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Congratulations, it's a boy! Bench-marking children's perceptions of the Robokind Zeno-R25

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Abstract. This paper explores three fundamental attributes of the Robokind Zeno-R25 (its status as person or machine, its 'gender', and intensity of its simulated facial expressions) and their impact on children's perceptions of the robot, using a one-sample study design. Results from a sample of 37 children indicate that the robot is perceived as being a mix of person and machine, but also strongly as a male figure. Children could label emotions of the robot's simulated facial-expressions but perceived intensities of these expressions varied. The findings demonstrate the importance of establishing fundamentals in user views towards social robots in supporting advanced arguments of social human-robot interaction.

Keywords: human-robot interaction, humanoid, psychology

1 Introduction

The field of human-robot interaction (HRI) is rapidly developing [19]; while this is extremely promising in addressing ground-breaking questions, it can mean that fundamental assumptions are not critically assessed. In many cases, fundamental assumptions based solely on good common-sense could lead to fruitful results, but this comes at a risk of relying on the 'valuable but inherently dangerous resource available' [8] of common-sense. Developing a solid empirical foundation on which to support boundary-pushing research, serves to strengthen established findings and generate new paths to explore.

This paper uses the Robokind, Zeno humanoid robot [9], Figure 1, as a case-study for exploration of three fundamentals in user perceptions of a robot [1]. The Zeno series of robots are capable of generating life-like simulated facial expressions [9], developed with the aim of commercial release as interactive, educational and play partners for children (as is the now retired-from-production Alice model counterpart). The current production model of Zeno (Zeno-R25) is described as a humanoid boy robot in Robokind's promotional literature [15]. Further to this, various Zeno models are referred to as humanoid-boys, or variations thereof, across multiple papers [4, 5, 10, 14, 17, 18].

[1] These assumptions could apply beyond the Zeno R-25 case-study to other humanoids or even non-humanoid social-robots

Fig. 1. The Robokind Zeno R25 platform (humanoid figure approximately 60cm tall)

To date, it seems there is no bench-marking of Zeno's 'gender' in the research literature. Appropriate confirmation of this common-sense assumption about a fundamental perception: Zeno's 'gender' is important. Recent literature suggests differences in boys' and girls' interactions with, and responses towards, Zeno could be due to their perceptions of the robot as being a boy (who just happens to be mechanical) [5].

A further fundamental assumption made across the literature is the life-like or human-like appearance and nature of the robot [1, 2, 5, 14]. At present, one study indicates that while children perceive Zeno to be marginally more like a person than a machine; however, this is influenced by child's age [6]. Again, fundamental assumptions made about the nature of the robot could impact findings upstream; the expectancies children have for Zeno's social behaviour could be impacted by their particular beliefs surrounding its life-like (or otherwise) appearance.

One fundamental that the literature *does* address is the validity of the robot's simulated facial expressions, particularly people's accuracy in decoding these. Zeno's simulated facial expressions have been accurately decoded by adults [18] and children [7, 16]. While research explores people's decoding of different expressive states, it currently does not yet consider children's interpretations of the *intensity* of emotion communicated by the facial expressions.

2 Method

2.1 Design

The bench-marking study primarily used a one-sample design, participant responses were compared against predefined means; predefined means for this study comprised of the midpoints of each scale (for scale midpoints, see section 2.3). Significant differences between participants' scores and the predefined means indicate that participants had, on average, made a choice tending towards the scales' endpoints.

2.2 Participants

The study took place as part of a single-day exhibit at a museum in the UK. Children visiting the exhibit were invited to participant in the study by playing a game with Zeno titled ‘Guess the robot’s expressions’. Forty-Three children took part in the study in total, although six children (each aged three or below) did not complete all measures and are not included in analysis. Of the remaining participants, 15 were female and 22 were male (M age = 6.73, SD = 2.16).

2.3 Measures

Our first measure was children’s perceptions of Zeno as being more like a person or machine. To assess this, children completed the statement ’I think Zeno is’ with one of the following five responses on a Likert scale: ‘Lots more like a machine’, ‘A bit more like a machine’, ‘An even mix of machine and person’, ‘A bit more like a person’, ‘Lots more like a person’ (scale endpoints of -2: ‘a lot like a machine’ and 2: ‘a lot like a person’).

Children were given a follow-up question (regardless of their first response) concerning their perceptions of the robot’s gender. This followed same format as the prior question with the terms ‘machine’ and ‘person’ replaced with ‘boy’ and ‘girl’, respectively. Children were also given the option for ‘not either’.

Two additional measures were taken to assess children’s perceptions of the robot’s ‘Happy’ and ‘Sad’ facial expressions. Children pointed to one of the five pictures on the Self-Assessment Manikin for valence that they thought best matched the robot’s expression for each (SAM; endpoints: -2 (lowest valence) to 2 (highest valence) [3]).

