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# How do Roboticists Imagine a Robotised Future?
# A Case Study on a Japanese HRI Research Project

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**Abstract**

This study observes, interprets, and analyses the knowledge production in the research field of Human–Robot Interaction (HRI). It intends to foreground the hidden assumptions that are often taken for granted when roboticist design and conduct their research. By doing so, this study demonstrates how these assumptions influence the result of their research. Based on data collected through sociological field observation, this study argues that the current practise in HRI research is highly anthropocentric. In short, the robots are designed to be like human instead of for human. Therefore, the human–robot relationship embodies the existing power relations between human beings. These relations generate inequality, hierarchy, and dominance, which are the opposite of the common imagination of the robotised future among roboticists. For the purpose of enabling the robotised future closer to their ideal, this study suggests that HRI researchers to go beyond the conventional methodology, to allow a human–robot relationship that realises reciprocity.

**Keywords: Social Robot; Empirical Research; Human-Robot Interaction; Human-Computer Interaction; Ethnomethodology; Robot development; HCI; HRI; Qualitative Research**

## 1. Introduction

This study deals with the making of knowledge about robots, namely how scientific works on robotics are produced. It aims at exploring the logics, ideas, and visions of roboticists, when these robot makers in the academia develop new robotic systems and functions. In other words, the roboticists, who do research on robots, are the research object of this study. In doing so, this research pays careful attention to the following questions:

- How do robotic researchers frame their research question?
- Which assumptions do they take for granted?
- How do they picture a robotised future?

Indeed, the field of robotics has started to pay attention to the 'non-technical' research questions after the drastic development in techniques in the second half of the 20th century [9]. Yet the discussions seldom reflect on the methodological framework that has long been practised, or how this framework has shaped the knowledge produced within itself. Therefore, this sociological study is especially interested in what had rarely been questioned within robotics: the examination of the conventional methodology of robotic research, the untold connection of experimental design and researchers' visions of ideal human–robot relationship.

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## 2. State of the Art: The Emergence of Social Robotics and HRI

Since the beginning of its gradual formation in the past three decades, HRI has constantly been described as a relatively young yet vigorously developing research field in the international academia. It is generally agreed among the English academic works that HRI only started to attract researchers' interest since the 1990s. Even though, the idea of an automata might have been playing a role in human's fantasies since the eighteenth century, the study of robotics, a research area traditionally involving computer science and engineering, has not begun to develop in a systematic way until the second half of the twentieth century, and it was at an even later point when this technology was applied in the actual field of production to achieve industrial goals including automation, cost reduction and increasing productivity. It was another two decades after industrial robots became part of production in the 70s that the research focus moved in the 90s from the actual construction of a robot, either hardware- or software-wise, to its interaction with its surroundings, which would require not only hardware and software advancements, but also a deeper understanding of the 'surrounding' itself. This change of focus is commonly addressed as a paradigm shift towards 'social robotics' in the robotics research. Promoted by a group of Japanese scholars, the first IEEE[1] conference on Robot and Human Interactive Communication (RO-MAN) was held in Tokyo, Japan in 1992, and has become an annual conference ever since [8]. Following that, IEEE International Conference on Human-Robot Interaction (HRI) was first held in 2006 in Salt Lake, UT, USA, and has since then been considered one of the most important HRI conferences among researchers around the globe. As for academic journals, the Journal of Human-Robot Interaction was initially launched in 2012 and was rebranded as ACM Transactions on Human-Robot Interaction in 2018 as it became an ACM2 publication.

Despite the brief history of HRI or even social robotics in general, the literature has been expanding rapidly, which could be considered a result of highly cross-disciplinary cooperation [e.g., 10, 11, 14]. As the core research topic—namely, the human-robot interaction and sociality—can be approached from various academic methods and requires multi-disciplinary collaboration to be better understood, analysed and improved, HRI and social robotics attract researchers from academic backgrounds of a great variety. Without any doubt, scholars specialised in various subfields of mechanics and informatics, the two 'classic' disciplines regarding robotics, would find HRI an area where they could fully apply their skills. While engineers work on new materials for physical components of robots, programmers develop software, based on which robots are expected to run smoothly. However, since there is an increasing interest in building social robots that are expected to have more interactions with their surroundings, including the environments, human beings and/or other robots, a need to better study the surrounding and to model ways of interactions emerges. Interaction is studied by psychologists and social scientists. Psychologists offer insights in analysing patterns of people's emotional and the behavioural reactions when encountering a robot. On the other hand, social scientists are relied to simplify all the nuances in the complex human world into less simple rules for the robots' behaviour to be based on. It is believed that the robots are becoming more 'human' with such contributions.

