Reconfiguring HRI - Combining EMCA Interaction Analysis and Design*

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***Abstract*—HRI research is currently dominated by experimental lab studies centered on individual users. Recent work has called for more critical and diverse approaches to studying robots as part of socio-technical systems. Studying robots in everyday interaction is a crucial step in this direction but requires suitable analytic methods. This paper presents ethnomethodology and conversation analysis (EMCA) as an approach that can deal with the contingencies of real world data, including instances that would typically be removed from experimental data. The paper highlights what types of questions the EMCA approach can raise and argues that for a true reconfiguration of HRI, EMCA video studies need to be embedded in ongoing design processes.**

***Index Terms*—conversation analysis, ethnomethodology, interaction design**

I. Introduction

The majority of HRI studies are conducted in laboratory settings, typically with one user interacting with a robot. In recent years this has been challenged. Dautenhahn [1] stresses the importance of using real robots in real-world settings during long-term interactions. Jung and Hinds [2] highlight that robots need to be studied in the wild, in social environments that involve groups of people. Serholt and colleagues [3] call for more critical and diverse approaches to studying robots as part of socio-technical systems.

Fields that are adjacent to HRI (such as CSCW) have started to map in detail how robots reconfigure interaction in the wild, in settings such as operating rooms [4], [5], Mars Rover missions [6] and urban search and rescue [7]. Ethnographic and video studies result in a myriad of specific and detailed observations. However, translating these to more general design principles that can be applied to other types of robots in a broader array of settings remains difficult. Lupetti, Zaga and Cila [8] highlight that designers face similar problems: As design processes are rarely documented in detail, some of the knowledge that is generated during design processes stays inaccessible for researchers working on other robots and settings.

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In this paper I argue that to really achieve change and reconfigure HRI, we need stronger interdisciplinary dialogues. From a research philosophy perspective, experimental psychology and observational studies have different premises. The perspectives taken in lab experiments may be orthogonal to approaches suitable for studying interaction in the wild and during everyday activities. In the following, I will first briefly present the approach that ethnomethodologic conversation analysis (EMCA) takes to the study of interaction. Subsequently I will present a case that deviates from the general pattern, discussing how it is dealt with in EMCA as opposed to an experimental psychology approach. Finally, I argue for a stronger intertwinement of observatory methods with prototyping, presenting efforts of combining EMCA with design.

II. Ethnomethodology & Conversation Analysis (EMCA)

EMCA studies how social interaction is organized in detail, typically among humans but increasingly also with robots and voice interfaces [9]–[11]). Focus is usually on everyday interaction, including moments that may appear utterly mundane. EMCA draws on video recordings as data, which can be replayed and transcribed as part of the analytic process, helping to discover systematicity. It should be stressed here that being part of the analysis, transcripts are never final and fixed but may stimulate discussion around alternative interpretations.

Analytic focus lies on how participants make sense of each other's (or a robot's) actions. Human actions are seen as situated and dynamically adjusted rather than following a pre-determined plan [12]. EMCA is less interested in what someone (or the robot) may have privately intended, but instead focuses on what is publicly manifest for everyone in a specific moment and how it is demonstrably understood. For example, a roboticist may have programmed their robot to beep when the battery is about to run out. When deploying the robot in a public space, a stranger may find the robot stuck behind a pole and when asking "oh are you stuck?", interprets

the ”beep beep beep” as a positive response from the robot, subsequently lifting the robot away from the pole. In this case, EMCA would not see this as an error or misinterpretation on the human user's side but rather as one way in which the robot's sounds can get interpreted in specific situations. Conversation analysis focuses on the sequential organization of action, studying how participants through a current action display their understanding of a previous action and make particular next actions relevant. It can be used as a method to identify design problems and point towards possible solutions.

III. Dealing with Outliers

Identifying in which ways HRI needs to be re-configured, it can be helpful to discuss concrete issues. One such example is the way in which different research traditions deal with instances in their data that seem to be different from the general pattern. In approaches dominated by experimental psychology these are usually referred to as ”outliers” and excluded from analysis. Reasons for exclusion may be that the participant did not understand the instruction correctly or did not successfully complete the task. In other traditions, including ethnomethodology and conversation analysis, these cases are studied with particular attention. In a famous conversation analytic study, Emmanuel Schegloff [13] found 499 phone calls to all begin with the called party speaking first. The 500th case was different, with the caller speaking before the called person said anything. By thoroughly analyzing it, he found that it was in fact not deviating from the general ”rule” but instead illustrating what happens when the called person fails to answer the phone ring by speaking first: the caller summons them again, e.g. by asking ”hello?”. Thus, analysing cases that seemingly do not fit the observed rule can provide further and particularly strong evidence for its existence: in this case that the person who is answering the phone should speak first.

