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# Learning From Unstructured Child-Robot Interactions

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***Abstract*—This reflective piece highlights some unexpected outcomes observed during selected Child-Robot Interaction (CRI) studies. As these were peripheral to the investigations underway, they were not included in related publications, yet they have been instrumental in directing subsequent research. We advise new researchers of the value of an open interactive environment in CRI studies, and careful observation of interactions, even when adjacent to the research question.**

***Index Terms*—child-robot interaction, social robotics, qualitative robotics**

## I. Introduction

Here we present a collection of anecdotes from various Child-Robot Interaction (CRI) studies, representing moments which enlightened us to insights from outside the remit of the planned research, whilst helping provide directions for subsequent research and study design.

## II. Is he a robot?

The EASEL project was an international collaboration to explore the potential impact and relevance for social robotics in educational settings. A key branch of the EASEL project included user testing with various versions of the Synthetic Tutoring Assistant, primarily deployed through the Robokind [4] Zeno R50 and R25 platforms. EASEL research included examinations of the impacts of different synthetic personalities and tutoring approaches to both architecture build and robot deployment [2], and measurements of children's perceptions of robots' social competences [3], to name just two.

One of the earlier findings from the project indicated there were differences between girls' and boys' responses towards the Zeno robot with regards to its life-like facial expressions [12]. While not formally tested in the study, children's spontaneous descriptions of the robot and their vocalisations towards it indicated some value in considering the robot's apparent gender and its animacy as mediating factors. Children would at times describe the robot as *a boy* or *a robot* and sometimes interchangeably use these or similar terms with researchers. This flexibility in their descriptions of the robot did raise a pertinent question of children's views towards the appearance of the robot, given the manufacturer's use of male personal pronouns to promote it.

Given this, we redirected a follow-up study to focus on the children's descriptions of the robot as being *like a boy* or not, both in terms of apparent animacy (as opposed to being *like a machine*) and apparent gender [7]. This work continued the quantitative approaches used in the previous study and, while it successfully indicated children had varied views of the robot, in a third (now qualitative) study in this series we found further nuance and sophistication in evaluations from children [8]. Refining the work to make use of a qualitative approach meant children had far fewer constraints on how they expressed their views of the robot, effectively recreating the original environment that prompted spontaneous discussions of gender and animacy during [12].

## III. Seals eat Fish; Robot Seals eat Robot Fish.

Our second example of adaptations of study direction given what was learned from observed, unstructured CRI, comes from a public event in which children were invited to participate in a healthy-living scenario with a Zeno 'tutor' [5]. The study was complex, as such an alternative 'interaction opportunity', with a Nao robot and PARO robot, was set-up for waiting child-participants. Again, while peripheral to the study, unstructured observations illuminated upon children's understanding of robots outside the quantitative research underway. For example, a frequent question topic children would ask on seeing the Paro robot was *Is it real?*.

While this may seem an unusual question to ask of an object they could physically interact with, it would invariably transpire that children were inquiring as to its animacy. Of particular note were the variations in discussions on animacy with regards to describing both what a robot needs, and can do, and that these things had some internal logic to them (even if not factually correct). The most striking example included a careful and detailed discussion determining if *real* seals eat real fish, *robot* seals must eat robot fish.

Thus, despite not gathering data on the goal topic of perceived apparent gender or animacy in these studies, the information learned from seeing children of varying ages (6-10) interactions with the robot, helped us to reconsider the

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impacts of a broader set of psychological theories for our future HRI work. For example, in considering how CRI can be used to explore Carey's developmental theory of biological understanding, and the ages at which children move from a superficial view of the world, to a scientific one [6]. Specifically, the transitions in understanding and expressing of this, were identifiable in subsequent quantitative [13] and qualitative [14] work. Again, as was learned during EASEL, the loosely structured environment for expressing views in a qualitative manner afforded children the means to articulate their complex, charming, and sometimes contradictory understandings of robotic animacy.

## IV. Miro: Not all development is done in the lab

Miro is a companion robot designed to engage users in both an educational and entertaining manner [9]. It is built around a differential drive base and a three-DOF neck, and designed to evoke a "cute" mammalian identity. Miro's control system is modelled on a layered architectural understanding of the brain. Here, different loop-layers are used to implement reflex-like behaviours, or cognitive competences, and make use of short-term memory. Miro represents affective state using the circumplex model [10]. Sound, movement, and colour (via six internal RGB LEDs under its shell) combine to communicate meaningful patterns in various rates [11].