[1] The Institute of Electrical and Electronics Engineers, originally a professional association for electronic engineering and electoral engineering based in the US, now the most significant organisation of the field

[2] The Association for Computing Machinery. It has sponsored the International Conference on HRI since the 2006 inaugural event too.

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In addition to that, designers help construct robots based on all the above. This is how researchers and specialists of all different training come into play altogether, dedicating to explore the ways how humans and robots interact with each other, and better them.

While HRI is a recently emerging research field characterised by its great diversity and dynamic, there has been continuous attempts to assert something normative. Scholars began to define the nature of this subject, to describe its history and to construct a normative framework for categorisation, especially between 2004 and 2007, which is about the same time when a series of special issues dedicated to HRI started to appear. Indeed, each of these attempts is based on a certain already existing disciplinary supposition and thus varies from each other in different ways, yet traits that are commonly shared between them do exist. A detailed investigation on the differences and similarities between these works will not only illustrate the development of this academic field as a mere review but could also reveal the roboticists' underlying suppositions as a second-order observation.

## 3. Case Introduction

Our work examines a government funded HRI research project on developing symbiotic robots. The research project is led by Professor H, a professor of Informatics in a prestigious university in Japan. The main project is divided into several research projects of a smaller scale, which are assigned to the members of the laboratory. Like most social robotics research, the research project is carried out with an envision of a robotised future, in which robots will 'become more common in our daily life' and 'help people with professional or serious job' as described in a research proposal. Therefore, the ultimate purpose of the project is to contribute to the realisation of a symbiotic relation between people and robots by improving the interaction between human and robots.

One obstacle on the way towards this future that is singled out by the researchers is the lack of sense 'morality' that robots can display. It has been previously observed that robots are often ignored, not taken seriously and even abuse during their interaction with human [2, 12], 'which may reduce the effectiveness of the robots'. According to the assumptions of the research project, the reason for this is that 'robots are not seen as a moral entity, and as such, they are neither granted respect nor is their presence providing any moral pressure'. Therefore, this HRI research project aims to attribute 'morality', as termed by the researchers, to robots, meaning that researchers are finding out ways to make robot respected as a peer by human beings. Another goal is to equip robots with the ability of 'moral encouragement.' That is, researchers are finding out ways for robots to encourage human's moral behaviour with their own presence.

## 4. Methodology

The data for this study was collected through qualitative methods, including field observation, semi-structured interviews and document reviews and followed an ethnomethodological approach [7, 15]. The researcher followed the approach of reflexive thematic analysis, namely the process of identifying and interpreting patterns within the collected data with reflexivity [1, 6]. Below are tables with more details. All data has been pseudonymised.

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**Table 1**. Research Methods.

| Research Method | Description |
|---|---|
| Field Observation | A researcher of this paper visits the HRI laboratory for three months, sometimes as a participant of their research project, sometimes simply as an observer. Field notes were always taken within twenty-four hours after each visit. |
| Semi-structured Interview | Three interviews were conducted with the HRI researchers, all ranging between one to two hours. The interviews were recorded under the interviewees' consensus for the purpose of research. |
| Document Analysis | The analysed documents include (1) publications of the laboratory; (2) the proposal of the project; and (3) researchers' applications for grants. The first two documents could be publicly accessed, while the applications for grants were kindly offered by the members of the laboratory for research use. |

**Table 2**. The Interviewees.

| | Position | Gender | Interview Language | Research Project at the time |
|---|---|---|---|---|
| A | Postdoctoral Researcher | Male | English (the interviewee's second language) | No specific one going on |
| B | Postdoctoral Researcher | Male | English (the interviewee's first language) | Attribute authority to robots by changing robots' attitude |
| C | PhD Student | Female | Mandarin (the interviewee's first language) | Attribute authority to robots by changing robots' appearance |

## 5. Analysis: Implications of the Research Design

Casually referred as the 'mean robot experiment', B aims at finding out if people would 'take robots more seriously' when robots appear to be unkind. B's experiment was divided into two rounds, in which the robot interacts with participants as a gym coach. In the first round, the robot said supportive sentences such as 'you are doing a great job' in an encouraging tone; while in the second, it uttered harsh comments like 'is this really the best you can do?' in an upset tone. 'There has been a lot of research done to develop "good robots," "friendly robots," (…) but do robots have to be good?' asked B. 'Do you remember that you ended up doing more squats under the instructions of the mean robot?' B added, implying that a mean robot could potentially do its job better in certain scenarios.

