Gain*) and then used to construct high-level qualitative theories.

Think — This category considers important beliefs, desires, and intentions of our interviewee or others they interact with. Our interviewee demonstrated commitment to their patients' care and the belief that technology can make a difference in children's lives. Our interviewee conveyed an intent to distract patients from being hospitalized, and a desire to uplift the feelings of being in a hospital.
Feel — This category considers important emotions experienced by our interviewee or others they interact with. Our interviewee was acutely aware of the stress put onto children and parents, especially during long-term stays. Our interviewee demonstrated empathy toward patients and their parents, describing the extent of care they provide, and circumstances (e.g. getting an infection) that necessitate longer care than intended, describing such experiences as "brutal."

Say — This category considers what our interviewee explicitly said mattered to them. Our interviewee highlighted key challenges faced by patients:

> *"[F]or babies like their world is supposed to explode. They're supposed to go out and discover things and being a outdoor and, you know, even if they're indoors going places and instead they're like in the same room all the time, like, you know, it's impairs their development. And for older kids, they're stuck in the hospital, it starts to, you know, affect them psychologically stresses, stresses on families, all that stuff."*

The interviewee also highlighted the role technology plays in their work:

> *"[W]e don't currently use robotics, but we do use a lot of computers like the ventilators are computers, the whole monitors are computers and I in talking about this like or thinking through, like, I definitely think there's some way that there could be some HRI (human-robot interaction) going on."*

Do — This category considers actions our interviewee described as being important. Our interviewee discussed having to keep the hospital clean and safe to avoid putting patients at risk (e.g. being careful not to spread infections and maintaining privacy) and easing the difficulties of hospital life for patients and their families. As mentioned under *Think*, the latter is in part addressed by medical personnel being positive, uplifting, and distracting.

Pain — This category consisted of frustrations, concerns, obstacles, and risks faced by our interviewee or those they interact with. Our interviewee was primarily concerned with the stress faced by patients and their families, and patient safety. Our interviewee indicated children face stress from being hospitalized, requiring continuous monitoring, being in a fragile state, and missing out on opportunities non-hospitalized children have, while parents face stress from having and caring for a child with a life threatening illness and the possibilities of something bad happening and their child getting worse.

Our interviewee also indicated obstacles faced by patients and their families. Patients face overall physical weakness and often must use wheelchairs. Some can navigate a wheelchair on their own and others are completely dependent on others to go anywhere. "Technology dependant" patients or those needing 24/7 monitoring face extra risks and require extra care/assistance. Overall, patients face restrictions to exploration and interactions due to fragile conditions.

Gain — This category considers what our interviewee wants or needs to achieve, how they measure success, and how they try to achieve success. Our interviewee aims to help patients heal as much as they can and as safely as possible while meeting each patient's unique needs and easing the negative impacts of their hospital stays. Our interviewee measures success by the physical health and stability of patient, quality of life after treatment (i.e. how technology dependant a patient is), and what patients focus on (e.g. when getting a shot, are the children distracted by toys presented by a child life specialist). Outside of physical treatment, our interviewee tries to achieve success by providing children with opportunities that make their hospital stay feel more normal, distracts patients from the stress of their hospital stays, and makes sure families are supported and understand how life with a child requiring treatment and hospitalization will be.

Overall, this analysis revealed the following high-level needs for long-term hospitalized children: the ability to socialize and engage with their surroundings and garner emotional support to have high quality of life and sense of normalcy.

3 Interaction Design: Storyboarding and Improvisation

To identify how a social robot may address the needs identified in our interview, we heavily relied on storyboarding and improvisation. First, we identified a common interaction pattern for our desired context: the first interaction between a child and a robot. Here, a robot is introduced to a child by a third party (such as a nurse) and begins to become acquainted with the child. Through this interaction, a robot can build rapport with the child and determine how to interact with them to begin to address their needs.

Next, we used paper-and-pencil storyboarding to refine this interaction pattern, and used *Embodied Design Improvisation* [11] to physically act out the interaction pattern to see how it would play out off paper. Through improvisation, we found moments that made the interaction feel disjointed due to poor flow of conversation and lack of comforting language. To address the poor flow of conversation, we developed the idea of robots explicitly providing the choices to "learn, chat, play" to allow a child to choose how they wish to interact with the robot and move the interaction forward. This raised two questions: (1) How should the flow of conversation be maintained within each of those choices? and (2) How should robots provide comforting language?

Through further discussion of the interaction pattern, we identified *followup questions* as a mechanism to keep conversation going while gaining better understanding of a child, how they may be feeling and how they may prefer to be interacted with (i.e. what makes the child feel comfortable).

