Co-designing with children: An approach to social robot design

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Abstract—**In this paper, we explore the use of Cooperative Inquiry and intergenerational co-design groups to design social robots. We include best practices for facilitating a session and findings from a session on friend robots.**

Keywords—Cooperative Inquiry; robot design; children

I. INTRODUCTION

KidsTeam UW (University of Washington) is an intergenerational co-design group of children and adults developing new children's technologies WITH children, FOR children. It involves a co-design team composed of children and adults working together to explore new technologies and gather requirements from children. We utilized Cooperative Inquiry, a participatory design method created by Allison Druin, focusing on design partnerships with children [1, 2]. Cooperative Inquiry with an ongoing team of children and adults allows us to build trust to hear children's stories and to gain deep knowledge of children's relationships and social bonds to one another, adults, and technology [3]. We conducted a KidsTeam UW session focused on designing friend robots for children. This session revealed themes in children's preferences of social robot features. In this paper we will cover those themes as well as methodology for running a KidsTeam session and our contributions to this workshop.

II. BACKGROUND

Historically social robots have been designed using a variety of methods. One method is using best practices and expertise as in the case of Kismet [4]. This allows researchers to study people's reactions to the robot that they have designed. Another method is to survey children, asking them about what they know about robots and to draw a robot [5]. This method shows us what children think of as a robot and how they are influenced by media references and stereotypes, as children exposed to robotics tended to design mechanical anthropomorphic systems. Although these methods help us to explore attitudes towards and perceptions of robots, they miss the opportunity to tap into children's imaginations to have them explore what a social robot should be, both in form and function, from their point of view.

There has been previous research in creating robots for children using Cooperative Inquiry as the design methodology. One of the outcomes was PETS: a Personal Electronic Teller of Stories at the University of Maryland [6]. The robot created,

Fig. 1. Introducing children to "friend robots"

PETS, has a focus on the specific functionality of storytelling, whereas the social robots created in our study focused on the features and specific needs and wants of the children in a social or friend robot. As a result we saw that the children created social robots that could display a variety of functionality to meet their individual needs. The Cooperative Inquiry approach provides a unique opportunity to explore social robotics and child-robot interaction within a social environment of an intergenerational design team.

III. METHODS

KidsTeam UW is a design team composed of 8-10 typically developing children ages 6 through 11. Ninety-minute (90) sessions occur twice weekly throughout the school year. Each session has a director and approximately six university researchers present. The ongoing nature of the team and projects allow children to get to know one another and researchers and over time, to work more collaboratively. Researchers are able to understand group dynamics in the team and also track design themes across multiple sessions.

The session on social robots took place during the 15th session of the school year and consisted of the following sections:

A. Coming together

At the beginning of each session, children play games and have a snack while waiting for the other children to arrive. We provide a comfortable environment by opening space for

Fig. 2. Children's friend robot designs

interactions with adults to create a feeling that all children and adults are equal in the design process.

B. Circle time

After the informal gather, we come together in circle time. Children and researchers sit on the floor in a circle. The director leads by asking a "Question of the Day" to get members thinking about the design problem. In general, the Question of the Day should be related to the day's design activity. During the friend robot session, the question was, "What is something that you like about your friends?"

After the Question of the Day, the day's design activity is presented to the children. On this day, children were shown examples of friend robots (Fig. 1.). We used the term "friend robots" rather than social robots or companion robots to be more understandable for the children. The children crowded around the researcher, grabbing at the robots, shrieking, and talking excitedly.

C. Design activity

Once the design problem is established, the director breaks up larger group into smaller groups consisting of 2-3 children and 1-2 researchers. In this session, we used a design technique called Bags of Stuff [7]. Small groups are each given a bag of art supplies for low-tech prototyping (i.e., felt, glue, feathers, and Styrofoam). Children then use the materials to construct their friend robots. During this time, researchers assist the children and ask questions about their design decisions, and make suggestions, while at the same time making their own friend robot prototypes. The researchers also take notes in small notebooks that include notes on group dynamics, individual children's mood and themes, and ways that children are co-designing.

