Trust “in the field": Reflections on a Real-World Lab Deploying Social Robots in Childcare Settings - Abstract

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Abstract

Trust is highly relevant in human-robot interaction, particularly when it takes place in complex and dynamic social environments. Here, we give an overview of our research within the *Real-World Lab Robotics-AI*, an inter- and transdisciplinary research effort in which robots are embedded in society in long-term field research. We focus on two particularly challenging research sites, a kindergarten and an inclusive daycare, and reflect upon implications for researching and designing for trust in robots in this context.

Keywords

Child-Robot Interaction, Field Research, Trust

1. Introduction

Trust in robots is a concept as fundamental as it is elusive for Human-Robot Interaction (HRI) research [1, 2]. A person’s trust in an AI-enabled technology, as most robots are, affects their intention to engage with the technology [3] and thus ultimately determines whether the potential benefits associated with the new technology will translate into real gains. Research on trust in HRI, following the same path as robotics itself, initially focused on industrial automation contexts and adults directly interacting with the robot [1] and only recently opened to socially assistive robots and their unique challenges [4].

The potential benefits of integrating socially assistive robots into kindergartens are well documented in the literature: social robots can deliver personalised and interactive learning experiences [5], thereby improving engagement and comprehension among young children [6], and they can act and be perceived as non-judgemental companions, aiding in the development of critical social skills and emotional regulation [7]. However, as expected, the effectiveness of social robots in these roles is heavily dependent on the level of trust that children, educators, managers and parents place in them [8, 9]. The variety of stakeholders is only one of the challenges facing the analysis of trust in social robots in childcare settings, alongside the dynamic and unstructured nature of the environment in which the human-robot interactions occur, the necessarily long-term nature of the interventions and the need to properly account for the capabilities of the stakeholders (e.g., including 3-5 year old children) when developing measurement tools [2, 4].

The possibility of conducting long-term research on socially assistive robotics in childcare settings offered by the Real-World Lab Robotics-AI project provides us with a unique opportunity to contribute to the understanding of trust (and its evolution) on socially assistive robots “in the field”. In this position

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Figure 1: Left: the partner kindergarten. Right: the robots.

paper, we outline the specific objectives we aim for and the methodology we intend to pursue to achieve them.

2. The Real-World Lab "Robotics-AI"

The Real-World Lab Robotics-AI project involves multiple research sites, including a kindergarten and a daycare, and follows the “Real-World Lab” paradigm [10] which seeks to bring research outside of its usual controlled settings to enable involving society in research and mutual learning.

2.1. Research Site 1: Robot-Mediated learning activities for a Kindergarten Setting

One of the project partners is a kindergarten operated by a state-recognised provider of youth welfare services, which offers 50 spots for children aged 3 years up to school entry (see Figure 1-left). The pedagogical focus of the kindergarten is on science and technology, as well as movement and sports. Additionally, the kindergarten provides a cross-group bilingual program through native English-speaking teachers. Through a years-long collaboration with KIT, the kindergarten regularly incorporates socially assistive robots (NAO and Pepper, shown in Figure 1-right) into their activities with children. Under teacher guidance, these robots engage children through playful activities, such as guiding them through language learning games and physical exercises.

2.2. Research Site 2: Supporting Children in an Inclusive Daycare Setting

Within the project we also cooperate with an inclusive daycare centre that cares for approximately 75 children. As an inclusive institution, the daycare is looking after both disabled and non-disabled children who spend their daily lives together. While this inclusive approach can lead to different development stages between children of similar ages, a wide age range - of one to six years - further introduces a plethora of different needs and desires managed by the caregivers. Caregivers put great effort toward the inclusion of all by e.g. including lessons in sign language in their interactions with the children equipping both non-verbal and verbal children alike with tools to communicate with them and amongst each other. The daycare also routinely incorporates a NAO robot to engage the children in physical activities or storytelling sessions.

