Reconfiguring HRI by Putting Interaction back into Human-Robot Interaction Research: The Case of Anthropomorphism

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***Abstract*—In this paper, I suggest that HRI research has hitherto focused too little on what is actually happening between humans and robots in interaction, how people make sense of robots, and what processes are at work in human-robot interactions. I illustrate what current methodological approaches are missing out on based on the example of the study of anthropomorphism, one of the core features of human-robot interactions.**

Keywords—Human-Robot Interaction; Anthropomorphism; Methodology; Interaction Dynamics; Interpersonal Differences; Sense Making

I. Introduction

While HRI research has yielded an enormous amount of interesting findings over the past two decades, the focus has rarely been on the interaction between robots and people itself. Most importantly, we know very much about the effects of certain aspects of robot appearance and behavior. The way we study these effects is by having people interact with a robot that exhibits a certain appearance or behavior in one condition but not in another (cf., for instance, Hoffman & Zhao 2020 for an elaboration of this approach to HRI research). The difference in participants' behaviors or post-experimental ratings of the robot is taken as evidence for an effect of the specific design feature or behavior of the robot in which the experimental conditions differed. While this procedure yields important information to further our understanding of the effects of specific robot behaviors and provides useful robot design recommendations, it does not allow us to develop an understanding of what happens in the interactions themselves. For instance, in a recent study of ours (Langedijk et al. under revision), we had people interact with a robot that either said: "it is important to drink enough water during the day. Most participants drink half a liter after this game" (people condition) or: "it is important to drink enough water during the day. Most female/male participants drink half a liter after this game" depending on participants' gender (gender condition), or none of these (baseline condition). In addition to measuring how much water people drank after the experiment, we also administered the Robot Social Attribution Scale (RoSAS, Carpinella et al. 2019) after the session and found significant differences between the conditions; Figure 1 shows people's rating on the Discomfort Scale in the three different conditions. The results show significant differences between the conditions, but what does an average rating of 1.41 for aggression actually mean? What experience is it that people refer to when they rate aggression with a 2 on a 5-point Likert scale? In fact, we have no idea. Given the methodology applied, there is no way we can know what actually happens between individuals and robots over the course of an interaction.

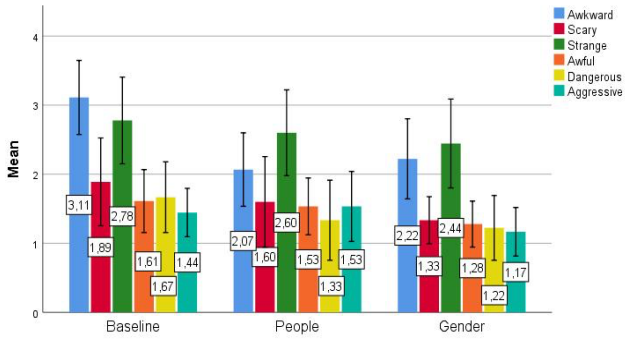

Figure 1: Discomfort scale ratings in the persuasion experiment across the three conditions

In the next section, I Illustrate our lack of understanding of interpersonal differences, individual sense making processes, and the processes and mechanisms that underly human-robot interaction using the example of anthropomorphism, a central feature of human-robot interactions without which social robots would not even exist.

II. Case Study: Anthropomorphism in Interaction

Much is known about anthropomorphism; specifically, it has been shown ubiquitously that people tend to anthropomorphize robots (e.g. Reeves & Hancock 2020; Zlotowski et al. 2018). Furthermore, we know much about the circumstances under which this happens, and the strongest factor seems to be anthropomorphic design features of the robot (e.g. Powers & Kiesler 2006) or anthropomorphic behaviors (e.g. Fraune et al. 2020). We also know that certain dispositions of the human interactants, such as loneliness, may lead to higher degrees of anthropomorphism (e.g. Epley 2018). There is in fact evidence for considerable interpersonal variation concerning the extent to which people treat robots as social actors (e.g. Lee et al. 2010; Fischer 2011; Chang & Sabanovic 2015), most of which has however not been accounted for, and in Fischer (2021), I show that people may

also vary in how much they anthropomorphize a robot over the course of an interaction.

In the following, I illustrate how micro-analyses of what is happening over the course of an interaction in the wild indicate how people make sense of the human-robot interaction situation, how they differ in their sense-making and involvement, and that labeling an anthropomorphic action anthropomorphism falls short of accounting for the differences between interactions between humans and between humans and robots. That is, I argue that to understand how robots do become social actors, we have to focus on what is happening in the interactions themselves.

A. Data

The data for this case study were elicited in the lobby of a concert hall while people were gathering to be let in for an event. In total, about 200 interactions between the robot and one to five participants were recorded (about three on average).

The robot, a large service robot developed in the Smooth project to fulfil several different functions in an elderly care facility (Juel et al. 2020), including several transport tasks, drove around and offered water to people. Since the robot was developed for transport, it carried a tray with a set of glasses of water on its back. Even though the robot was equipped with autonomous navigation and interaction capabilities (Krüger et al. 2021), for security reasons, it was teleoperated by two wizards, one of whom was responsible for its movements whereas the other chose the robot's verbal utterances from a set of predefined and presynthesized utterances. In order to address overhearer effects, each dialog act (i.e. greeting, offer, encouraging utterance (water-related joke, persuasive utterance, toast) and farewell) was instantiated by several utterances, from which the wizard could choose freely. Otherwise, the order of utterances and the utterances themselves were scripted.