B does not appear as anything like an evil-minded scientist who is ambitious to create wicked robots, but instead an enthusiastic and upright researcher that is simply interested in finding out how to make people show more respect when interacting with robots. The patterns B had noticed is that people tend to respect people of high authority,

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and therefore B intended to entitle robots with more authority. As for how to realise this purpose, B noticed that an authoritative character 'seems to be pretty mean' and this is where the experimental idea of a mean robot originated from.

In similar fashion, C's research intends to attribute more authority to robots as well. Instead of controlling what a robot says, C focuses on its appearance. C designed a questionnaire composed of pictures of robots of different sizes, colours, compositions etc. and asked the participants to describe what they feel when they see these robots working as a security guard. Some exact scenarios were specified in the questionnaire. For example, 'if this robot shows up right when you are about to litter your garbage, would you change your mind?' C tries to investigate how a robot's appearance associates with the respect it earns from human beings, so that it will become possible to 'manipulate robot's authoritative presence' by controlling robots' appearance in future research.

It is noteworthy that the relation between morality and authority is naturalised in their research designs. Both B and C were investigating on how to strengthen people's respect shown to robots, and both intend to achieve this goal by presenting robots as an object of authority. They believe the sense of authority is critical to the robotised future, because robots would perform many professional jobs (e.g. care robots [3-5]) that require people to follow their instructions. Therefore, both B and C first collected the information about what makes people appear to be authoritative, then designed robots with such traits, and finally observed if this successfully wins robots human's respect. Familiar with their research project, A agreed with the underlying logic too. All three of them believe that authority is the basis of respect and being respected is equal to being treated as a 'moral entity'. A design method based on anthropomorphism seems natural to the robot makers. C did not seem to understand my question when asked 'do you not respect people of no authority?'. After pointing out that this is what the research design implies, C answered in an unsure tone, 'I do, and I believe most people do, but I suppose robot is a different case'. On the other hand, A simply said, 'you've got to be practical', when asked the same question. This 'practical' world they have in mind appears to be highly hierarchical, and this trait did not seem to bother the robotics researchers.

In addition to defining 'morality' with the concept of 'authority,' Prof. H's researchers also measure the degree of 'symbiosis' based on 'effectiveness'. When B explained the research idea of the 'mean robot', he mentioned how this research challenged the long-held assumption that the sociality of robots relies on positive attitudes. With the example of me doing more squats during the round of mean coach than the round of nice coach, B argued that friendliness is not essential for a 'positive relationship'. B said, 'it shows kind robots is not necessary to form a positive human-robot relationship'. I said, 'but I told you in the interview that I had more fun when the coach was nice', and B replied in a half-joking tone, 'but you did more squats when it was mean!' This reveals the fact that the quality of a human-robot relation is sometimes evaluated not by the process but the result, and that a 'symbiotic relationship' is in fact defined by productivity instead of reciprocation.

## 6. Limitations

This work is preliminary and of a qualitative nature, it therefore is not representative and reflects only the observations of the authors. Further research in this area is needed to gain broader knowledge.

## 7. Conclusion

This case study on knowledge production in the scientific field of robotics presents how typical it is for roboticist to design robots by simply attributing human traits, emotions, or intentions to robots. The method is so commonly practised that none of the interviewees or members in the observed laboratory have had a second thought about it. From raising the research questions to designing experiments, roboticists ceaselessly imagine robots from an anthropocentric point of view. This study does not aim at questioning this method from ethical or philosophical perspective. Instead, this sociological study presents how the anthropomorphic approach would 'copy' the existing concepts of authority, hierarchy, and power in human relations into human-robot interaction. Therefore, the creation of robots does not sound as revolutionary as it is often claimed. When faced with this question, the roboticists tend to respond with the realistic concerns. By staying realistic or practical, however, the robot makers are excluding options of interaction that are not based on human traits, and thus limit the possibilities to create something new.

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