D. Presenting and wrapping up

After the design session, children and researchers come back together in a circle as a larger group. Children stand up and present their friend robot designs. During the presentations, the director stands at the whiteboard and writes down the children's features, ideas, likes, dislikes, etc. After all of the children have presented, themes are discussed as a group as the director marks similarities across the different designs on the whiteboard.

IV. Robot design themes *(Fig. 2.)*

A. Individualism

In our design session, every child presented an individual robot. Many of the robots reflected the child's individual personality and needs. For example, robots' functionality included ability to play, store important items in pockets, and express complex emotions. One child said that everyone should work independently but that all of their robots would be part of the same line, like a company.

B. Emotional expression

The children designed robots with complex displays of emotions, both positive and negative. They wanted robots with different interactions and ways to show emotion. One child designed an origami ball that would inflate and deflate based on its feeling. Another child's robot would get hot and cold, depending on its emotion. Children said that the robot would mirror their emotions, cheer them up when they are sad, and also express when it was lonely.

C. Small size

All of the children stated that they wanted smaller, not larger robots. One child stated that this was because she would want the robot to be small enough to carry in her backpack to school.

D. Social interaction

Some surprising behaviors that the children mentioned was that the robots would play pranks, lie, or tease them. Other robot behaviors that the children talked about included academic coaching, playing catch with a ball, and encouraging caretaking on the part of the child. One child said that the robot could play a role in relieving tension in the family, playing with him when siblings would not and being a punching bag when he is angry.

V. Challenges and Solutions

In Cooperative Inquiry we are not working with a child but with a group of children in ages six to eleven. They differ in knowledge and have different styles of exploring materials for ideas. It takes time in understanding how to work best as a team by not excluding any ideas. Adults need to be patient as the team learns to collaborate, share ideas with one another, and work as a design team. Challenges using this method when designing social robots were as follows:

A. Lack of consensus

During Bags of Stuff, the children rarely worked together on this activity, preferring to each work on individual designs. Although we were able to see what each child would want in a friend robot, we did not explore if one robot could meet all of the children's needs. In a future session, asking the children to take their individual robots and combine them into one robot could provide insights into must-have versus nice-to-have features. Interestingly, during this session, several of the adult researchers also created and presented their own social robot prototypes. It may provide insightful to compare similarities and differences between the children- and adult-created robot prototypes.

B. Impressionable

It is possible that the children were influenced in their designs by the social robots presented at the beginning of the activity as well as robots that they are familiar with from movies, for example. Robot is quite a loaded word that can have different meanings to people from different cultural backgrounds [8]. Perhaps by having the children design a friend object or being rather than a robot would tell us about what features we could include in a social robot.

C. Contextual

At KidsTeam, children were designing robot prototypes in a supportive, exploratory environment that is separate from their everyday lives. It would be interesting to see what type of robots the children would design at home or at school and if the functionality would change due to a change in the environment and surrounding individuals. There is also an opportunity to explore the relationships among the child-robot-parent and child-robot-friend/sibling in future studies.

VI. CONTRIBUTIONS TO HRI RESEARCH

When designing products for children, including them in the design process is a way to gain unique insights. KidsTeam has created a comfortable and collaborative environment where the adults are able to listen to the children's stories behind their creations of a friend robot. During the session one child mentioned that she wanted a friend robot whenever her sister was not playing with her and she felt lonely.

This session also revealed that adults tend to overestimate their ability to understand children's wants and needs based on past experiences. For example, one researcher thought that children would want a large-sized huggable robot. Instead several of the children said that they would want their friend robot to be small and portable.

Cooperative Inquiry with an ongoing team of children and adults allows us to build trust to hear children's stories and to gain deep knowledge of children's relationships and social bonds to one another, adults, and technology [8]. In this method, children are no longer passive responders to robot designs but rather active designers in the process. The group nature of this intervention provides an opportunity to see differences and common themes among the children's design requirements. Lastly, the ongoing nature of the group allows us to test hypotheses, get feedback on designs, and iterate prototypes as we gain knowledge of what features the children desire and require in a robot friend.

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