In video recordings of German adults playing with a Cozmo robot in their homes (for detailed description of the study see [9]), I found an example that could also be seen as differing from typical interactions. During an activity in which the robot is scanning human faces for later recognition, the majority of the participants waited until the robot confirmed that it had learnt their face by uttering their name. In one case however, the participant proposes a new activity before the robot has finished and a joint celebration of the fact that the robot has just successfully learnt a face is absent. Instead, the robot's behavior gets interpreted as something else, as illustrated in Excerpt 1.

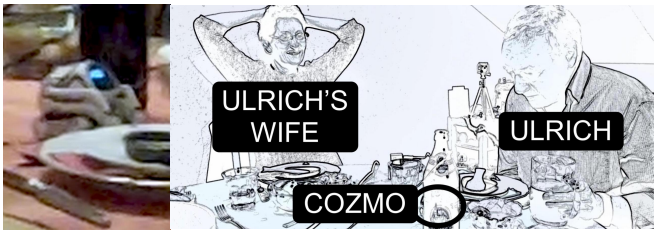

Fig. 1. Ulrich (right) offers beer to Cozmo (behind bottle, see left image).

Excerpt 1: A2-Cozmo at the dinner party. Translated from German, all names are pseudonyms. Transcription symbols: [] overlapping sounds, = latching of two utterances, (.) pause shorter than 200 milliseconds, (0.5) 500 millisecond pause, .h inbreath, h outbreath, (h) laughter particle, xxx stressed syllables, : lenghtened sounds, °utterance° more silent than surrounding talk, UTTERANCE louder than surrounding talk, >utterance< faster than surrounding talk, ↓ falling intonation, ↑ rising intonation.

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01 ULRICH       hello respond
02 COZMO        me↓oooooo
03 ULRICH       well (.) what kind of a response is that
04              (0.9)
05 RESEARCHER   would you like him to learn your names?
06 COZMO        owai?
07              (0.9)
08 HOST1?       [ye:s]
09 ULRICH       [my n]ame is ulrich
10 ULRICH       (.) an' what's your name?
11              (0.5) ((RESEARCHER grabs phone))
12 RESEARCHER   well he can't do it that fast
13 RESEARCHER   i have to help him a bit=
14 ULRICH       =my (.) name is (.) ulrich
15              (1.2)
16 ULRICH       and what is your name?
17 COZMO        o[wai      ]
18 JONAS         [hey there] ((to RESEARCHER))
19              (0.8)
20 ULRICH       [you are suppos]ed to speak clearly
21 RESEARCHER   [hhe           ]

(( 12 lines skipped, discussion between HOST1 and WIFE))

33              (0.3)
34 WIFE         [.hh he he he:]
35 RESEARCHER   [now    now   h[e] is learning your face]
36 COZMO                      [                rrrrrrr]rrr
                ((HOST1 and his son JONAS talk in background))
37              (0.4)
38 COZMO         ding:::|::[::]:  |
39 ULRICH              |  [.h]   |
   ulrich              |gaze@beer|
40              (0.2)
41 ULRICH       °tr(y)-° let's do it di[fferently] ((grabs beer glass))
42 COZMO                               [     aaA]aaaaaaoooo
43              (0.8)
44 ULRICH       do [you like- do you like ((local] brand)) beer?=
45 COZMO           [u::lrich:::                  ]
46 WIFE         =[(h) ]
47 JONAS         [k(h)]a
48 RESEARCHER   e(h)[h]
49 COZMO            [o]aaaaow
50 ULRICH       O[H    ]
51 RESEARCHER    [ha↑ha]↓ha[haha]
52 ULRICH                  [haha][ha[haha hahaha]ha  ha ha he]
53 WIFE                         [haha   (h)(h)(h)  (h)(h)(h)]
54 COZMO                          [°°    rich°°]
55 ULRICH       [.hhh [hehe [ha]heha .h] (h)] (h)   ]
56 WIFE         [(h)  (h)(h)(h) (h) (h)]
57 RESEARCHER   [(h)(h)  (h)(h)      (h) (h)]
58 HOST2              [↑hi: ↓ha]
59 COZMO                  [>adeo dae-eo< dAo deo A]-Ao= ((“happy to
                meet you” animation, smiley eyes and waving forklift))
60 ULRICH       =ohYES
61              (1.6) ((more joint laughter))
62 ULRICH       full agreement
63              (1.1) ((laughter))
64 WIFE         now he almost rolls over (with joy)
65              ((joint laughter))
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At the beginning of the excerpt, the researcher proposes to start the face learning activity (l. 05), saving the robot from a previous failure to respond (l. 01-04). Ulrich, who is currently looking at the robot and has been leading the play with the robot immediately starts introducing himself, by saying ”my name is Ulrich” (l. 09) and asking the robot for its name (l. 10). The researcher indicates that she has to help with making this happen (l. 11-13). Ulrich immediately repeats his introduction, speaking more slowly and articulated (l. 14-16). As the robot produces a sound (l. 17), Ulrich further asks the robot to speak

more clearly, possibly suggesting that he cannot make anything of this sound (l. 20). When the robot finally is set up to learn the face and starts scanning (as indicated by the "rrr" sounds, l. 36), the researcher instructs "now he is learning your face" (l. 35). When the robot plays a "ding" sound, Ulrich starts gazing at his beer and eventually proposes "to do something else" (l. 41), lifting up his glass. When the robot plays another sound (l. 42), he hesitates (l. 43) but as the robot does not produce further action he proceeds with asking the robot whether it likes the local beer (l. 44). His wife (l. 46), the host's son Jonas (l. 47) and the researcher (l. 48) all produce laughter particles. The fact that Cozmo utters Ulrich's name in overlap with the question (l. 45) gets ignored.

