

Referential Practices for a Museum Guide Robot

Human-Robot-Interaction as a Methodological Tool to Investigate Multimodal Interaction

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ABSTRACT

An autonomous robot system was equipped with basic means to monitor the users' success/failure in following a robot's verbal-gestural deictic reference to an object and – in case of problems – to provide additional help, i.e. to suggest a 'repair' action. A real-world field trial with the robot acting as museum guide constitutes the basis for analysis of the users' reactions. This example is used to explore HRI as a tool to investigate multimodal interaction.

CCS CONCEPTS

• Human-Computer-Interaction • Collaborative Interaction • Empirical Studies in HCI • Robotics • Artificial Intelligence • Cooperation and coordination • Discourse, dialogue and pragmatics

KEYWORDS

Social Robotics, HRI, Deixis, Referential Practices, Interactional Coordination, Multimodality, Methodology, Guide Robot

1 Challenge: Situated Interaction & Contingency

In the fields of Social Robotics/Human-Robot-Interaction, recent advances have seen the advent of novel forms of human-machine interfaces: robotic systems that are endowed with resources that should allow them to "interact with people in a natural, interpersonal manner" (Breazeal et al 2016: 1935). These technical systems are equipped with means for perceiving and interpreting their environment, with bodily resources oriented to those of humans and with interactional conduct based on features of human multimodal conduct. They are thus situated at the interdisciplinary intersection between approaches in engineering/ informatics, data sciences and interactional

modeling on the one hand, and research on multimodal conduct and social interaction on the other hand. The project to design such interfaces is thus a genuine interdisciplinary one in which these different approaches can inform each other and together create fruitful new perspectives and insights.

A central challenge for designing such technical interfaces consists in the situated nature and contingency of human communication and social interaction (Suchman 2006, Schegloff 1996). Within the field of Ethnomethodology and Conversation Analysis, from early days on researchers have pointed both to the critical dimension of this challenge (e.g. Button 1990) and – at the same time – suggested it to be a valuable scientific resource: "Just as the project of building intelligent artifacts has been enlisted in the service of a theory of mind, the attempt to build interactive artifacts, taken seriously, could contribute much to an account of situated human action and shared understanding." (Suchmann 2006: 186).

In this paper, we suggest to explore the ways in which human-robot-interaction can be a valuable methodological tool to investigate the multimodal and situated nature of interaction. Considering it as a genuine interdisciplinary project, it enables an incremental research cycle which consists of analysis of (human-human or human-machine) communication, interactional and technical modeling, experimentation in studies of human-robot-interaction both in the lab and 'in the wild', evaluating the model and thereby both understanding the limits of the initial account as experienced in a socio-technical encounter and refining the research question or opening up new perspectives e.g. on sociality. In such an endeavor, questions arise with regard e.g. to precision in the analytical description, ways of systematization, the combination of qualitative and quantitative analysis and ways of integrating novel types of data (e.g. Motion Capture).

To explore these questions, we investigate situations in which a research prototype of a museum guide robot attempts to orient visitors to an exhibit (Pitsch et al. 2014, 2016). The design of the system's referential (in linguistic terms: deictic) practices have undergone successive re-design and evaluation in a series of studies in both in real-world and in the lab and require a high degree of mutual monitoring and interactional coordination. In the study analyzed here, the robot system is explored in a real-

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world museum and set up to monitor the visitors' conduct when referring to an exhibit and to provide – in case they fail to follow the suggested orientation – to provide additional resources and 'repair'. The following research questions are addressed:

(1) How do the visitors react to the robot's deictic reference under different situational-structural conditions? (2) How do visitors react if the robot treats their conduct as problematic and offers a second referential hint, i.e. undertakes a deictic 'repair'? (3) Given that such attempts of interactional coordination are highly challenging for a technical system: How do visitors deal with cases of the robot misinterpreting the situation and offering a repair although it is inadequate?

2 Technical System: Museum Guide Robot 'Nao'

A Nao robot (Aldebaran, V4, 58 cm high) was set up as a research prototype to act as museum guide and to run autonomously (Pitsch et al. 2016). It was based on a set of modularized system components including visual perception, speech-recognition, dialogue management, localization etc. and equipped with (a) means to observe the head orientation of multiple visitors and (b) a basic 'repair' strategy which provides – in case of assumed problems – additional information about the object indicated.