2.4 Procedure

The experiment took place in a publicly accessible lab. Interactions lasted approximately five minutes. Brief information about the experiment was provided to parents/carers and informed consent for participation was obtained prior to participation. If children were hesitant in the study, parents were available to offer reassurance or help clarify questions asked all parents were made aware of the children’s right to withdraw at any point in the study. Ethical approval for this study was obtained prior to any data collection.

The children were told that they were going to play a quick game of guessing the expression made by Zeno. The experimenter pressed one of two buttons on the front of the Zeno-R25 to generate the Happiness and Sadness simulated facial expressions (children were given no indication as to which expression the button corresponded to). Children responded by pointing to their chosen answers on the SAM on a sheet of paper.

The children then answered the two questions about the robot’s status (person/machine, boy/girl, see section 2.3), by pointing to the answers that best matched their opinion. The order of questions presented was alternated (i.e.

questions of the robot's status, before or after expressions) to counterbalance any effect the expressions may have.

After all interactions, children and their parents were given opportunity to ask questions and interact with the robot. At the close of the interaction, the experimenter pressed the button for Zeno to wave goodbye.

3 Results

3.1 Robot Animacy

A one-sample T-test indicated that children's classification of the robot as machine or person was not significantly different from reporting the robot as being an even mix of machine and person, t(36) = 1.34 p = .19 (M = -.30 SD = 1.35). Responses were distributed across all five points on the scale (see figure) , with a plurality of responses (27.03%) of 'an even mix of machine and person'.

3.2 Robot Gender

A one-sample T-test indicated that children's classification of the robot's gender were significantly different from reporting the robot as being an even mix of boy and girl, t(36) = 18.12 $p < .01$ (M = -1.64, SD = .54). The majority of responses (66.67%) given were for Zeno being 'a lot like a boy', 30.56% of responses for 'a bit like a boy' and only one response (2.78%) for 'an even mix of boy and girl'.

There was no difference in children's ratings based on their own gender ($F(1,32) = .65$, $p = .43$) nor their age (Median split of groups aged six-and-under or over-six; $F(1,32) = .92$, $p = .34$). Across all groups, children consistently report the Zeno robot as being more like a boy. Only one child (age 12) responded that robots are neither boys nor girls.

3.3 Robot Expressions

Children accurately classified the simulated expressions presented by the robot. For simulated happiness expression (M = 1.32, SD = .71), a one-sample T-test indicated that children's responses were significantly different from reporting the robot as having a neutral expression t(36) = 11.36, p < .01. For simulated sadness expression (M = -1.14, SD = .79), a one-sample T-test indicated that children's responses were significantly different from reporting the robot as having a neutral expression t(36) = -8.77, p < .01. Results for participant ratings are presented in Figure 2.

4 Discussion

Our findings indicate that assumptions made in the research literature about the Zeno R-25 have good grounding. Children view the robot as male, albeit a mix of person and machine. This outcome supports existing research [6] and suggests

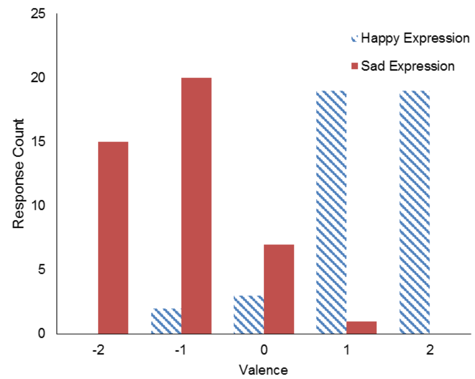

Fig. 2. Frequency count of participant ratings for the robot's 'Happy' and 'Sad' expressions

that exploring which factors children use to identify a humanoid-robot's status as person or machine could benefit future robot and research designs.

Children perceiving the robot as male has implications for studies concerning social HRI (e.g., [5]) because children typically show gender differences in their preference of, and behaviour towards, play-partners [13]. In particular, younger children may view humanoid robots as persons to play with rather than objects to interact with[6]. Seemingly arbitrary design choices may discourage individuals, in this case girls, from interaction with humanoid robots and the learning opportunities this may afford.

Children successfully identify simulated facial expressions on the Zeno-R25 but vary in their interpretation of the affect intensity. Further work could establish if this recognition is a cognitive process (e.g., primary channel processing [11]) or if this is supported by processes such as mimicry and emotion contagion [12]. Establishing the mechanisms that children use to determine the robot's expressed state could further improve robot and HRI-scenario development.

These findings indicate the importance of critically assessing fundamental assumptions that can be made in HRI. Addressing these are steps towards a robust, empirically-based taxonomy of robots to support boundary-pushing HRI research, strengthen established findings, and generate new paths to explore.

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