We thus focused on the following design strategy: For a robot to be comforting, it must maintain the flow of a conversation and ask followup questions to further understand childrens' feelings. We then storyboarded scenarios in which a robot recognizes a child's emotional state through dialogue and responds by: (1) asking a related followup question, further pressing for more information as to why a child feels a certain way, or (2) asking an unrelated followup question ("Do you want to play a game?") to help improve the child's mood. In (1), since the robot asks a related followup question that aims to further understand the child, the robot appears to be actively listening which may improve the perceived empathy of the robot as opposed to (2).

4 METHOD

While ideally we would evaluate our designed interactions using in-person experiments with local hospitalized children, this was not possible due to COVID-19 [4]. Thus, to provide a preliminary evaluation of the potential effectiveness of our designs, we conducted an online ethics-board-approved experiment using Amazon's Mechanical Turk crowdsourcing platform, to test the following hypothesis: *A robot designed to maintain the flow of conversation and ask related followup questions to further understand a person's feelings will be perceived as more empathetic.*

After providing informed consent and demographic information, participants were first shown a pre-test video in which a Nao robot introduces itself to a human named "Jane". Participants then watched two post-test videos in a randomized order. In each post-test video, Jane indicates she is having bad day, and the robot responds according to one of two within-subject conditions. In the Related Followup condition, the robot asks a related followup question asking what is wrong, in order to demonstrate active listening and gain further understanding of Jane's feelings. In the Unrelated Followup condition, the robot instead asks an unrelated followup question, asking if Jane wants to play a game; an utterance that is prosocial and relevant to the interaction but that does not demonstrate active listening and serves to provide a distraction rather than gaining further understanding of Jane's feelings.

In all videos, only dialogue was changed, while the movements and tone of the robot were left unchanged, ensuring that any observed differences between conditions was most likely due to the differing robot response.

After each video, participants were asked to complete a series of Likert items derived from the RoPE Scale, a measure of perceived robot empathy [3]. Participants also completed a free response question after each series of items to explain their ratings. Finally, participants completed an attention check.

5 RESULTS AND CONCLUSION

Data was collected from 48 participants, but 22 were removed from the analyzed data: 17 removed for not completing all questions and 5 for providing responses suggesting they were bots. Data from the remaining 26 participants was analyzed: 15 male, 11 female, mean age=42 (SD=11). Pre-test/post-test gain scores were computed and analysed using Bayesian Paired Samples t-tests. Strong evidence was found in favor of our alternative hypothesis (BF = 37.11). These results show that perceived empathy was significantly higher relative to the pre-test in the Related Followup condition (M=104.19, SD=159.48) than in the Unrelated Followup condition (M=-51.81, SD=115.18).

Our work highlights the needs of children in long-term hospitalization and shows the effect communication strategy (Related Followup vs Unrelated Followup) has on perceived empathy and its potential to facilitate robots' emotional support. Future work should validate these results within in-person child-robot interactions as perceived empathy may differ in-person and with children.

References

1. Batson, C.D.: The altruism question: Toward a social-psychological answer. Psychology Press (2014)
2. Burleson, B.R.: What counts as effective emotional support? explorations of individual and situational differences. Studies in applied interpersonal comm. (2008)
3. Charrier, L., Rieger, A., Galdeano, A., Cordier, A., Lefort, M., Hassas, S.: The rope scale: a measure of how empathic a robot is perceived. In: Comp. HRI (2019)
4. Feil-Seifer, D., Haring, K.S., Rossi, S., Wagner, A.R., Williams, T.: Where to next? the impact of covid-19 on human-robot interaction research (2020)
5. Ferreira, B., Silva, W., Oliveira, E., Conte, T.: Designing personas with empathy map. In: SEKE. vol. 152 (2015)
6. Kramer, J.: Empathy machine: Humans communicate better after robots show their vulnerable side (2020)
7. Leite, I., Castellano, G., Pereira, A., Martinho, C., Paiva, A.: Long-term interactions with empathic robots: Evaluating perceived support in children. In: International Conference on Social Robotics. pp. 298–307. Springer (2012)
8. Leite, I., Castellano, G., Pereira, A., Martinho, C., Paiva, A.: Modelling empathic behaviour in a robotic game companion for children: an ethnographic study in real-world settings. In: Proc. HRI. pp. 367–374 (2012)
9. Leite, I., Castellano, G., Pereira, A., Martinho, C., Paiva, A.: Empathic robots for long-term interaction. International Journal of Social Robotics (2014)
10. Pantofaru, C., Takayama, L.: Need finding: A tool for directing robotics research and development. In: Persp. and cont. to rob. from the human sciences (2011)
11. Sirkin, D., Ju, W.: Using embodied design improvisation as a design research tool. In: Proc. Human Behavior in Design (2014)