3. Research Objectives

Since trust (by all involved stakeholders) is a pre-requisite for a successful robot integration in any educational context and since the “Real-World Lab Robotics-AI" project ultimately aims at developing and deploying social robots that can support the activities and objectives of the partner research sites, a key objective of the project is to understand how trust in robots evolves in the two complex social environments. Referring to established findings and naming conventions on trust in HRI settings [1], we specifically aim to consider:

- *environmental factors*, namely the impact of the deployment context, including its social setting and dynamics;
- *human-related factors*, including ability-based factors such as prior experience with robots and technical competence and personal characteristics such as demographics, attitude towards robots and, specifically, disabilities;
- *robot-related factors*, including the robot’s behaviour and role in the interactive activity, as well as the perceived individual and/or community benefit.

To address these research objectives, we have formulated the following key questions that guide our investigation:

1. To what extent does the social environment within a kindergarten, including peer and teacher interactions, affect children’s trust in social robots?
2. How do disabled children engage in interaction with social robots, and are there specific adaptations that can enhance trust?
3. How do perceived educational and developmental benefits influence children’s, educators’ and parents’ trust in social robots in early childhood education?
4. How does the nature and quality of interaction experiences between children and social robots influence the development of trust over time?

4. Research Methodology

The striking diversity among our stakeholders suggests that a portfolio of research methods should be favoured over a "one-fits-all" solution, to take into account and adjust to different abilities, roles and requirements [2, 4]. The use of different instruments and methods, while promoting the validity of the results, brings up the challenge of ensuring their comparability.

Alongside the problem of *how* to measure trust, stands the challenge of identifying *what else* we need to measure, since the real-world, peculiar and dynamic conditions of our research sites make it non-trivial to identify the environmental and social factors that need to be modelled to obtain an accurate picture of user trust.

To address our research questions and overcome the afore-identified challenges, our project will undertake an exploration of trust at the two research sites, examining each context both separately and comparatively. We envision to leverage the multidisciplinary expertise within the project consortium (including our practice partners) to utilise a mixed-methods approach attuned to each of the sites and capture the multifaceted nature of trust by combining *day-to-day observations and robot logs* with *questionnaires* and *semi-structured interviews*.

Given the embedded nature of our research approach, day-to-day observations of participant interactions with robots in combination with robot activity logs and metrics of use will lay the foundation for work; such real-time behavioural observations (conducted and analysed by qualified experts) will offer insight into non-verbal indicators of trust, e.g., body language, and allow for identifying potential correlations with contextual, social and/or robot-related events.

These data will be supplemented by questionnaires and semi-structured interviews, regularly exploring user trust levels. This will provide additional insight into subjective experiences and the underlying reasons for user trust or distrust in the robots. Since valid and reliable questionnaire only exist for

adults directly interacting with robots [11], semi-structured interviews will be particularly useful with all the adults indirectly involved in the human-robot interaction. To overcome the lack of validated questionnaires for children [2], while looking forward to advancements from the community, we will explore research approaches that are accessible to verbal and non-verbal children alike, facilitating modes of participation that align with individual children's preferences (e.g., drawing upon augmentative and alternative communication, employing visual methods [12], and working closely with carers and parents/guardians), and generally building on previous work on inclusive participation in our research community [13].

5. Conclusions

Measuring trust in socially assistive robots is an open challenge due to the varying perspectives and expectations among different stakeholders, the long interaction required for the robot to reveal its benefits and the dynamic and unstructured environment in which the human-robot interaction occurs.

The Real-World Lab approach pursued in the "Real-World Lab Robotics-AI" project allows us to study the full complexity of human-robot trust beyond the dyadic relationship between humans and robots, particularly in the dynamically changing environments of the two different childcare settings.

Through the project we aim to develop accessible methods to explore what *trust in socially assistive robots* means to our different stakeholders groups, with a special emphasis on the needs of the children. We hope that by identifying and contextualising factors of relevance, real-world labs can provide deeper insights into the dynamics of trust in human-robot interactions in realistic social and assistive settings.

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