When Cozmo finally plays a prolonged happy sound and waves its arms, an animation which is intended to demonstrate happiness of having met a new person (l. 59), Ulrich proceeds and translates this as "oh yes" (l. 60), i.e. a positive response to the question about beer. He goes on and formulates it more precisely as "full agreement" from Cozmo's side (l. 62). His wife builds this further, suggesting that the robot is almost rolling over with joy (as in the sense of doing a somersault/going head over heels, l. 64). The animations which were initially designed to indicate that Cozmo successfully learnt a name and face get playfully reinterpreted by the participants.

One could argue that Ulrich did not pay proper attention to the process or did not understand the instructions from the researcher. Similarly, one may put forward that the play with Cozmo was disturbed by the hosts of the dinner party popping into the room and being involved in what was happening. These would be valid reasons for excluding the case in an experimental context. However, as this is what happened in the real world, it may provide important clues to the challenges of placing robots in everyday settings: Users get distracted by other activities and more than one user may be present, resulting in constantly changing participation frameworks. Host2 who has been busy in the kitchen gets attracted by the laughter and becomes involved in the scene by laughing along (l. 58), which is something that may naturally happen when robots are deployed with people - however it is rarely designed for when testing robots in controlled lab settings.

By analyzing such a case that is different from the typical pattern one can gain interesting insights into how robots get embedded into larger activities in the home. People may choose to put the robot in the focus, giving them space to finish their actions and interpreting robot actions in line with what the designers intended. However, they may also choose to interpret the robot's actions differently from what is intended by the designer - here in the specific context of a question about beer. A closer analysis reveals that the participant is not so much challenging the robot by refusing to go along with the designed trajectory. Rather, from the participants' perspective the relevant robot actions are produced too late. Ulrich has introduced himself twice (l. 09 and l. 14) and asked for the robot's name (l. 10, l. 16). Cozmo failed to answer his question (as indicated by the request to speak clearly, l. 20). Once the robot plays a "ding" sound (l. 38) similar to that of a microwave that finished heating up food, Ulrich seems to treat the face learning activity as finished. He announces the transition to a new activity (l. 41) and waits a moment (l. 43) before finally asking whether Cozmo likes beer (l. 44). From Ulrich's perspective the robot missed multiple opportunities to say its own name or to indicate that it learnt Ulrich's name. Including such cases in the analysis can provide important insights into how robots fail at keeping up with the dynamics of everyday interaction and highlights specific moments in which trouble manifests and escalates.

IV. Concluding Discussion

A starting point for re-configuring HRI is to enter a dialogue about the premises of studying human-robot interaction. What aspects do we pay attention to and what gets included (or excluded) from analysis? Which aspects are missing in mainstream experimental studies and currently get too little attention? As HRI is moving towards real-world settings, we may need to reinspect what we understand as "interaction". Currently, the term may be understood as one-on-one encounters, in which users pay full attention to the robot. Re-configuring HRI may mean to broaden this to include situations in which multiple people are present with their participation status dynamically changing [14]. Naturally, this means that the robot's status may also change – from being intensely gazed at during a face scanning activity, to being temporarily ignored, to becoming part of a joke. Clearly, perspectives like EMCA can offer novel and critical perspectives to HRI. A challenge that remains however, is how to make such studies relevant for the larger community, i.e. how to generalize from individual examples like the one analyzed here to different robots and contexts.

Embedding EMCA video analysis in the design process can be a way forward, firmly anchoring non-experimental approaches in mainstream robot design and evaluation. EMCA research has been important for re-configuring the field of human-computer interaction [12], [15] and I strongly believe it is equally needed in HRI. However, to remain relevant and truly change practices, EMCA video analysis needs to be made more accessible for prototyping processes. Thorough EMCA work will always provide us with opportunities to gain novel insights into the complexities of the contexts in which we plan to embed a robot at the beginning of a design process, and to evaluate how robots fare in everyday life settings after their design has been completed. Careful transcription of methodically selected episodes throughout a design process however, can constitute the springboard for generalizability. Enabling roboticists and designers to iteratively develop their prototypes on systematic observations will support the articulation of intermediate-level knowledge [8], [16] through transcripts and video clips, while simultaneously changing the way in which robots are built by designing for and based on everyday interaction. A first step in such a direction is a course that bridges video interaction analysis and prototyping

at CHI 2022 with the aim to teach EMCA-informed interaction analysis to a wider audience https://videohci.wordpress.com.

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