3 Study: Multi-party situation at Museum

The robotic museum guide was positioned in an open space of a historical museum alongside a set of exhibits from the museum's Middle Ages collection to which the robot referred during its explanation. To compensate for its small size, it was placed on a table (1.20 x 2 m, 0.7 m high). It was set up to get in contact with visitors, to give explanations about three different objects (with varying degrees of interactional complexity), walk across the table, involve visitors in a small question/answer sequence, and to close the encounter. Human-robot encounters lasted for about 4 minutes. The study was co-located with the local Science Festival 'Geniale' so that users of the system were groups of 2 to 5 visitors comprised of adults and children curious about robots.

4 Data & Analytical Methodology

In total, 72 runs of HRI with mostly 2 to 5 participants each were recorded with 4 external HD video cameras. For 23 runs also the robot's internal data was recorded, i.e. the VGA stream from the robot's head camera as well as log-files of the system's calculations. Additionally, the visitors' conduct was recorded with two Kinect motion capture cameras (not connected to the robotic system) to provide a basis for offline analysis. Analysis is based on Conversation Analysis (CA) and its multimodal extensions and allows to gain insights into the sequential structure and the micro-processes involved in the interaction between human and robot.

5 Observations & Preliminary Findings

Initial analysis of these situations reveals: In cases with low complexity of the referential situation, a repair action is only rarely required. In more complex cases, however, additional orientational hints are indeed needed and – when provided by the robotic systems – successful in most cases (fig. 1). The 'inadequate' repair actions (i.e. those situations in which visitors already followed the robot's reference) did not seem to produce much problems for the users.

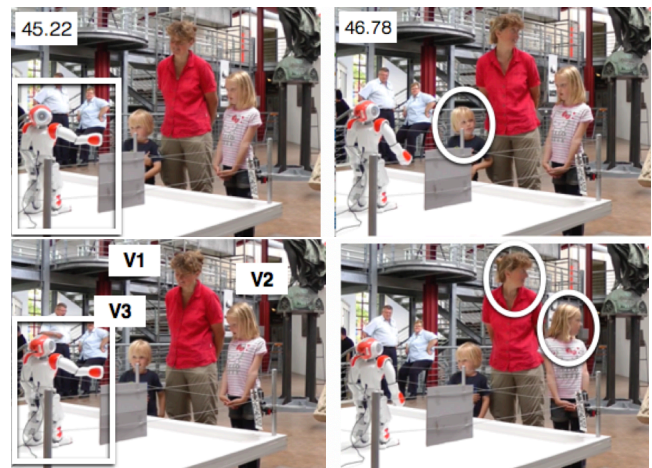


Fig. 1: Robot referring to object and providing 'repair'



Fig. 2: Participants' mutual support to follow the robot's reference

Investigating the visitors' practices in detail, we find different strategies in following a robot's deictic reference, which consist (a) of following step by step the orientational hints or (b) of using the robot's deictic reference as an initiation to search for the correct referent by themselves. Dissecting the notion of 'group' of visitors (who came in constellations of 2 to 5 participants comprised of adults and children), we find that adults closely monitor the children's success in understanding the robot's conduct and provide help pointing out the correct referent (fig. 2).

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REFERENCES

- [1] Button, G. (1990). Going Up a Blind Alley. Conflating Conversation Analysis and Computational Modelling. In P. Luff, N. Gilbert, & D. M. Frohlich (Eds.), *Computers and Conversation* (pp. 67-90). San Diego: Academic Press.

- [2] Pitsch, K., & Wrede, S. (2014). When a robot orients visitors to an exhibit. Referential practices and interactional dynamics in real world HRI. Paper presented at the Ro-Man 2014, Edinburgh.
- [3] Pitsch, K., Dankert, T., Gehle, R., & Wrede, S. (2016). Referential practices. Effects of a museum guide robot suggesting a deictic 'repair' action to visitors attempting to orient to an exhibit. Ro-Man 2016, New York, 225-231.
- [4] Schegloff, E. A. (1996). Issues of Relevance for Discourse Analysis: Contingency in Action, Interaction, and Co-Participant Context. In E. H. Hovy & D. R. Scott (Eds.), *Computational and Conversational Discourse: Burning Issues - An Interdisciplinary Account* (pp. 3-38): Springer.
- [5] Suchman, L. (2006). *Human and Machine Reconfigurations: Plans and Situated Actions*: Cambridge University Press.