While people were gathering, the robot was driving around, offering them water by driving up to them and addressing them directly (cf. Palinko et al. 2020). The two wizards were hidden on a balcony above the lobby, and there is no evidence that anyone has detected them there over the course of the four-day deployment of the robot. Video is recorded by means of the camera mounted on the robot's head. Figure 2 illustrates the scenario.

Figure 2: The Smooth robot serves water to people gathering for an event at the concert hall

B. Example Analysis

In the following example, the robot is driving towards a group of three people, of whom one (the woman) interacts with the robot, whereas the two men do not. The images stem from the video footage from the camera mounted on the robot.

Video stills (Interaction #135)

Three people observing the robot while it drives towards them. They glance at each other to determine how the robot is to be interacted with. The woman repositions herself.

R: "Hi there!"

R: "I wonder if you would like something to drink?"
While the robot speaks, the man on the left starts moving around the robot.

The man returns and reports back in Danish: "den har vand med" ("it carries water")

The woman says "ja?" while still looking at the robot. The robot turns to deliver the water on its back. The woman laughs. R: "take your drink please". The woman takes a glass of water.

R: "cheers" The woman replies "cheers" and lifts her glass a bit

The woman laughs and says something in Danish while tilting her head to the two men. The man on the left takes out his mobile to film the robot. The woman drinks.

While the robot drives away, all three observe the robot, the woman still smiling. Then she laughs and says something in Danish.

In this example, all three group members observe the robot as it approaches. However, while the woman repositions herself to interact with the robot, the man on the right retains his body orientation to the center of the group of (human) interaction partners over the course of the whole interaction, just turning his head towards the robot; this indicates that he does not consider the interaction with the robot as the main activity (cf. Schegloff 1998).

When the robot approaches, the three people briefly look at each other to determine how the robot is to be interacted with (cf. also Fischer et al. 2015). That is, they check in with each other how the situation is to be evaluated. Here, interpersonal variation becomes apparent: some do and some don't respond to the robot in social ways. Specifically, the man on the left starts walking around the robot while talking about it in another language than the robot has used (which would be very impolite in human interaction).

In contrast, the woman orients herself to the robot, follows its suggestion to take some water and replies "cheers" when the robot says "cheers" and lifts her glass. This constitutes clearly an anthropomorphizing response during which she ignores that the robot doesn't lift its glass itself when saying "cheers" because it doesn't have arms and does not drink itself. However, right after engaging with robot in one moment, she talks about the robot to the other people in another language (which would again be very impolite in human interaction). Thus, her behavior shows anthropomorphism by responding to social cues of the robot while ignoring its machinelike properties at the same time, but just for one moment, while she treats it like a machine (which can be talked about) in the next moment. However, when the robot utters the toast, she only lifts her glass a bit, while she chooses to drink only a few seconds later.

C. Discussion

The analysis shows that anthropomorphism is not an all-or-none phenomenon, and that whether people treat the robot in social ways may change from second to second. While the woman exhibits attention to many social rules - for instance, her utterances to the robot are timed as in human interaction (cf. also Hutchby 2001), she responds relevantly to the robot's utterances, she keeps her body oriented to the robot over the course of the interaction and she reciprocates the toasting utterance - she does not drink right after the toast, and she talks about the robot in a language the robot has not used itself while still facing it, which would be considered a violation of social rules in human interactions. Thus, her anthropomorphizing response is incomplete (she does not drink in response to the toast) and it is fleeting (since she treats the robot as a machine right after).

The analysis also reveals considerable interpersonal variation. While the woman engages with the robot by placing herself directly in front of it, the man on the left walks around the robot, reports on its function in a language the robot has not used and then starts filming it - behavior that would not be appropriate with a human interaction partner. The man on the right exhibits ambivalent behavior by positioning his body stably in a 45-degree angle to the robot, moving only his face between the other man and the robot.

III. General Discussion

The analysis revealed that people make sense of human-robot interactions in radically different ways. This has an effect on who interacts with robots at all, i.e. who counts as a participant. While most human-robot interaction studies are carried out at universities with students and staff as participants, very little is known about the wish to interact with robots by the general public. While those who interacted with the robot in our study were interviewed afterwards and responded 100% positively in the questionnaire we asked them to fill out afterwards (like the woman in the example interaction discussed), those who do not choose to interact with the robot remain largely invisible. Correspondingly, also in our study, the two men were not interviewed and were not asked to fill out the questionnaire, so we do not actually know how they received the robot. Thus, the current practices in which participants are recruited for human-robot interaction studies do not allow us to conclude that "**people** tend to anthropomorphize robots."

Furthermore, the analysis shows that even the woman who exhibited anthropomorphizing behavior towards the robot did so only partially and only for a few seconds. It would thus be too much to say that "robots **are** social actors" (cf. Nass & Moon 2000; Groom et al. 2009) The extent to which robots are anthropomorphized may change dynamically over the course of an interaction (cf. also Fischer 2021). Anthropomorphism thus depends not only on characteristics of the robot and on personal characteristics and dispositions,

but also on a range of contextual factors and eventually on people's own sensemaking. This requires a different sets of methodologies and research interests than those currently employed in mainstream HRI research.

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