In 2017, Sheffield University members of the Miro development team were invited to demonstrate their platform at the London Science Museum *Robots* exhibition. During several days, over a warm school holiday period, the team were set up on a balcony overlooking the museum's main entrance. Nearly a thousand visitors engaged with the demonstration during that time. Here, our robots were not active in a stimulus-free, clean laboratory. They were challenged by noise, echos, shadows, high ceilings, and vibrations from the footfalls of excited children running towards them. At first an outreach event can feel like a drain on the precious resource of time. This event was not designed to gather publishable data. However, the experience, and subsequent anecdotes, informed much of our future work. Knowing how the robots finely tuned affective states responded when overwhelmed by stimulus was vital to the non-lab space marketability of future iterations of the platform. While engaging such a large number of people allowed us to observe the more nuanced effects the robot had on a huge range of individuals. The 'challenge' of getting our over-stimulated robots to switch from displaying aroused, exploratory behaviours, to calm, 'sleeping' states, left even the most over exuberant children quickly quiet and still (resulting in much gratitude from fatigued adults). The over-stimulated Miro's would trundle towards changes in light, and quickly retreat from noise and vibration. But, sitting with a unit, and gently stroking its touch sensors, render Miro's still, slows their pulsating and now mutely coloured lights, and puts them to 'sleep': lowering their necks and resting their heads on the leg of an equally still child beneath it.

## V. Reflections

Across several studies during the course of the EASEL project, we saw many valuable and informative instances of CRI that could not be captured by the investigations in the moment. The questions children asked, their spontaneous declarations, or their surprising turns of phrase have been instrumental in guiding our research efforts as they appear to reach to a crucial question: *What is it really like to meet a robot?*. We see this as being indicative of the value of the more qualitative approaches to robotics, which are currently under applied [15], and as a path for children to meaningfully contribute to research directions on issues perhaps more representative of a future in which daily CRI is more commonplace.

## References


[1] D., Reidsma, V., Charisi, D., Davison, F., Wijnen, J., van der Meij, V., Evers, ... P. Verschure. The EASEL project: Towards educational human-robot symbiotic interaction. In Conference on Biomimetic and Biohybrid Systems 2016 pp. 297–306

[2] V. Vouloutsi, M. Blancas, R. Zucca, P. Omedas, D. Reidsma, D. Davison, ... P. Verschure. Towards a synthetic tutor assistant: the easel project and its architecture. In Conference on Biomimetic and Biohybrid Systems 2016 pp. 353–364

[3] V. Charisi, D. Davison, F. Wijnen, D. Reidsma, V. Evers, Measuring children's perceptions of robots' social competence: design and validation. In International Conference on Social Robotics 2017 pp. 676–686

[4] D. Hanson, S. Baurmann, T. Riccio, R. Margolin, T. Dockins, M. Tavares, K. Carpenter. Zeno: A cognitive character. In Ai magazine, and special proc. of aaai national conference. 2007

[5] D. Cameron, S. Fernando, A. Millings, M. Szollosy, E. Collins, R. Moore, ... T. Prescott. Designing robot personalities for human-robot symbiotic interaction in an educational context. In Conference on Biomimetic and Biohybrid Systems 2016 pp. 413–417

[6] S. Carey. Conceptual change in childhood. 1985. MIT press.

[7] D. Cameron, S. Fernando, A. Millings, M. Szollosy, E. Collins, R. Moore, A. Sharkey, T. Prescott. Congratulations, it's a boy! Benchmarking children's perceptions of the Robokind Zeno-R25. In Annual Conference Towards Autonomous Robotic Systems 2016 pp. 33–39

[8] D. Cameron, E.C. Collins. Children's reasoning on robots and gender. In Child-Robot Interaction: Present and Future Relationships workshop at the 12th International Conference on Social Robotics. 2020

[9] E.C. Collins, T. Prescott, B. Mitchinson, S. Conran. MIRO: a versatile biomimetic edutainment robot. In Proceedings of the 12th International Conference on Advances in Computer Entertainment Technology 2015 pp. 1–4

[10] J. Posner, J. Russell, and B. Peterson, The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathologyy. Development and psychopathology, 2005 17(3), pp. 715–734.

[11] E.C. Collins, T. Prescott, B. Mitchinson Saying it with light: A pilot study of affective communication using the MIRO robot. In Conference on Biomimetic and Biohybrid Systems. 2015 pp. 243–255.

[12] D. Cameron, A. Millings, S. Fernando, E.C. Collins, R. Moore, A. Sharkey, ... T. Prescott. The effects of robot facial emotional expressions and gender on child–robot interaction in a field study. Connection science, 30(4) 2018 pp.343–361.

[13] D. Cameron, S. Fernando, E.C. Collins, A. Millings, M. Szollosy, R. Moore, ... T. Prescott. You made him be alive: Children's perceptions of animacy in a humanoid robot. In Conference on Biomimetic and Biohybrid Systems 2017 pp. 73–85

[14] D. Cameron, S. Fernando, E. Cowles-Naja, A. Perkins, A., E.C. Collins, A. Millings, T. Prescott. Children's age influences their use of biological and mechanical questions towards a humanoid. In Annual Conference Towards Autonomous Robotic Systems 2017 pp. 290–299.

[15] K.A. Riddoch, E. Cross. Hit the robot on the head with this mallet"–making a case for including more open questions in HRI research. Frontiers in Robotics and AI, 2021. 8, p.17.